VISVESVARAYA TECHNOLOGICAL UNIVERSITY
BELAGAVI

Scheme of Teaching and Examinations and Syllabus

M.Tech in Computer Science and Engineering (SCS)

(Effective from Academic year 2020 - 21)

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI
Scheme of Teaching and Examinations – 2020 - 21
M.Tech in Computer Science and Engineering (SCS)
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)

I SEMESTER

SL. No.	Course	Course Code	Course Title	Teaching Hours / Week			Examination				Credits
				Theory	Practical / Seminar	Skill Development Activities	Duration in Hours	CIE Marks	SEE Marks	Total Marks	
1	PCC	20SCS11	Mathematical Foundations of Computer Science	03	--	02	03	40	60	100	4
2	PCC	20SCS12	Artificial Intelligence and Machine Learning	03	--	02	03	40	60	100	4
3	PCC	20SCS13	Advanced Database Management Systems	03	--	02	03	40	60	100	4
4	PCC	20SCS14	Advanced Algorithms	03	--	02	03	40	60	100	4
5	PCC	20SCS15	Internet of Things and Applications	03	--	02	03	20+ 20	60	100	4
6	PCC	20SCSL16	Algorithms and Database Management Systems Laboratory	--	04	--	03	40	60	100	2
7	PCC	20RMI17	Research Methodology and IPR	01	--	02	03	40	60	100	2
			TOTAL	**16**	**04**	**12**	**21**	**280**	**420**	**700**	**24**

Note: PCC: Profession Core

Skill development activities:

Students and course instructor/s to involve either individually or in groups to interact together to enhance the learning and application skills. The students should interact with industry (small, medium and large), understand their problems or foresee what can be undertaken for study in the form of research/ testing / projects, and for creative and innovative methods to solve the identified problem. The students shall

1. Gain confidence in modeling of systems and algorithms.
2. Work on different software/s (tools) to Simulate, analyze and authenticate the output to interpret and conclude. Operate the simulated system under changed parameter conditions to study the system with respect to thermal study, transient and steady state operations, etc.
3. Handle advanced instruments to enhance technical talent.
4. Involve in case studies and field visits/ field work.
5. Accustom with the use of standards/codes etc., to narrow the gap between academia and industry.

All activities should enhance student's abilities to employment and/or self-employment opportunities, management skills, Statistical analysis, fiscal expertise, etc.

Internship: All the students have to undergo mandatory internship of 6 weeks during the vacation of I and II semesters and /or II and III semesters. A University examination shall be conducted during III semester and the prescribed credit shall be counted for the same semester. Internship shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not take-up/complete the internship shall be declared as fail in internship course and have to complete the same during the subsequent University examination after satisfying the internship requirements.

Note: (i) Four credit courses are designed for 50 hours Teaching – Learning process.
(ii) Three credit courses are designed for 40 hours Teaching – Learning process.

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II SEMESTER

SL. No.	Course	Course Code	Course Title	Teaching Hours / Week			Examination				Credits
				Theory	Practical / Seminar	Skill Development Activity	Duration in Hours	CIE Marks	SEE Marks	Total Marks	
1	PCC	20SCS21	Data Science	03	--	02	03	40	60	100	4
2	PCC	20SCS22	Semantic Web and Social Networks	03	--	02	03	40	60	100	4
3	PCC	20SCS23	Blockchain Technology	03	--	02	03	40	60	100	4
4	PEC	20SCS24X	Professional elective 1	04	--	--	03	40	60	100	4
5	PEC	20SCS25X	Professional elective 2	04	--	--	03	40	60	100	4
6	PCC	20SCSL26	Data Science Laboratory	--	04	--	03	40	60	100	2
7	PCC	20SCS27	Technical Seminar	--	02	--	--	100	--	100	2
			TOTAL	**17**	**06**	**06**	**18**	**340**	**360**	**700**	**24**

Note: PCC: Profession Core, PEC: Professional Elective Course

Professional Elective-1		**Professional Elective-2**	
Course Code 20LSCS24X	**Course Title**	**Course Code 20SCS25X**	**Course Title**
20SCS241	Advanced Cryptography	20SCS251	Image Processing and Machine Vision
20SCS242	Natural Language Processing	20SCS252	Object Oriented Design
20SCS243	Cloud Computing	20SCS253	Software Defined Networks
20SCS244	Pattern recognition	20SCS254	Modern Computer Architecture

Note:

1. Technical Seminar: CIE marks shall be awarded by a committee comprising of HoD as Chairman, Guide/co-guide, if any, and a senior faculty of the department. Participation in the seminar by all postgraduate students of the program shall be mandatory.
The CIE marks awarded for Technical Seminar, shall be based on the evaluation of Seminar Report, Presentation skill and performance in Question and Answer session in the ratio 50:25:25.

2. Internship: All the students shall have to undergo mandatory internship of 6 weeks during the vacation of I and II semesters and /or II and III semesters. A University examination shall be conducted during III semester and the prescribed internship credit shall be counted in the same semester. Internship shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not take-up/complete the internship shall be declared as fail in internship course and have to complete the same during the subsequent University examination after satisfying the internship
requirements.

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III SEMESTER

SL. No.	Course	Course Code	Course Title	Teaching Hours / Week			Examination				Credits
				Theory	Practical / Seminar	Skill Development Activity	Duration in Hours	CIE Marks	SEE Marks	Total Marks	
1	PCC	20SCS31	Deep Learning	03	--	02	03	40	60	100	4
2	PEC	20SCS32X	Professional elective 3	03	--	--	03	40	60	100	3
3	PEC	20SCS33X	Professional elective 4	03	--	--	03	40	60	100	3
4	Project	20SCS34	Project Work phase -1	--	02	--	--	100	--	100	2
5	PCC	20SCS35	Mini-Project	--	02	--	--	100	--	100	2
6	Internship	20SCSI36	Internship	(Completed during the intervening vacation of I and II semesters and /or II and III semesters.)			03	40	60	100	6
			TOTAL	**09**	**04**	**02**	**12**	**360**	**240**	**600**	**20**

Note: PCC: Profession Core, PEC: Professional Elective Course

Professional Elective-3		**Professional Elective-4**	
Course Code 20SCS32X	**Course Title**	**Course Code 20SCS33X**	**Course Title**
20SCS321	Engineering Economics	20SCS331	Business Intelligence and its Applications
20SCS322	Virtual Reality	20SCS332	Robotics and Automation
20SCS323	Soft and Evolutionary Computing	20SCS333	Speech Processing
20SCS324	Multi Core Architecture and Programming	20SCS334	Wireless Sensor Networks

Note:
1. Project Work Phase-1: Students in consultation with the guide/co-guide if any, shall pursue literature survey and complete the preliminary requirements of selected Project work. Each student shall prepare relevant introductory project document and present a seminar.
CIE marks shall be awarded by a committee comprising of HoD as Chairman, Guide/co-guide if any, and a senior faculty of the department. The CIE marks awarded for project work phase -1, shall be based on the evaluation of Project Report, Project Presentation skill and Question and Answer session in the ratio 50:25:25. SEE (University examination) shall be as per the University norms.
2. Internship: Those, who have not pursued /completed the internship, shall be declared as fail in internship course and have to complete the same during subsequent University examinations after satisfying the internship requirements. Internship SEE (University examination) shall be as per the University norms.

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IV SEMESTER

SL. No.	Course	Course Code	Course Title	Teaching Hours / Week			Examination				Credits
				Theory	Practical / Seminar	Skill Development Activity	Duration in Hours	CIE Marks	SEE Marks	Total Marks	
1	Project	20SCS41	Project work phase 2	--	04	03	03	40	60	100	20
			TOTAL	**--**	**04**	**03**	**03**	**40**	**60**	**100**	**20**

Note:
Project Work Phase-2:
CIE marks shall be awarded by a committee comprising of HoD as Chairman, Guide/co-guide, if any, and a Senior faculty of the department. The CIE marks awarded for project work phase -2, shall be based on the evaluation of Project Report subjected to plagiarism check, Project Presentation skill and Question and Answer session in the ratio 50:25:25.

SEE shall be at the end of IV semester. Project work evaluation and Viva-Voce examination (SEE), after satisfying the plagiarism check, shall be as per the University norms.

M.TECH IN NETWORK AND INTERNET ENGINEERING (LNI)
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER -I

MATHEMATICAL FOUNDATION OF COMPUTER SCIENCE

Course Code	20LNI11, 20SCS11, 20SCE11, 20SFC11, 20SCN11, 20SSE11, 20SIT11, 20SAM11, 20SIS11	CIE Marks	40
Teaching Hours/Week (L:P:S)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Vector Spaces: Vector spaces; subspaces Linearly independent and dependent vectors Basis and dimension; coordinate vectors-Illustrative examples. Linear transformations, Representation of transformations by matrices;
(RBT Levels: **L1 & L2)** (Textbook:1)

Module-2

Orthogonality and least squares: Inner product, orthogonal sets, orthogonal projections, orthogonal bases. Gram-Schmidt orthogonalization process. QR factorizations of a matrices, least square problems, applications to linear models (least square lines and least square fitting of other curves).
(RBT Levels: **L2 & L3)** (Textbook:1)

Module-3

Symmetric and Quadratic Forms: Diagonalization, Quadratic forms, Constrained Optimization, The Singular value decomposition. Applications to image processing and statistics, Principal Component Analysis
(RBT Levels: **L2 & L3)** (Textbook:1)

Module-4

Statistical Inference: Introduction to multivariate statistical models: Correlation and Regression analysis, Curve fitting (Linear and Non-linear)
(RBT Levels: **L2 & L3)** (Textbook:3)

Module-5

ProbabilityTheory: Random variable (discrete and continuous), Probability mass function (pmf), Probability density function (pdf), Mathematical expectation, Sampling theory: testing of hypothesis by ***t***-test, χ^2- test.
(RBT Levels: **L1 & L2)** (Textbook:3)

Course Outcomes:

On completion of this course, students are able to:

1. Understand the numerical methods to solve and find the roots of the equations.
2. Apply the technique of singular value decomposition for data compression, least square approximation in solving inconsistent linear systems
3. Understand vector spaces and related topics arising in magnification and rotation of images.
4. Utilize the statistical tools in multi variable distributions.
5. Use probability formulations for new predictions with discrete and continuous RV's.

Question Paper Pattern:

- The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.
- The question paper will have ten full questions carrying equal marks.
- Each full question consisting of 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbooks:

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Linear Algebra and its Applications	David C. Lay, Steven R. Lay and J. J. McDonald	Pearson Education Ltd	5th Edition 2015.
2	Numerical methods for Scientific	M K Jain, S.R.K	New Age	6th Ed., 2014

	and Engg. Computation	Iyengar, R K. Jain	International	
3	Probability, Statistics and Random Process	T. Veerarajan	Tata Mc-Graw Hill Co	3rd Edition 2016
Reference books:				
Sl No	**Title of the book**	**Name of the Author/s**	**Publisher Name**	**Edition and year**
1	Optimization: Theory & Applications Techniques	Rao. S.S	Wiley Eastern Ltd New Delhi.	
2	Signals, Systems, and Inference	Alan V. Oppenheim and George C. Verghese	Spring	2010.
3	Foundation Mathematics for Computer Science	John Vince	Springer International	
4	Higher Engineering Mathematics	B.S. Grewal	Khanna Publishers	44th Ed.,2017

M.TECH IN COMPUTER SCIENCE AND ENGINEERING (SCS)
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER –I

ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

Course Code	**20SCS12**, 20SSE254, 20SAM12, 20SIS31	CIE Marks	40
Teaching Hours/Week (L:P:S)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Introduction, problem Solving: state space search and control strategies

Module-2

Problem reduction and Game playing, Logic concepts and logic programming

Module-3

Advanced problem-solving paradigm: planning Knowledge representation

Module-4

Uncertainty Measure: Probability Theory, Bayesian Belief Networks,
Machine Learning Paradigms: Machine learning system, supervised and unsupervised learnings, Inductive, deductive learning, Clustering

Module-5

Support vector Machine, case-based reasoning and learning.
ANN: Single Layer, Multilayer. RBF, Design issues in ANN, Recurrent Network

Course outcomes: At the end of the course the student will be able to:

- Define Artificial intelligence and identify problems for AI. Characterize the search techniques to solve problems and recognize the scope of classical search techniques
- Define knowledge and its role in AI. Demonstrate the use of Logic in solving AI problems
- Demonstrate handling of uncertain knowledge and reasoning in probability theory.
- Understanding of Learning methods

Question paper pattern: The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbook/ Textbooks

Sl No	**Title of the book**	**Name of the Author/s**	**Publisher Name**	**Edition and year**

1	Artificial Intelligence:	SarojKaushik	Cengage Learning	2014 Edition
Reference Books				
1	Artificial Intelligence: Structures and Strategies for Complex Problem Solving	George F Luger	Pearson Addison Wesley	6th Ed, 2008
2	Artificial Intelligence	E Rich, K Knight, and S B Nair	Tata Mc-Graw Hill	3rd Ed, 2009
3	Artificial Intelligence: A Modern Approach	Stuart Russell and Peter Norvig	Prentice Hall	3rd, 2009

M.TECH IN COMPUTER SCIENCE AND ENGINEERING (SCS)
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SEMESTER -I

ADVANCES IN DATA BASE MANAGEMENT SYSTEM

Course Code	**20SCS13,** 20SCE252, 20SIT14, 20SSE15,	CIE Marks	40
Teaching Hours/Week (L:P:S)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Review of Relational Data Model and Relational Database Constraints:
Relational model concepts; Relational model constraints and relational database schemas; Update operations, anomalies, dealing with constraint violations, Types and violations.

Object and Object-Relational Databases:
Overview of Object Database Concepts, Object Database Extensions to SQL, The ODMG Object Model and the Object Definition Language ODL, Object Database Conceptual Design, The Object Query Language OQL, Overview of the C++ Language Binding in the ODMG Standard.

Module-2

Disk Storage, Basic File Structures, Hashing, and Modern Storage Architectures:
Introduction, Secondary Storage Devices, Buffering of Blocks, Placing File Records on Disk Operations on Files, Files of Unordered Records (Heap Files), Files of Ordered Records (Sorted Files), Hashing Techniques, Other Primary File Organizations, Parallelizing Disk Access Using RAID Technology, Modern Storage Architectures.

Distributed Database Concepts:
Distributed Database Concepts, Data Fragmentation, Replication, and Allocation Techniques for Distributed Database Design, Overview of Concurrency Control and Recovery in Distributed Databases, Overview of Transaction Management in Distributed Databases,Query Processing and Optimization in Distributed Databases, Types of Distributed Database Systems , Distributed Database Architectures, Distributed Catalogue Management.

Module-3

NOSQL Databases and Big Data Storage Systems:
Introduction to NOSQL Systems, The CAP Theorem, Document-Based NOSQL Systems and MongoDB, NOSQL Key-Value Stores, Column-Based or Wide Column NOSQL Systems, NOSQL Graph Databases and Neo4j.

Big Data Technologies Based on MapReduce and Hadoop:
What Is Big Data? Introduction to MapReduce and Hadoop, Hadoop Distributed File System (HDFS), MapReduce: Additional Details Hadoop v2 alias YARN, General Discussion

Module-4

Enhanced Data Models: Introduction to Active, Temporal, Spatial, Multimedia, and Deductive Databases: Active Database Concepts and Triggers, Temporal Database Concepts, Spatial Database Concepts, Multimedia Database Concepts, Introduction to Deductive Databases.

Introduction to Information Retrieval and Web Search: Information Retrieval (IR) Concepts, Retrieval Models, Types of Queries in IR Systems, Text pre-processing, Inverted Indexing, Evaluation Measures of Search relevance, web Search and Analysis. Trends in Information Retrieval

Module-5

Data Mining Concepts: Overview of Data Mining Technology, Association Rules, Classification, Clustering, Approaches to Other Data Mining Problems, Applications of Data Mining, Commercial Data Mining Tools

Overview of Data Warehousing and OLAP: Introduction, Definitions, and Terminology, Characteristics of Data Warehouses, Data Modelling for Data Warehouses, building a Data Warehouse, Typical Functionality of a Data Warehouse, Data Warehouse versus Views, Difficulties of Implementing Data Warehouses.

Course outcomes:
At the end of the course the student will be able to:

- Select the appropriate high-performance database like parallel and distributed database
- Infer and represent the real-world data using object-oriented database
- Interpret rule set in the database to implement data warehousing of mining
- Discover and design database for recent applications database for better interoperability

Question paper pattern:
The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbook/ Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Fundamentals of Database Systems	Elmasri and Navathe	Pearson Education	2013
2	Database Management Systems	Raghu Ramakrishnan and Johannes Gehrke	McGraw-Hill	3rd Edition, 2013.
Reference Books				
1	Database System Concepts	Abraham Silberschatz, Henry F. Korth, S. Sudarshan	McGraw Hill	6th Edition, 2010

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SEMESTER – I

ADVANCED ALGORITHMS

Course Code	**20SCS14,** 20SSE244, 20SIS321	CIE Marks	40
Teaching Hours/Week (L:P:S)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Review of Analysis Techniques: Growth of Functions: Asymptotic notations; Standard notations and common functions; Recurrences and Solution of Recurrence equations- The substitution method, The recurrence – tree method, The master method; Amortized Analysis: Aggregate, Accounting and Potential Methods.

Module-2

Graph Algorithms: Bellman - Ford Algorithm; Single source shortest paths in a DAG; Johnson's Algorithm for sparse graphs; Flow networks and Ford-Fulkerson method; Maximum bipartite matching. **Polynomials and the FFT:** Representation of polynomials; The DFT and FFT; Efficient implementation of FFT.

Module-3

Number -Theoretic Algorithms: Elementary notions; GCD; Modular Arithmetic; Solving modular linear equations; The Chinese remainder theorem; Powers of an element; RSA cryptosystem; Primality testing; Integer factorization

Module-4

String-Matching Algorithms: Naïve string Matching; Rabin - Karp algorithm; String matching with finite automata; Knuth-Morris-Pratt algorithm; Boyer – Moore algorithms.

Module-5

Probabilistic and Randomized Algorithms: Probabilistic algorithms; Randomizing deterministic algorithms, Monte Carlo and Las Vegas algorithms; Probabilistic numeric algorithms

Course outcomes:

At the end of the course the student will be able to:

- Design and apply iterative and recursive algorithms.
- Design and implement optimization algorithms in specific applications.
- Design appropriate shared objects and concurrent objects for applications.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbook/ Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Introduction to Algorithms	T. H Cormen, C E Leiserson, R L Rivest and C Stein	PHI	3rd Edition, 2010
2	Algorithms	Kenneth A. Berman	Cengage Learning	2002.

Reference Books

1	Fundamentals of Computer Algorithms	Ellis Horowitz, SartajSahni, S.Rajasekharan	Universities press	2nd Edition, 2007

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SEMESTER – I

INTERNET OF THINGS AND APPLICATIONS

Course Code	**20SCS15**, 20LNI22, 20SCE23, 20SCN14, 20SAM323, 20SIS14	CIE Marks	20+20 (IA test+ Mini project)
Teaching Hours/Week (L:P:S)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Note: CIE marks can be distributed as: IA test (20 marks) + Mini project (individual/Group) 20 Marks

Module-1

What is The Internet of Things? Overview and Motivations, Examples of Applications, IPV6 Role, Areas of Development and Standardization, Scope of the Present Investigation.Internet of Things Definitions and frameworks-IoT Definitions, IoT Frameworks, Basic Nodal Capabilities. Internet of Things Application Examples-Overview, Smart Metering/Advanced Metering Infrastructure-Health/Body Area Networks, City Automation, Automotive Applications, Home Automation, Smart Cards, Tracking, Over-The-Air-Passive Surveillance/Ring of Steel, Control Application Examples, Myriad Other Applications.

Module -2

Fundamental IoT Mechanism and Key Technologies-Identification of IoT Object and Services, Structural Aspects of the IoT, Key IoT Technologies. Evolving IoT Standards-Overview and Approaches, IETF IPV6 Routing Protocol for RPL Roll, Constrained Application Protocol, Representational State Transfer, ETSI M2M,Third Generation Partnership Project Service Requirements for Machine-Type Communications, CENELEC, IETF Ipv6 Over Low power WPAN, Zigbee IP(ZIP),IPSO

Module – 3

Layer ½ Connectivity: Wireless Technologies for the IoT-WPAN Technologies for IoT/M2M, Cellular and Mobile Network Technologies for IoT/M2M,Layer 3 Connectivity:Ipv6 Technologies for the IoT: Overview and Motivations. Address Capabilities,Ipv6 Protocol Overview, Ipv6 Tunnelling, Ipsec in Ipv6,Header Compression Schemes, Quality of Service in Ipv6, Migration Strategies to Ipv6.

Module-4

Case Studies illustrating IoT Design-Introduction, Home Automation, Cities, Environment, Agriculture, Productivity Applications.

Module-5

Data Analytics for IoT – Introduction, Apache Hadoop, Using HadoopMapReduce for Batch Data Analysis, Apache Oozie, Apache Spark, Apache Storm, Using Apache Storm for Real-time Data Analysis, Structural Health Monitoring Case Study.

Note: CIE marks can be distributed as: IA test (20 marks) + Mini project (individual/Group) 20 Marks

Course outcomes:

At the end of the course the student will be able to:

- Develop schemes for the applications of IOT in real time scenarios
- Manage the Internet resources
- Model the Internet of things to business
- Understand the practical knowledge through different case studies

Understand data sets received through IoT devices and tools used for analysis

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbook/ Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Building the Internet of Things with Ipv6 and MIPv6:The Evolving World of M2M Communications	Daniel Minoli	Wiley	2013
2	Internet of Things: A Hands-on Approach	ArshdeepBahga, Vijay Madisetti	Universities Press	2015
Reference Books				
1	The Internet of Things	Michael Miller	Pearson	2015 First Edition
2	Designing Connected Products	Claire Rowland,Elizabeth Goodman et.al	O'Reilly	First Edition, 2015

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SEMESTER – I

ALGORITHMS AND DATABASE MANAGEMENT SYSTEMS LABORATORY

Course Code	**20SCSL16**	CIE Marks	40
Teaching Hours/Week (L:P:S)	0:4:0	SEE Marks	60
Credits	02	Exam Hours	03

PART A: Algorithms Laboratory

List of Experiments:

1. Program to implement Ford-Fulkerson method.

2. Program to implement Naive algorithm.
3. Program to implement Rabin - Karp algorithm.
4. Program to implement Boyer – Moore algorithm.
5. Program to implement Monte Carlo algorithm.

PART B: ADBMS Laboratory

List of Experiments

Note: The following experiments may be implemented on MySQL/ORACLE or any other suitable RDBMS with support for Object features

1. **Develop a database application to demonstrate storing and retrieving of BLOB and CLOB objects.**
   a. Write a binary large object (BLOB) to a database as either binary or character (CLOB) data, depending on the type of the field in your data source. To write a BLOB value to the database, issue the appropriate INSERT or UPDATE statement and pass the BLOB value as an input parameter. If your BLOB is stored as text, such as a SQL Server text field, pass the BLOB as a string parameter. If the BLOB is stored in binary format, such as a SQL Server image field, pass an array of type byte as a binary parameter.
   b. Once storing of BLOB and CLOB objects is done, retrieve them and display the results accordingly.

2. **Develop a database application to demonstrate the representation of multi valued attributes, and the use of nested tables to represent complex objects. Write suitable queries to demonstrate their use.**

   Consider Purchase Order Example: This example is based on a typical business activity: managing customer orders. Need to demonstrate how the application might evolve from relational to object-relational, and how you could write it from scratch using a pure object-oriented approach.
   a. Show how to implement the schema -- Implementing the Application under the Relational Model -- using only Oracle's built-in data types. Build an object-oriented application on top of this relational schema using object views

3. **Design and develop a suitable Student Database application by considering appropriate attributes. Couple of attributes to be maintained is the Attendance of a student in each subject for which he/she has enrolled and Internal Assessment Using TRIGGERS, write active rules to do the following:**
   a. Whenever the attendance is updated, check if the attendance is less than 85%; if so, notify the Head of the Department concerned.
   b. Whenever, the marks in an Internal Assessment Test are entered, check if the marks are less than 40%; if so, notify the Head of the Department concerned.

Use the following guidelines when designing triggers:

- Use triggers to guarantee that when a specific operation is performed, related actions are performed.
- Use database triggers only for centralized, global operations that should be fired for the triggering statement, regardless of which user or database application issues the statement.
- Do not define triggers that duplicate the functionality already built into Oracle. For example, do not define triggers to enforce data integrity rules that can be easily enforced using declarative integrity constraints.
- Limit the size of triggers (60 lines or fewer is a good guideline). If the logic for your trigger requires much more than 60 lines of PL/SQL code, it is better to include most of the code in a stored procedure, and call the procedure from the trigger.
- Be careful not to create recursive triggers. For example, creating an AFTER UPDATE statement trigger on the EMP table that itself issues an UPDATE statement on EMP causes the trigger to fire recursively until it has run out of memory.

1. **Design, develop, and execute a program to implement specific Apriori algorithm for**

mining association rules. Run the program against any large database available in the public domain and discuss the results.

Association rules are if/then statements that help uncover relationships between seemingly unrelated data in a relational database or other information repository. An example of an association rule would be "If a customer buys a dozen eggs, he is 80% likely to also purchase milk."

Course outcomes:
At the end of the course the student will be able to:

- Work on the concepts of Software Testing and ADBMS at the practical level
- Compare and pick out the right type of software testing process for any given real-world problem
- Carry out the software testing process in efficient way
- Establish a quality environment as specified in standards for developing quality software
- Model and represent the real-world data using object-oriented database
- Embed the rules set in the database to implement various features of ADBMS
- Choose, design and implement recent applications database for better interoperability

Conduction of Practical Examination:
All laboratory experiments (nos) are to be included for practical examination.
Students to pick one experiment from **each part and execute both**
Strictly follow the instructions as printed on the cover page of answer script for breakup of marks
Change of experiment is allowed only once and marks allotted to the procedure part to be made zero.

RESEARCH METHODOLOGY AND IPR			
Course Code	20RMI17	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	1:0:2	SEE Marks	60
Credits	02	Exam Hours	03

Module-1

Research Methodology: Introduction, Meaning of Research, Objectives of Research, Motivation in Research, Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Importance of Knowing How Research is Done, Research Process, Criteria of Good Research, and Problems Encountered by Researchers in India.
Defining the Research Problem: Research Problem, Selecting the Problem, Necessity of Defining the Problem, Technique Involved in Defining a Problem, An Illustration.

Module-2

Reviewing the literature: Place of the literature review in research, Bringing clarity and focus to your research problem, Improving research methodology, Broadening knowledge base in research area, Enabling contextual findings, How to review the literature, searching the existing literature, reviewing the selected literature, Developing a theoretical framework, Developing a conceptual framework, Writing about the literature reviewed.
Research Design: Meaning of Research Design, Need for Research Design, Features of a Good Design, Important Concepts Relating to Research Design, Different Research Designs, Basic Principles of Experimental Designs, Important Experimental Designs.

Module-3

Design of Sampling: Introduction, Sample Design, Sampling and Non-sampling Errors, Sample Survey versus Census Survey, Types of Sampling Designs.
Measurement and Scaling: Qualitative and Quantitative Data, Classifications of Measurement Scales, Goodness of Measurement Scales, Sources of Error in Measurement Tools, Scaling, Scale Classification Bases, Scaling Technics, Multidimensional Scaling, Deciding the Scale.
Data Collection: Experimental and Surveys, Collection of Primary Data, Collection of Secondary Data, Selection of Appropriate Method for Data Collection, Case Study Method.

Module-4

Testing of Hypotheses: Hypothesis, Basic Concepts Concerning Testing of Hypotheses, Testing of Hypothesis, Test Statistics and Critical Region, Critical Value and Decision Rule, Procedure for Hypothesis Testing, Hypothesis Testing for Mean, Proportion, Variance, for Difference of Two Mean, for Difference of Two Proportions, for Difference of Two Variances, P-Value approach, Power of Test, Limitations of the Tests of Hypothesis.
Chi-square Test: Test of Difference of more than Two Proportions, Test of Independence of Attributes, Test of Goodness of Fit, Cautions in Using Chi Square Tests.

Module-5

Interpretation and Report Writing: Meaning of Interpretation, Technique of Interpretation, Precaution in Interpretation, Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Precautions for Writing Research Reports.
Intellectual Property: The Concept, Intellectual Property System in India, Development of TRIPS Complied Regime in India, Patents Act, 1970, Trade Mark Act, 1999,The Designs Act, 2000, The Geographical Indications of Goods (Registration and Protection) Act1999, Copyright Act,1957,The Protection of Plant Varieties and Farmers' Rights Act, 2001,The Semi-Conductor Integrated Circuits Layout Design Act, 2000, Trade Secrets, Utility Models, IPR and Biodiversity, The Convention on Biological Diversity (CBD) 1992, Competing Rationales for Protection of IPRs, Leading International Instruments Concerning IPR, World Intellectual Property Organisation (WIPO),WIPO and WTO, Paris Convention for the Protection of Industrial Property, National Treatment, Right of Priority, Common Rules, Patents, Marks, Industrial Designs, Trade Names, Indications of Source, Unfair Competition, Patent Cooperation Treaty (PCT), Advantages of PCT Filing, Berne Convention for the Protection of Literary and Artistic Works, Basic Principles, Duration of Protection, Trade Related Aspects of Intellectual Property Rights(TRIPS) Agreement, Covered under TRIPS Agreement, Features of the Agreement, Protection of Intellectual Property under TRIPS, Copyright and Related Rights, Trademarks, Geographical indications, Industrial Designs, Patents, Patentable Subject Matter, Rights Conferred, Exceptions, Term of protection, Conditions on Patent Applicants, Process Patents, Other Use without Authorization of the Right Holder, Layout-Designs of Integrated Circuits, Protection of Undisclosed Information, Enforcement of Intellectual Property Rights, UNSECO.

Course outcomes:
At the end of the course the student will be able to:

- Discuss research methodology and the technique of defining a research problem
- Explain the functions of the literature review in research, carrying out a literature search, developing theoretical and conceptual frameworks and writing a review.
- Explain various research designs, sampling designs, measurement and scaling techniques and also different methods of data collections.
- Explain several parametric tests of hypotheses, Chi-square test, art of interpretation and writing research reports
- Discuss various forms of the intellectual property, its relevance and business impact in the changing global business environment and leading International Instruments concerning IPR.

Question paper pattern:

- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module.

Textbooks

(1) Research Methodology: Methods and Techniques, C.R. Kothari, Gaurav Garg,New Age International,4th Edition, 2018.

(2) Research Methodology a step-by-step guide for beginners. (For the topic Reviewing the literature under module 2), RanjitKumar,SAGE Publications,3rd Edition, 2011.

(3) Study Material (For the topic Intellectual Property under module 5),
Professional Programme Intellectual Property Rights, Law and Practice, The Institute of Company Secretaries of India, Statutory Body Under an Act of Parliament, September 2013.

Reference Books

(1) Research Methods: the concise knowledge base, Trochim, Atomic Dog Publishing, 2005.

(2) Conducting Research Literature Reviews: From the Internet to Paper, Fink A, Sage Publications, 2009.

M.TECH IN COMPUTER SCIENCE AND ENGINEERING (SCS)
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER – II

DATA SCIENCE

Course Code	**20SCS21,** 20SAM14, 20SIS22	CIE Marks	40
Teaching Hours/Week (L:P:S)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Introduction: What is Data Science? Big Data and Data Science hype – and getting past the hype, Why now? – Datafication, Current landscape of perspectives, Skill sets. NeededStatistical Inference: Populations and samples, Statistical modelling, probability distributions, fitting a model, - Introduction to R

Module-2

Exploratory Data Analysis and the Data Science Process: Basic tools (plots, graphs and summary statistics) of EDA, Philosophy of EDA,The Data Science Process, Case Study: RealDirect (online real estate firm). Three Basic Machine Learning Algorithms: Linear Regression, k-Nearest Neighbours (k-NN), k-means

Module-3

One More Machine Learning Algorithm and Usage in Applications: Motivating application: Filtering Spam, Why Linear Regression and k-NN are poor choices for Filtering Spam, Naive Bayes and why it works for Filtering Spam, Data Wrangling: APIs and other tools for scrapping the Web

Module-4

Feature Generation and Feature Selection (Extracting Meaning from Data): Motivating application: user (customer) retention. Feature Generation (brainstorming, role of domain expertise, and place for imagination), Feature Selection algorithms. Filters; Wrappers; Decision Trees; Random Forests. Recommendation Systems: Building a User-Facing Data Product, Algorithmic ingredients of a Recommendation Engine, Dimensionality Reduction, Singular Value Decomposition, Principal Component Analysis, Exercise: build your own recommendation system

Module-5

Mining Social-Network Graphs: Social networks as graphs, Clustering of graphs, Direct discovery of communities in graphs, Partitioning of graphs, Neighbourhood properties in graphs, Data Visualization: Basic principles, ideas and tools for data visualization. Data Science and Ethical Issues, Discussions on privacy, security, ethics, Next-generation data scientists

Course outcomes:
At the end of the course the student will be able to:

- Define data science and its fundamentals
- Demonstrate the process in data science
- Explain machine learning algorithms necessary for data sciences
- Illustrate the process of feature selection and analysis of data analysis algorithms
- Visualize the data and follow of ethics

Question paper pattern:
The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbook/ Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Doing Data Science	Cathy O'Neil and Rachel Schutt	Straight Talk from The Frontline.O'Reilly	2014
2	Mining of Massive Datasets. V2.1	Jure Leskovek, AnandRajaraman and Jeffrey Ullman	Cambridge University Press	2014
Reference Books				
1	Machine Learning: A Probabilistic Perspective	Kevin P. Murphy		2013
2	Data Mining: Concepts and Techniques	Jiawei Han, MichelineKamber and Jian Pei	ThirdEdition	2012.
3	Practical Statistics for Data Scientists	Peter Bruce and Andrew Bruce	O'reilly series	

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SEMESTER – II

SEMANTIC WEB AND SOCIAL NETWORKS

Course Code	**20SCS22,** 20LNI12, 20SAM332	CIE Marks	40
Teaching Hours/Week (L:P:S)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Web Intelligence Thinking and Intelligent Web Applications, The Information age,The World Wide Web, Limitations of Today's Web, The Next Generation Web, Machine Intelligence, Artificial Intelligence, Ontology, Inference engines, Software Agents, Berners-Lee www, Semantic Road Map, Logic on the semantic Web.

Module 2

Knowledge Representation for the Semantic Web Ontologies and their role in the semantic web, Ontologies Languages for the Semantic Web – Resource Description Framework(RDF) / RDF Schema, Ontology Web Language(OWL), UML, XML/XML Schema.

Module 3

Ontology Engineering, Ontology Engineering, Constructing Ontology, Ontology Development Tools, Ontology Methods, Ontology Sharing and Merging, Ontology Libraries and Ontology Mapping, Logic, Rule and Inference Engines.

Module 4

Semantic Web Applications, Services and Technology Semantic Web applications and services, Semantic Search, e-learning, Semantic Bioinformatics, Knowledge Base, XML Based Web Services, Creating an OWL-S Ontology for Web Services, Semantic Search Technology, Web Search Agents and Semantic Methods.

Module 5

Social Network Analysis and semantic web What is social Networks analysis, development of the social networks analysis, Electronic Sources for Network Analysis – Electronic Discussion networks, Blogs and Online Communities, Web Based Networks. Building Semantic Web Applications with social network features.

Course outcomes:

At the end of the course the student will be able to:

- Demonstrate the semantic web technologies like RDF Ontology and others
- Learn the various semantic web applications
- Identify the architectures and challenges in building social networks
- Analyse the performance of social networks using electronic sources

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbook/ Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Thinking on the Web	Berners Lee, Godel and Turing	Wiley inter science	2008
2	Social Networks and the Semantic Web	Peter Mika	Springer	2007
Reference Books				
1	Semantic Web and Semantic Web Services	Liyang Lu Chapman and Hall	CRC Publishers	
2	Semantic Web Technologies, Trends and Research in Ontology Based Systems.			
3	Programming the Semantic Web	T.Segaran, C.Evans, J.Taylor	O'Reilly.	

M.TECH IN **COMPUTER NETWORK ENGINEERING (SCN), COMPUTER SCIENCE & ENGINEERING(SCS) ARTIFICIAL INTELLIGENCE & MACHINE LEARNING(SAM)**

Choice Based Credit System (CBCS) and Outcome Based Education (OBE) SEMESTER - I

BLOCKCHAIN TECHNOLOGY

Course Code	20SCN15, 20SCS23, 20SAM254,	CIE Marks	40
Teaching Hours/Wee(L:P:S)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Course Objectives:

The blockchain technology course allows the students to explore the driving force behind the cryptocurrency Bitcoin. Along with the Decentralization, Cryptography, Bitcoins with its alternative coins, Smart contracts and outside of currencies.

Module-1

Blockchain 101: Distributed systems, History of blockchain, Introduction to blockchain, Types of blockchain, CAP theorem and blockchain, Benefits and limitations of blockchain.

Module-2

Decentralization and Cryptography:
Decentralization using blockchain, Methods of decentralization, Routes to decentralization, Decentralized organizations. Cryptography and Technical Foundations: Cryptographic primitives, Asymmetric cryptography, Public and private keys

Module-3

Bitcoin and Alternative Coins A: Bitcoin, Transactions, Blockchain, Bitcoin payments B: Alternative Coins, Theoretical foundations, Bitcoin limitations, Namecoin, Litecoin, Primecoin, Zcash

Module-4

Smart Contracts and Ethereum 101: Smart Contracts: Definition, Ricardian contracts. Ethereum 101:Introduction, Ethereum blockchain, Elements of the Ethereum blockchain, Precompiled contracts.

Module-5

Alternative Blockchains: Blockchains Blockchain-Outside of Currencies: Internet of Things, Government, Health, Finance, Media

Course outcomes:

At the end of the course the student will be able to:

1. Understand the types, benefits and limitation of blockchain.
2. Explore the blockchain decentralization and cryptography concepts.
3. Enumerate the Bitcoin features and its alternative options.
4. Describe and deploy the smart contracts
5. Summarize the blockchain features outside of currencies.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.
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Textbook/ Textbooks

1 Mastering Blockchain - Distributed ledgers, decentralization and smart contracts explained, Author- Imran Bashir, Packt Publishing Ltd, Second Edition, ISBN 978-1- 78712-544-5, 2017

Reference Books

1 Bitcoin and Cryptocurrency Technologies, Author- Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, Steven Goldfeder, Princeton University, 2016

2 Blockchain Basics: A Non-Technical Introduction in 25 Steps, Author- Daniel Drescher, Apress, First Edition, 2017

3 Mastering Bitcoin: Unlocking Digital Cryptocurrencies, Andreas M. Antonopoulos, O'Reilly Media, First Edition, 2014

M.TECH IN COMPUTER SCIENCE AND ENGINEERING (SCS) **Choice Based Credit System (CBCS) and Outcome Based Education (OBE)**			
ADVANCED CRYPTOGRAPHY			
Course Code	**20SCS241**, 20LNI254	CIE Marks	40
Teaching Hours/Week (L:P:S)	4:0:0	SEE Marks	60
Credits	04	Exam Hours	03
Module-1			
Number Theory: Introduction to number theory, Overview of modular arithmetic, discrete logarithms, and primality/factoring, Euclid's algorithm, Finite fields, Prime numbers, Fermat's and Euler's theorem-Testing for primality.			
Module-2			
Symmetric & Asymmetric Cryptography: Classical encryption techniques, Block cipher design principles and modes of operation, Data encryption standard, Evaluation criteria for AES, AES cipher, Principles of public key cryptosystems, The RSA algorithm, Key management – Diffie Hellman Key exchange, Elliptic curve arithmetic-Elliptic curve cryptography.			
Module-3			
Authentication functions:MAC,Hash function, Security of hash function and MAC,MD5,SHA,HMAC, CMAC, Digital signature and authentication protocols, DSS,EI Gamal – Schnorr.			
Module-4			
Authentication applications: Kerberos & X.509 Authentication services Internet Firewalls for Trusted System: Roles of Firewalls , Firewall related terminology-,Types of Firewalls ,Firewall designs, Intrusion detection system , Virus and related threats, Countermeasures , Firewalls design principles ,Trusted systems, Practical implementation of cryptography and security.			
Module-5			
Quantum Cryptography and Quantum Teleportation: Heisenberg uncertainty principle, polarization states of photons, quantum cryptography using polarized photons, local vs. nonlocal interactions,			

entanglements, EPR paradox, Bell's theorem, Bell basis, teleportation of a single qubit theory and experiments.

Course outcomes:

At the end of the course the student will be able to:

- Understand OSI security architecture and classical encryption techniques.
- Acquire fundamental knowledge on the concepts of finite fields and number theory.
- Understand various block cipher and stream cipher models.
- Describe the principles of public key cryptosystems, hash functions and digital signature.
- Compare various Cryptographic Techniques
- Design Secure applications
- Inject secure coding in the developed applications

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbook/ Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Cryptography and Network Security Principles And Practice	William Stallings	Pearson Education	Fourth Edition
2	A Course in Number Theory and Cryptology	Neal Koblitz	Springer	1987
Reference Books				
1	Cryptography and Network Security	Behrouz A Forouzan, DebdeepMukhopadhyay	Mc-GrawHill	3rd Edition, 2015
2	Applied Cryptography and Network Security	Damien Vergnaud and Michel Abdalla	7th International Conference, ACNS 2009, Paris-Rocquencourt, France	June 2-5, 2009, Proceedings
3	**Quantum Computation and Quantum Information**	**Michael A. Nielsen and Issac L Chuang**	**Cambridge University Press**	**10th Anniversary Edition Hardcover – Illustrated 2010**

M.TECH IN COMPUTER SCIENCE AND ENGINEERING (SCS)
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER - II

NATURAL LANGUAGE PROCESSING

Course Code	**20SCS242**, 20SCE243, 20SAM23	CIE Marks	40
Teaching Hours/Week (L:P:S)	4:0:0	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

OVERVIEW AND LANGUAGE MODELING: Overview: Origins and challenges of NLP-Language and Grammar-Processing Indian Languages- NLP Applications-Information Retrieval. Language Modeling: Various Grammar- based Language Models-Statistical Language Model.

Module -2

WORD LEVEL AND SYNTACTIC ANALYSIS: Word Level Analysis: Regular Expressions-Finite-

State Automata-Morphological Parsing-Spelling Error Detection and correction-Words and Word classes-Part-of Speech Tagging. Syntactic Analysis: Context-free Grammar-Constituency- Parsing-Probabilistic Parsing.

Module - 3

Extracting Relations from Text: From Word Sequences to Dependency Paths: Introduction, Subsequence Kernels for Relation Extraction, A Dependency-Path Kernel for Relation Extraction and Experimental Evaluation. Mining Diagnostic Text Reports by Learning to Annotate Knowledge Roles: Introduction, Domain Knowledge and Knowledge Roles, Frame Semantics and Semantic Role Labelling, Learning to Annotate Cases with Knowledge Roles and Evaluations. A Case Study in Natural Language Based Web Search: InFact System Overview, The GlobalSecurity.org Experience.

Module-4

Evaluating Self-Explanations in iSTART: Word Matching, Latent Semantic Analysis, and Topic Models: Introduction, iSTART: Feedback Systems, iSTART: Evaluation of Feedback Systems, Textual Signatures: Identifying Text-Types Using Latent Semantic Analysis to Measure the Cohesion of Text Structures: Introduction, Cohesion, Coh-Metrix, Approaches to Analysing Texts, Latent Semantic Analysis, Predictions, Results of Experiments. Automatic Document Separation: A Combination of Probabilistic Classification and Finite-State Sequence Modelling: Introduction, Related Work, Data Preparation, Document Separation as a Sequence Mapping Problem, Results. Evolving Explanatory Novel Patterns for Semantically based Text Mining: Related Work, A Semantically Guided Model for Effective Text mining.

Module-5

INFORMATION RETRIEVAL AND LEXICAL RESOURCES: Information Retrieval: Design features of Information Retrieval Systems-Classical, Non classical, Alternative Models of Information Retrieval – valuation Lexical Resources: World Net-Frame Net- Stemmers-POS Tagger- Research Corpora.

Course outcomes:

At the end of the course the student will be able to:

- Analyse the natural language text.
- Generate the natural language.
- Demonstrate Text mining.
- Apply information retrieval techniques.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbook/ Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Natural Language Processing and Information Retrieval	TanveerSiddiqui, U.S. Tiwary	Oxford University Press	2008
2	Anne Kao and Stephen R. Potee	Natural LanguageProcessing andText Mining	Springer-Verlag London Limited	2007

Reference Books

1	Speech and Language Processing: Anintroduction to Natural Language Processing, Computational Linguistics and SpeechRecognition	Daniel Jurafsky and James H Martin	Prentice Hall	2008 2nd Edition
2	Natural Language Understanding	James Allen	Benjamin/Cummingsp ublishing company	2nd edition, 1995
3	Information Storage and Retrieval systems	Gerald J. Kowalski and Mark.T.	Kluwer academic Publishers	2000.

		Maybury		
4	Natural Language Processing with Python	Steven Bird, Ewan Klein, Edward Loper	O'Reilly Media	2009
5	Foundations of Statistical Natural Language Processing	Christopher D.Manning and HinrichSchutze	MIT Press	1999

M.TECH IN COMPUTER SCIENCE AND ENGINEERING (SCS)
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SEMESTER – II

CLOUD COMPUTING

Course Code	**20SCS243**, 20LNI15, 20SCE14, 20SIT22, 20SSE251, 20SCN31, 20SIS12	CIE Marks	40
Teaching Hours/Week (L:P:S)	4:0:0	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Introduction, Cloud Infrastructure: Cloud computing, Cloud computing delivery models and services, Ethical issues, Cloud vulnerabilities, Cloud computing at Amazon, Cloud computing the Google perspective, Microsoft Windows Azure and online services, Open-source software platforms for private clouds, Cloud storage diversity and vendor lock-in, Energy use and ecological impact, Service level agreements, User experience and software licensing. Exercises and problems.

Module 2

Cloud Computing: Application Paradigms.: Challenges of cloud computing, Architectural styles of cloud computing, Workflows: Coordination of multiple activities, Coordination based on a state machine model: The Zookeeper, The Map Reduce programming model, A case study: The Gre The Web application, Cloud for science and engineering, High-performance computing on a cloud, Cloud computing for Biology research, Social computing, digital content and cloud computing.

Module 3

Cloud Resource Virtualization: Virtualization, Layering and virtualization, Virtual machine monitors, Virtual Machines, Performance and Security Isolation, Full virtualization and paravirtualization, Hardware support for virtualization, Case Study: Xen a VMM based paravirtualization, Optimization of network virtualization, vBlades, Performance comparison of virtual machines, The dark side of virtualization, Exercises and problems

Module 4

Cloud Resource Management and Scheduling: Policies and mechanisms for resource management, Application of control theory to task scheduling on a cloud, Stability of a two-level resource allocation architecture, Feedback control based on dynamic thresholds, Coordination of specialized autonomic performance managers, A utility-based model for cloud-based Web services, Resourcing bundling: Combinatorial auctions for cloud resources, Scheduling algorithms for computing clouds, Fair queuing, Start-time fair queuing, Borrowed virtual time, Cloud scheduling subject to deadlines, Scheduling MapReduce applications subject to deadlines, Resource management and dynamic scaling, Exercises and problems.

Module 5

Cloud Security, Cloud Application Development: Cloud security risks, Security: The top concern for cloud users, Privacy and privacy impact assessment, Trust, Operating system security, Virtual machine Security, Security of virtualization, Security risks posed by shared images, Security risks posed by a management OS, A trusted virtual machine monitor, Amazon web services: EC2 instances, Connecting clients to cloud instances through firewalls, Security rules for application and transport layer protocols in EC2, How to launch an EC2 Linux instance and connect to it, How to use S3 in java, Cloud-based simulation of a distributed trust algorithm, A trust management service, A cloud service for adaptive data streaming, Cloud based optimal FPGA synthesis .Exercises and problems.

Course outcomes:
At the end of the course the student will be able to:

- Compare the strengths and limitations of cloud computing

- Identify the architecture, infrastructure and delivery models of cloud computing
- Apply suitable virtualization concept.
- Choose the appropriate cloud player
- Address the core issues of cloud computing such as security, privacy and interoperability
- Design Cloud Services
- Set a private cloud

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbook/ Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Cloud Computing Theory and Practice	Dan C Marinescu	Elsevier(MK)	2013.
Reference Books				
1	RajkumarBuyya , James Broberg, AndrzejGoscinski	Computing Principles and Paradigms	Willey	2014
2	Cloud Computing Implementation, Management and Security	John W Rittinghouse, James F Ransome	CRC Press	2013

M.TECH IN COMPUTER SCIENCE AND ENGINEERING (SCS)
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER - II

PATTERN RECOGNITION

Course Code	**20SCS244**, 20SCE242, 20SAM253	CIE Marks	40
Teaching Hours/Week (L:P:S)	4:0:0	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Introduction: Definition of PR, Applications, Datasets for PR, Different paradigms for PR, Introduction to probability, events, random variables, Joint distributions and densities, moments. Estimation minimum risk estimators, problems

Module -2

Representation: Data structures for PR, Representation of clusters, proximity measures, size of patterns, Abstraction of Data set, Feature extraction, Feature selection, Evaluation

Module – 3

Nearest Neighbour based classifiers & Bayes classifier: Nearest neighbour algorithm, variants of NN algorithms, use of NN for transaction databases, efficient algorithms, Data reduction, prototype selection, Bayes theorem, minimum error rate classifier, estimation of probabilities, estimation of probabilities, comparison with NNC, Naive Bayes classifier, Bayesian belief network

Module-4

Naive Bayes classifier, Bayesian belief network, Decision Trees: Introduction, DT for PR, Construction of DT, splitting at the nodes, Over fitting & Pruning, Examples , Hidden Markov models: Markov models for classification, Hidden Markov models and classification using HMM

Module-5

Clustering: Hierarchical (Agglomerative, single/complete/average linkage, wards, Partitional (Forgy's, k-means, Isodata), clustering large data sets, examples, An application: Handwritten Digit recognition

Course outcomes:
At the end of the course the student will be able to:

- Explain pattern recognition principals
- Develop algorithms for Pattern Recognition.
- Develop and analyse decision tress.
- Design the nearest neighbour classifier.
- Apply Decision tree and clustering techniques to various applications

Question paper pattern:
The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbook/ Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Pattern Recognition (An Introduction)	V Susheela Devi, M Narsimha Murthy	Universities Press	2011
2	Pattern Recognition & Image Analysis	Earl Gose, Richard Johnsonbaugh, Steve Jost	PH	1996.
Reference Books				
1	Pattern Classification	Duda R. O., P.E. Hart, D.G. Stork	John Wiley and sons	2000.

M.TECH IN COMPUTER SCIENCE AND ENGINEERING (SCS)
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER - II

IMAGE PROCESSING AND MACHINE VISION

Course Code	**20SCS251**	CIE Marks	40
Teaching Hours/Week (L:P:S)	4:0:0	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Introduction and Digital Image Fundamentals
Motivation & Perspective, Applications, Components of Image Processing System, Fundamentals Steps in Image 20% Processing, Image Sampling and Quantization, Some basic relationships like Neighbours, Connectivity, Distance Measures between pixels

Module-2

Image Enhancement in the Spatial and Frequency Domain
Image enhancement by point processing, Image enhancement by neighbourhood processing, Basic Grey Level 20% Transformations, Histogram Processing, Enhancement Using Arithmetic and Logic operations, Zooming, Basics of Spatial Filters, Smoothening and Sharpening Spatial Filters, Combining Spatial Enhancement Methods. Introduction to Fourier Transform and the frequency Domain, Smoothing and Sharpening Frequency Domain Filters, Homomorphic Filtering

Module-3

Image Restoration and Image Compression
Model of The Image Degradation / Restoration Process, Noise Models, Restoration in the presence of Noise Only Spatial Filtering, Periodic Noise Reduction by Frequency Domain Filtering, Linear Position-Invariant Degradations, Estimation of Degradation Function, Inverse filtering, Wiener filtering, Constrained Least Square Filtering, Geometric Mean Filter, Geometric Transformations. Data Redundancies, Image Compression models, Elements of Information Theory, Lossless and Lossy compression, Huffman Coding, Shanon-Fano Coding, Arithmetic Coding, Golomb Coding, LZW Coding, Run Length Coding, Loss less predictive Coding, Bit Plane Coding, Image compression standards.

Module-4

Image Segmentation and Morphological Image Processing

Discontinuity based segmentation, similaritybased segmentation, Edge linking and boundary detection, 20% Threshold, Region based Segmentation Introduction to Morphology, Dilation, Erosion, Some basic Morphological Algorithms

Module-5

Object Representation and description and Computer Vision Techniques

Introduction to Morphology, Some basic Morphological Algorithms, Representation, Boundary Descriptors, Regional Descriptors, Chain Code, Structural Methods. Review of Computer Vision applications; Fuzzy-Neural algorithms for computer vision applications

Course outcomes:

At the end of the course the student will be able to:

- Explain the fundamentals of image processing and computer vision
- Illustrate the image enhancement techniques
- Illustrate Image restoration and image compression technique
- Tell about image segmentation and morphological image processing
- Summarize computer vision techniques and its uses

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbook/ Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Digital Image Processing	Rafael C. Gonzalez & Richard E. Woods	Pearson Education	3rd edition
2	Computer Vision: A Modern Approach	David A. Forsyth, Jean Ponce	Prentice Hall	
3	Fundamental of Digital Image Processing	A.K. Jain	PHI	
Reference Books				
1	Digital Image Processing	W.K. Pratt		

M.TECH IN COMPUTER SCIENCE AND ENGINEERING (SCS)
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SEMESTER - II

OBJECT ORIENTED DESIGN

Course Code	**20SCS252,** 20SCN254M 20SIS242	CIE Marks	40
Teaching Hours/Week (L:P:S)	4:0:0	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

The Motivation for Object-Oriented Programming, Classes and Objects: The Building Blocks of the Object-Oriented ParadigmTopologies of Action-Oriented Versus Object-Oriented Applications,

Module-2

The Relationships Between Classes and ObjectsThe Inheritance Relationship

Module-3

Multiple Inheritance, The Association Relationship,

Module-4

Class-Specific Data and Behaviour, Physical Object-Oriented Design,

Module-5

The Relationship Between Heuristics and Patterns, The Use of Heuristics in Object-Oriented Design

Course outcomes:

At the end of the course the student will be able to:

- Identify the heuristics of the object-oriented programming
- Explain the fundamentals of OOP
- Examine fine object-oriented relations
- Explain the role of Physical Object-Oriented Design,
- Make use of Heuristics in The Use of Heuristics in Object-Oriented Design

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbook/ Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Object Oriented Design Heuristics	Arthur J Riel	Addison-Wesley	1996
Reference Books				
1	Elements of Reusable Object-Oriented Software	Ralph Johnson, Erich Gamma, Richard Helm, John Vlissides	Pearson	
2	Object - Oriented Modeling and Design With UM	Paperback, Michael R. Blaha)	Pearson	2007

M.TECH IN COMPUTER SCIENCE AND ENGINEERING (SCS)
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SEMESTER - II

SOFTWARE DEFINED NETWORKS

Course Code	**20SCS253**, 20LNI31, 20SCE333, 20SCN243, 20SAM324, 20SIS243	CIE Marks	40
Teaching Hours/Week (L:P:S)	4:0:0	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Introduction, Centralized and Distributed Control and Data Planes, OpenFlow

Module-2

SDN Controllers, Network Programmability,

Module-3

Data Centre Concepts and Constructs, Network Function Virtualization

Module-4

Network Topology and Topological Information Abstraction, Building an SDN Framework

Module-5

Use Cases for Bandwidth Scheduling, Manipulation, and Calendaring, Use Cases for Input Traffic Monitoring, Classification, and Triggered Actions

Course outcomes:

At the end of the course the student will be able to:

- Explain the fundamentals of SDN and make use of open flow tool
- Illustrate the concepts of controllers and network programmability
- Explain data centre and NFV
- Build an SDN framework
- Report use case

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbook/ Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	SDN: Software Defined Networks	Ken Gray, Thomas D. Nadeau	O'Reilly	2013
Reference Books				
2	Software Defined Networks	Paul Goransson Chuck Black Timothy Culver	Elsevier	2nd Edition 2016

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SEMESTER - II

MODERN COMPUTER ARCHITECTURE

Course Code	**20SCS254**	CIE Marks	40
Teaching Hours/Week (L:P:S)	4:0:0	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Fundamentals of Computer Design, Pipelining, ILP Introduction; Classes of computers; Defining computer architecture; Trends in Technology, power in Integrated Circuits and cost; Dependability; Measuring, reporting and summarizing Performance; Quantitative Principles of computer design. Introduction; Pipeline hazards; Implementation of pipeline; What makes pipelining hard to implement? Instruction –Level Parallelism – 1 ILP: Concepts and challenges; Basic Compiler Techniques for exposing ILP; Reducing Branch costs with prediction; Overcoming Data hazards with Dynamic scheduling; Hardware-based speculation. Instruction –Level Parallelism – 2 Exploiting ILP using multiple issue and static scheduling; Exploiting ILP using dynamic scheduling, multiple issue and speculation; Advanced Techniques for instruction delivery and Speculation; The Intel Pentium 4 as example.

Module-2

Review of Memjory Hierarchy, Memory Hierarchy design Introduction; Cache performance; Cache Optimizations, Virtual memory, Introduction; Advanced optimizations of Cache performance; Memory technology and optimizations; Protection: Virtual memory and virtual machines.

Module-3

Theory of Parallelism Parallel Computer Models, The State of Computing, Multiprocessors and Multicomputer, Multivector and SIMD Computers, PRAM and VLSI Models, Program and Network Properties, Conditions of Parallelism, Program Partitioning and Scheduling, Program Flow Mechanisms, System Interconnect Architectures, Principles of Scalable Performance, Performance Metrics and Measures, Parallel Processing Applications, Speedup Performance Laws. For all Algorithm or mechanism any one example is sufficient.

Module-4

Hardware Technologies Processors and Memory Hierarchy, Advanced Processor Technology,

Superscalar and Vector Processors, Memory Hierarchy Technology, Virtual Memory Technology. For all Algorithms or mechanisms any one example is sufficient. Bus Systems, Cache Memory Organizations, Shared Memory Organizations, Sequential and Weak Consistency Models, Pipelining and Superscalar Techniques, Linear Pipeline Processors, Nonlinear Pipeline Processors. For all Algorithms or mechanisms any one example is sufficient

Module-5

Parallel and Scalable Architectures Multiprocessors and Multicomputers, Multiprocessor System Interconnects, Cache Coherence and Synchronization Mechanisms, MessagePassing Mechanisms, Multivector and SIMD Computers, Vector Processing Principles, Multivector Multiprocessors, Compound Vector Processing, Scalable, Multithreaded, and Dataflow Architectures, Latency-Hiding Techniques, Principles of Multithreading, FineGrainMulticomputers. For all Algorithms or mechanisms any one example is sufficient.

Course outcomes:

At the end of the course the student will be able to:

- Explain the fundamentals of Fundamentals of Computer Design, Pipelining, ILP
- Summarize the concept of memory
- Abstracting the concept of parallelism
- Summarize the hardware technologies
- Outlineparallel and scalable architectures

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbook/ Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Advanced Computer Architecture (SIE): Parallelism, Scalability, Programmability	Kai Hwang and NareshJotwani	McGraw Hill Education	3/e. 2015
2	Computer Architecture: A quantitative approach	John L. Hennessy and David A. Patterson	Morgan Kaufmann Elseveir	5th edition 2013
Reference Books				
1	Computer Systems and Design and Architecture	Vincent Heuring, et al	Pearson Education	2nd edition, 2009

M.TECH IN COMPUTER SCIENCE AND ENGINEERING (SCS)
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SEMESTER – II

DATA SCIENCE LABORATORY

Course Code	**20SCSL26**	CIE Marks	40
Teaching Hours/Week (L:P:S)	0:4:0	SEE Marks	60
Credits	02	Exam Hours	03

The purpose of this laboratory is to get you acquainted with Python/R and use them in implementing Data Science and Algorithms.

Data Sets

Iris

Iris is a particularly famous *toy dataset* (i.e. a dataset with a small number of rows and columns, mostly used for initial small-scale tests and proofs of concept). This specific dataset contains information about the Iris, a genus that includes 260-300 species of plants. The Iris dataset contains measurements for 150 Iris flowers, each belonging to one of three species: Virginica, Versicolor and Setose. (50 flowers for each of the three species). Each of the 150 flowers contained in the Iris dataset is represented by 5 values:

- Sepal length, in cm
- Sepal width, in cm
- petal length, in cm
- petal width, in cm

Iris species, one of: iris-setose, iris-versicolor, iris-virginica. Each row of the dataset represents a distinct flower (as such, the dataset will have 150 rows). Each row then contains 5 values (4 measurements and a species label). The dataset is described in more detail on the UCI Machine Learning Repository website. The dataset can either be downloaded directly from there (iris.data file), or from a terminal, using the *wget* tool. The following command downloads the dataset from the original URL and stores it in a file named iris.csv.

```
$ wget "https://archive.ics.uci.edu/ml/machine-learning-databases/iris/iris.data" -O iris.csv
```

Citybik.es

Citybik.es is a website that offers an Application Programming Interface (or API, for short) for the usage of bike-sharing services throughout the world. Among the others, data for one of Turin's bike sharing system is available. The information available is at a "station" granularity. This means that all the data available regards the bike stations: some of the useful information available is the station name, its position (in terms of latitude and longitude), the number of available bikes and the number of free docks. The data is offered in near real-time (i.e. it is updated every 15-30 minutes).

The API endpoint to request the data about for the Bike service is the following: http://api.citybik.es/v2/networks/to-bike. This dataset is in the JSON (JavaScript Object Notation) format.

MNIST

The MNIST dataset is another particularly famous dataset as CSV file. It contains several thousands of hand-written digits (0 to 9). Each hand-written digit is contained in a 28 × 28 8-bit grayscale image. This means that each digit has 784 (28^2) pixels, and each pixel has a value that ranges from 0 (black) to 255 (white). The dataset can be downloaded from the following URL: https://raw.githubusercontent.com/dbdmg/data-science-lab/master/datasets/mnist_test.csv. Each row of the MNIST datasets represents a digit. For the sake of simplicity, this dataset contains only a small fraction (10,000 digits out of 70,000) of the real MNIST dataset, which is known as the MNIST test set. For each digit, 785 values are available.

Exercises

1. **Iris dataset**

Load the Iris dataset as a list of lists (each of the 150 lists should have 5 elements). Compute and print the mean and the standard deviation for each of the 4 measurement columns (i.e. sepal length and width, petal length and width). Compute and print the mean and the standard deviation for each of the 4 measurement columns, separately for each of the three Iris species (Versicolor, Virginica and Setose). Which measurement would you consider "best", if you were to guess the Iris species based only on those four values?

2. **Citybik.es dataset**

Load the Citybik.es dataset as a Python dictionary. Use of the json module. Count and print the number of active stations (a station is active if its extra.status field is "online"). Count and print the total number of

bikes available (field free_bikes) and the number of free docks (field empty_slots) throughout all stations. Given the coordinates (latitude, longitude) of a point (e.g. 45.074512, 7.694419), identify the closest bike station to it that has available bikes. For computing the distance among two points (given their coordinates), you can use the function distance_coords() defined in the code snippet below (which is an implementation of the great-circle distance):

```
from math import cos, acos, sin
defdistance_coords(lat1, lng1, lat2, lng2):
    """Compute the distance among two points."""
    deg2rad = lambda x: x * 3.141592 / 180
    lat1, lng1, lat2, lng2 = map(deg2rad, [ lat1, lng1, lat2, lng2 ])
    R = 6378100 # Radius of the Earth, in meters
    return R * acos(sin(lat1) * sin(lat2) + cos(lat1) * cos(lat2) * cos(lng1 - lng2))
```

3. **MNIST dataset**

Load the MNIST dataset. Create a function that, given a position $1 \leq k \leq 10,000$, prints the k^{th} digit of the dataset (i.e. the k^{th} row of the csv file) as a grid of 28×28 characters. More specifically, you should map each range of pixel values to the following characters:

[0, 64) → " "
[64, 128) → "."
[128, 192) → "*"
[192, 256) → "#"

Compute the Euclidean distance between each pair of the 784-dimensional vectors of the digits at the following positions: 26^{th}, 30^{th}, 32^{nd}, 35^{th}. Based on the distances computed in the previous step and knowing that the digits listed are 7, 0, 1, 1, can you assign the correct label to each of the digits ?

4. **Tips dataset**

Read the dataset "Tips.csv" as a dataframe "Data". Extract the columns in the following sequence - Time, TotalBill, Tips. Plot a histogram for the variable 'TotalBill' to check which range has the highest frequency. Draw a bar chart for the variable "Day". Identify the category with the maximum count. Demonstrate the data distributions using box, scatter plot, histogram, and bar chart on iris dataset. Demonstrate the correlation plot on iris dataset and perform exploratory visualization giving an overview of relationships among data with covariance analysis.

5. Split the **Iris** dataset into two the datasets - **IrisTest_TrainData.csv, IrisTest_TestData.csv.** Read them as two separate data frames named Train_Data and Test_Data respectively.

   Answer the following questions:
   - How many missing values are there in **Train_Data**?
   - What is the proportion of Setosa types in the **Test_Data**?
   - What is the accuracy score of the K-Nearest Neighbor model (model_1) with 2/3 neighbors using **Train_Data** and **Test_Data**?
   - Identify the list of indices of misclassified samples from the '**model_1**'.
   - Build a logistic regression model (model_2) keeping the modelling steps constant. Find the accuracy of the model_2

6. Import a dataset from **http://www.ats.ucla.edu/stat/data/binary.csv**. Do the Logistic Regression to find out relation between variables that are affecting the admission of a student in a institute based on his or her GRE score, GPA obtained and rank of the student. Also check the model is fit or not. Apply regression Model techniques to predict the data on above dataset

7. Demonstrate Decision tree classification model and Evaluate the performance of classifier on **Iris**

dataset. **8.** Demonstrate any of the Clustering model and Evaluate the performance on **Iris dataset**.
Course outcomes: At the end of the course the student will be able to:
• Demonstration of data visualization methods • Understanding and implementation of data science algorithms
Conduction of Practical Examination: All laboratory experiments (nos) are to be included for practical examination. Students are allowed to pick one experiment from **the list** Strictly follow the instructions as printed on the cover page of answer script for breakup of marks **Change of experiment is allowed only once and marks allotted to the procedure part to be made zero.**

TECHNICAL SEMINAR			
Course Code	20SCS27	CIE Marks	100
Number of contact Hours/week (L:P:SDA)	0:0:2	SEE Marks	--
Credits	02	Exam Hours	--

Course objectives:

The objective of the seminar is to inculcate self-learning, face audience confidently, enhance communication skill, involve in group discussion and present and exchange ideas.

Each student, under the guidance of a Faculty, is required to

- Choose, preferably through peer reviewed journals, a recent topic of his/her interest relevant to the Course of Specialization.
- Carryout literature survey, organize the Course topics in a systematic order.
- Prepare the report with own sentences.
- Type the matter to acquaint with the use of Micro-soft equation and drawing tools or any such facilities.
- Present the seminar topic orally and/or through power point slides.
- Answer the queries and involve in debate/discussion.
- Submit two copies of the typed report with a list of references.

The participants shall take part in discussion to foster friendly and stimulating environment in which the students are motivated to reach high standards and become self-confident.

The CIE marks for the seminar shall be awarded (based on the relevance of the topic, presentation skill, participation in the question and answer session and quality of report) by the committee constituted for the purpose by the Head of the Department. The committee shall consist of three faculties from the department with the senior most acting as the Chairperson.

Marks distribution for CIE of the course 20XXX27 seminar:

Seminar Report: 30 marks

Presentation skill:50 marks

Question and Answer:20 marks

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SEMESTER - III

DEEP LEARNING

Course Code	**20SCS31,** 20SAM31, 20SIS334	CIE Marks	40
Teaching Hours/Week (L:P:S)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Machine Learning Basics: Learning Algorithms, Capacity, Overfitting and Underfitting, Hyperparameters and Validation Sets, Estimator, Bias and Variance, Maximum Likelihood Estimation, Bayesian Statistics, Supervised Learning Algorithms, Unsupervised Learning Algorithms, Stochastic Gradient Decent, building a Machine Learning Algorithm, Challenges Motivating Deep Learning.

Module-2

Deep Feedforward Networks: Gradient-Based Learning, Hidden Units, Architecture Design, Back-Propagation. **Regularization:** Parameter Norm Penalties, Norm Penalties as Constrained Optimization, Regularization and Under-Constrained Problems, Dataset Augmentation, Noise Robustness, Semi-Supervised Learning, Multi-Task Learning, Early Stopping, Parameter Tying and Parameter Sharing, Sparse Representations, Bagging, Dropout.

Module-3

Optimization for Training Deep Models: How Learning Differs from Pure Optimization, Challenges in Neural Network Optimization, Basic Algorithms. Parameter Initialization Strategies, Algorithms with Adaptive Learning Rates. **Convolutional Networks:** The Convolution Operation, Motivation, Pooling, Convolution and Pooling as an Infinitely Strong Prior, Variants of the Basic Convolution Function, Structured Outputs, Data Types, Efficient Convolution Algorithms, Random or Unsupervised Features.

Module-4

Sequence Modelling: Recurrent and Recursive Nets: Unfolding Computational Graphs, Recurrent Neural Networks, Bidirectional RNNs, Encoder-Decoder Sequence-to-Sequence Architectures, Deep Recurrent Networks, Recursive Neural Networks. Long short-term memory

Module-5

Practical Methodology: Performance Metrics, Default Baseline Models, Determining Whether to Gather More Data, Selecting Hyperparameters, Debugging Strategies, Example: Multi-Digit Number Recognition. **Applications:** Vision, NLP, Speech.

Course outcomes:
At the end of the course the student will be able to:

- Identify the deep learning algorithms which are more appropriate for various types of learning tasks in various domains.
- Implement deep learning algorithms and solve real-world problems.
- Execute performance metrics of Deep Learning Techniques.

Question paper pattern:
The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbook/ Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Deep Learning	Lan Good fellow and YoshuaBengio	MIT Press https://www.deeplearningbook.org/	2016.

		and Aaron Courville		
Reference Books				
1	Neural Networks:Asystematic Introduction	Raúl Rojas		1996.
2	Pattern Recognition and machine Learning	Chirstopher Bishop		2007.

M.TECH IN COMPUTER SCIENCE AND ENGINEERING (SCS)
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SEMESTER - III

ENGINEERING ECONOMICS

Course Code	**20SCS321**	CIE Marks	40
Teaching Hours/Week (L:P:S)	4:0:0	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Economic Decisions Making, Economic Decisions Making – Overview, Problems, Role, Decision making process. Engineering Costs & Estimation – Fixed, Variable, Marginal & Average Costs, Sunk Costs, Opportunity Costs, Recurring And Nonrecurring Costs, Incremental Costs, Cash Costs vs Book Costs, Life-Cycle Costs; Types Of Estimate, Estimating Models - Per-Unit Model, Segmenting Model, Cost Indexes, Power-Sizing Model, Improvement & Learning Curve, Benefits. Case Study - Price and Income Elasticity of Demand in the real world

Module-2

Cash Flow, Interest and Equivalence: Cash Flow – Diagrams, Categories & Computation, Time Value of Money, Debt repayment, Nominal & Effective Interest.

Module-3

Cash Flow & Rate Of Return Analysis Calculations, Treatment of Salvage Value, Annual Cash Flow Analysis, Analysis Periods; Internal Rate Of Return, Calculating Rate of Return, Incremental Analysis; Best Alternative Choosing An Analysis Method, Future Worth Analysis, Benefit-Cost Ratio Analysis, Sensitivity And Breakeven Analysis. Economic Analysis In The Public Sector - Quantifying And Valuing Benefits & drawbacks. Case Study – Tata Motors

Module-4

Inflation and Price Change Definition, Effects, Causes, Price Change with Indexes, Types of Index, Composite vs Commodity Indexes, Use of Price Indexes in Engineering Economic Analysis, Cash Flows that inflate at different Rates.
Case Study – Competition in the Advertise Segment in India

Module-5

Present Worth Analysis: End-Of-Year Convention, Viewpoint of Economic Analysis Studies, Borrowed Money Viewpoint, Effect Of Inflation & Deflation, Taxes, Economic Criteria, Applying Present Worth Techniques, Multiple Alternatives.

Course outcomes:
At the end of the course the student will be able to:

- Describe the principles of economics that govern the operation of any organization under diverse market conditions
- Comprehend macroeconomic principles and decision making in diverse business set up
- Explain the Inflation & Price Change as well as Present Worth Analysis
- Apply the principles of economics through various case studies

Question paper pattern:
The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each

	module.			
Textbook/ Textbooks				
Sl No	**Title of the book**	**Name of the Author/s**	**Publisher Name**	**Edition and year**
1	Economics for Engineers	James L.Riggs,David D. Bedworth, Sabah U. Randhawa	Tata McGraw-Hill	
2	Engineering Economics Analysis	Donald Newnan, Ted Eschembach, Jerome Lavelle	OUP	
3	Principle of Engineering Economic Analysis	John A. White, Kenneth E.Case,DavidB.Pratt	John Wiley	
4	Engineering Economy	Sullivan and Wicks	Pearson	
Reference Books				
1	Engineering Economics	Riggs James	TMG	

M.TECH IN COMPUTER SCIENCE AND ENGINEERING (SCS) **Choice Based Credit System (CBCS) and Outcome Based Education (OBE)** **SEMESTER - III**			
VIRTUAL REALITY			
Course Code	**20SCS322,** 20SAM321	,CIE Marks	40
Teaching Hours/Week (L:P:S)	4:0:0	SEE Marks	60
Credits	04	Exam Hours	03
Module-1			
Definition of VR, modern experiences, historical perspective. Hardware, sensors, displays, software, virtual world generator, game engines, human senses, perceptual psychology, psychophysics. Geometric modelling, transforming rigid bodies, yaw, pitch, roll, axis-angle representation, quaternions, 3D rotation inverses and conversions, homogeneous transforms, transforms to displays, look-at and eye transforms, canonical view and perspective transforms, viewport transforms.			
Module-2			
Light propagation, lenses and images, diopters, spherical aberrations, optical distortion; more lens aberrations; spectral properties; the eye as an optical system; cameras; visual displays. Parts of the human eye, photoreceptors and densities, scotopic and photopic vision, display resolution requirements, eye movements, neural vision structures, sufficient display resolution, other implications of physiology on VR. Depth perception, motion perception, vection, stroboscopic apparent motion, color perception, combining information from multiple cues and senses, implications of perception on VR.			
Module-3			
Graphical rendering, ray tracing, shading, BRDFs, rasterization, barycentric coordinates, VR rendering problems, anti-aliasing, distortion shading, image warping (time warp), panoramic rendering. Velocities, acceleration, vestibular system, virtual world physics, simulation, collision detection, avatar motion, vection			
Module-4			
Tracking systems, estimating rotation, IMU integration, drift errors, tilt and yaw correction, estimating position, camera-feature detection model, perspective n-point problem, sensor fusion, lighthouse			

approach, attached bodies, eye tracking, inverse kinematics, map building, SLAM.

Remapping, locomotion, manipulation, social interaction, specialized interaction mechanisms.

Module-5

Sound propagation, ear physiology, auditory perception, auditory localization; Fourier analysis; acoustic modelling, HRTFs, rendering, auralization.

Perceptual training, recommendations for developers, best practices, VR sickness, experimental methods that involve human subjects

Touch, haptics, taste, smell, robotic interfaces, telepresence, brain-machine interfaces.

Course outcomes:
At the end of the course the student will be able to:

- Explain fundamentals of virtual reality systems
- Summarize the hardware and software of the VR
- Analyse the applications of VR

Question paper pattern:
The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbook/ Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	VIRTUAL REALITY http://vr.cs.uiuc.edu/book.html	Steven M. LaValle.	Cambridge University Press	2016
Reference Books				
1	HANDBOOK OF VIRTUAL ENVIRONMENTS: Design, Implementation, and Applications	Kelly S. Hale Kay M. Stanney	CRC Press	2nd Edition, 2015

M.TECH COMPUTER SCIENCE AND ENGINEERING (SCS)
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER – III

SOFT AND EVOLUTIONARY COMPUTING

Course Code	**20SCS323,** 20SSE31 20SAM22	CIE Marks	40
Teaching Hours/Week (L:P:S)	4:0:0	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Introduction to Soft computing: Neural networks, Fuzzy logic, Genetic algorithms, Hybrid systems and its applications.
Introduction to classical sets and fuzzy sets: Classical relations and fuzzy relations, Membership functions.

Module 2

Defuzzification, Fuzzy decision making, and applications.

Module 3

Genetic algorithms: Introduction, Basic operations, Traditional algorithms, Simple GA General genetic algorithms, The schema theorem, Genetic programming, applications.

Module 4

Swarm Intelligence System: Introduction, background of SI, Ant colony system
Working of ant colony optimization, ant colony for TSP.
(Textbook 2)

Module 5

Unit commitment problem, particle Swarm Intelligence system
Artificial bee colony system, Cuckoo search system.
(Textbook 2)

Course outcomes:
At the end of the course the student will be able to:

- Implement machine learning through neural networks.
- Design Genetic Algorithm to solve the optimization problem.
- Develop a Fuzzy expert system.

Model Neuro Fuzzy system for clustering and classification

Question paper pattern:
The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbook/ Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Principles of Soft computing	Shivanandam, Deepa S. N	Wiley India	2011
2	Soft Computing with MATLAB Programming	N. P. Padhy S.P. Simon	Oxford	2015
Reference Books				
1	Neuro-fuzzy and soft computing	.S.R. Jang, C.T. Sun, E. Mizutani	Phi (EEE edition),	2012
2	Soft Computing	SarojKaushik SunitaTiwari	McGrawHill	2018

M.TECH IN COMPUTER SCIENCE AND ENGINEERING (SCS)
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER - III

MULTICORE ARCHITECTURE AND PROGRAMMING

Course Code	**20SCS324,** 20SCE22, 20SIS251	CIE Marks	40
Teaching Hours/Week (L:P:S)	4:0:0	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Classes of Computers, Trends in Technology, Power, Energy and Cost – Dependability –Measuring, Reporting and Summarizing Performance.
Single core to Multi-core architectures: Limitations of Single Core Processors - The Multi core era – Case Studies of Multi core Architectures.
System Overview of Threading: Defining Threads, System View of Threads, Threading above the Operating System, Threads inside the OS, Threads inside the Hardware, What Happens When a Thread Is Created, Application Programming Models and Threading,

Module-2

Fundamental Concepts of Parallel Programming: Designing for Threads, Task Decomposition, Data Decomposition, Data Flow Decomposition, Implications of Different Decompositions, Parallel Programming Patterns, A Motivating Problem: Error Diffusion, Analysis of the Error Diffusion Algorithm, An Alternate Approach: Parallel Error Diffusion.
Threading and Parallel Programming Constructs: Performance – Scalability – Synchronization and data sharing – Data races – Synchronization primitives (mutexes, locks, semaphores, barriers) – deadlocks and livelocks – communication between threads (condition variables, signals, message queues and pipes).

Module-3

TLP AND MULTIPROCESSORS : Symmetric and Distributed Shared Memory Architectures – Cache Coherence Issues -Performance Issues – Synchronization Issues – Models of Memory Consistency - Interconnection Networks – Buses, Crossbar and Multi-stage Interconnection Networks.

Module-4

A Portable Solution for Threading : Challenges in Threading a Loop, Loop-carried Dependence, Data-race Conditions, Managing Shared and Private Data, Loop Scheduling and Portioning, Effective Use of Reductions, Minimizing Threading Overhead, Work-sharing Sections, Performance-oriented Programming, Using Barrier and No wait, Interleaving Single-thread and Multi-thread Execution.
OpenMP: OpenMP Execution Model – Memory Model – OpenMP Directives – Work-sharing Constructs - Library functions – Handling Data and Functional Parallelism – Handling Loops – Performance Considerations.

Module-5

Solutions to Common Parallel Programming Problems : Too Many Threads, Data Races, Deadlocks, and Live Locks, Deadlock, Heavily Contended Locks, Priority Inversion, Solutions for Heavily Contended Locks, Non-blocking Algorithms, ABA Problem, Cache Line Ping-ponging, Memory Reclamation Problem, Recommendations, Thread-safe Functions and Libraries, Memory Issues, Bandwidth, Working in the Cache, Memory Contention, Cache-related Issues, False Sharing, Memory Consistency, Current IA-32 Architecture, Itanium Architecture.

Course outcomes:
At the end of the course the student will be able to:

- Identify the limitations of single core architecture and the need for multicore architectures
- Define fundamental concepts of parallel programming and its design issues
- Solve the issues related to multiprocessing and suggest solutions
- Demonstrate the role of OpenMP and programming concept
- Make out the salient features of different multicore architectures and how they exploit parallelism

Question paper pattern:
The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbook/ Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Multicore Programming, Increased Performance through Software Multi-threading	ShameemAkhter and Jason Roberts	Intel Press	2006
2	An Introduction to Parallel Programming	Peter S Pacheco	Morgan/Kuffman, Elsevier	2011
3	Multicore Application Programming for Windows, Linux, Oracle, Solaris	Darryl Gove	Pearson	2011

Reference Books

1	Parallel Programming in C with MPI and OpenMP	Michael J Quinn	Tata McGraw Hill	2003

M.TECH IN COMPUTER SCIENCE AND ENGINEERING (SCS) **Choice Based Credit System (CBCS) and Outcome Based Education (OBE)** **SEMESTER - III**			
BUSINESS INTELLIGENCE AND ITS APPLICATIONS			
Course Code	**20SCS331**, 20SIT252	CIE Marks	40
Teaching Hours/Week (L:P:S)	4:0:0	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Development Steps, BI Definitions, BI Decision Support Initiatives, Development Approaches, Parallel Development Tracks, BI Project Team Structure, Business Justification, Business Divers, Business Analysis Issues, Cost – Benefit Analysis, Risk Assessment, Business Case Assessment Activities, Roles Involved In These Activities, Risks Of Not Performing Step, Hardware, Middleware, DBMS Platform, Non Technical Infrastructure Evaluation

Module -2

Managing The BI Project, Defining And Planning The BI Project, Project Planning Activities, Roles And Risks Involved In These Activities, General Business Requirement, Project Specific Requirements, Interviewing Process

Module – 3

Differences in Database Design Philosophies, Logical Database Design, Physical Database Design, Activities, Roles And Risks Involved In These Activities, Incremental Rollout, Security Management, Database Backup And Recovery

Module-4

Growth Management, Application Release Concept, Post Implementation Reviews, Release Evaluation Activities, The Information Asset and Data Valuation, Actionable Knowledge – ROI, BI Applications, The Intelligence Dashboard

Module-5

Business View of Information technology Applications: Business Enterprise excellence, Key purpose of using IT, Type of digital data, basics f enterprise reporting, BI road ahead.

Course outcomes:

At the end of the course the student will be able to:

- Explain the complete life cycle of BI/Analytical development
- Illustrate technology and processes associated with Business Intelligence framework
- Demonstrate a business scenario, identify the metrics, indicators and make recommendations to achieve the business goal.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbook/ Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Business Intelligence Roadmap: The Complete Project Lifecycle for Decision Support Applications	Larissa T Moss and ShakuAtre	Addison Wesley Information Technology Series	2003.

2	Fundamentals of Business Analytics	R N Prasad, SeemaAcharya	Wiley India	2011.
Reference Books				
1	Business Intelligence: The Savvy Manager's Guide	David Loshin	Morgan Kaufmann	
2	Delivering Business Intelligence with Microsoft SQL Server 2005	Brian Larson	McGraw Hill	2006
3	Foundations of SQL Server 2008 Business Intelligence	Lynn Langit	Apress	2011

M.TECH IN COMPUTER SCIENCE AND ENGINEERING (SCS)
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SEMESTER - III

ROBOTICS AND AUTOMATION

Course Code	**20SCS332,** 20SAM251, 20SIS253	CIE Marks	40
Teaching Hours/Week (L:P:S)	4:0:0	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

History of Automation, Reasons for automation, Disadvantages of automation, Automation systems, Types of automation – Fixed, Programmable and Flexible automation, Automation strategies Automated Manufacturing Systems: Components, classification and overview of manufacturing Systems, Flexible Manufacturing Systems (FMS), Types of FMS, Applications and benefits of FMS.

Module-2

Definition of Robot, History of robotics, Robotics market and the future prospects, Robot Anatomy, Robot configurations: Polar, Cartesian, cylindrical and Jointed-arm configuration. Robot motions, Joints, Work volume, Robot drive systems, Precision of movement – Spatial resolution, Accuracy, Repeatability, End effectors – Tools and gripper

Module-3

Basic Control System concepts and Models, Transfer functions, Block diagrams, characteristic equation, Types of Controllers: on-off, Proportional, Integral, Differential, P-I, P-D, P-I-D controllers. Control system and analysis.
Robot actuation and feedback components Position sensors – Potentiometers, resolvers, encoders, velocity sensors. Actuators - Pneumatic and Hydraulic Actuators, Electric Motors, Stepper motors, Servomotors, Power Transmission systems

Module-4

Robot Sensors and Machine vision system Sensors in Robotics - Tactile sensors, Proximity and Range sensors, use of sensors in robotics. Machine Vision System: Introduction to Machine vision, the sensing and digitizing function in Machine vision, Image processing and analysis, Training and Vision systems.

Module-5

Robots Technology of the future: Robot Intelligence, Advanced Sensor capabilities, Telepresence and related technologies, Mechanical design features, Mobility, locomotion and navigation, the universal hand, system integration and networking. Artificial Intelligence: Goals of AI research, AI techniques – Knowledge representation, Problem representation and problem solving, LISP programming, AI and Robotics, LISP in the factory.

Course outcomes:
At the end of the course the student will be able to:

- Classify various types of automation & manufacturing systems
- Discuss different robot configurations, motions, drive systems and its performance parameters.
- Describe the basic concepts of control systems, feedback components, actuators and power transmission systems used in robots.
- Explain the working of transducers, sensors and machine vision systems

- Discuss the future capabilities of sensors, mobility systems and Artificial Intelligence in the field of robotics.

Question paper pattern:
The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbook/ Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Automation, Production Systems and Computer Integrated Manufacturing	M.P. Groover	Pearson Education	2nd Edition, 2007
Reference Books				
1	Robotics, control vision and Intelligence	Fu, Lee and Gonzalez	McGraw Hill International	2nd Edition, 2007.
2	Robotic Engineering - An Integrated approach	Klafter, Chmielewski and Negin	Prentice Hall of India	1st Edition, 2009.

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SEMESTER - III

SPEECH PROCESSING

Course Code	**20SCS333** 20SAM334	CIE Marks	40
Teaching Hours/Week (L:P:S)	4:0:0	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Introduction, Fundamentals of Digital Speech Processing

Module-2

Digital models for the speech signals, Time domain models for speech processing

Module-3

Digital representation of the speech waveform, short term Fourier analysis

Module-4

Homomorphic speech processing, Linear predictive coding of speech: Introduction, Basic principles of LP analyse, Computation of gain for the model, solution of LPC equation, Comparison between the methods of solution of the LPC analysis equation, the prediction error signal.

Module-5

Linear predictive coding of speech: Frequency domain interpretation of LP analysis, Relation of LP analysis, Relations between various speech parameters, applications

Digital speech for man machine communication by voice

Course outcomes:
At the end of the course the student will be able to:

- Explain the fundamentals of speech processing
- Summarize the models of speech processing
- Infer the linear predictive coding
- Illustrate the application of speech processing

Question paper pattern:
The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to

60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbook/ Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Digital Processing of Speech Signals	Lawrence R. Rabiner , Ronald W. Schafer	Pearson	
Reference Books				
1	Speech and Audio Signal Processing	Paperback, A.R. JAYAN	PHI	
2	Speech and Audio Processing	Apte Shaila D	Wiley India Pvt. Ltd	

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SEMESTER - III

WIRELESS SENSOR NETWORKS

Course Code	**20SCS334**, 20LNI324, 20SCE251, 20SCN251,20SIS13	CIE Marks	40
Teaching Hours/Week (L:P:S)	4:0:0	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

CHARACTERISTICS OF WSN
Characteristic requirements for WSN - Challenges for WSNs – WSN vsAdhoc Networks - Sensor node architecture – Commercially available sensor nodes –Imote, IRIS, Mica Mote, EYES nodes, BTnodes, TelosB, Sunspot -Physical layer and transceiver design considerations in WSNs, Energy usage profile, Choice of modulation scheme, Dynamic modulation scaling, Antenna considerations.

Module-2

MEDIUM ACCESS CONTROL PROTOCOLS
Fundamentals of MAC protocols - Low duty cycle protocols and wakeup concepts – Contention based protocols - Schedule-based protocols - SMAC - BMAC - Traffic-adaptive medium access protocol (TRAMA) - The IEEE 802.15.4 MAC protocol.

Module-3

ROUTING AND DATA GATHERING PROTOCOLS
Routing Challenges and Design Issues in Wireless Sensor Networks, Flooding and gossiping – Data centric Routing – SPIN – Directed Diffusion – Energy aware routing - Gradient-based routing - Rumor Routing – COUGAR – ACQUIRE – Hierarchical Routing - LEACH, PEGASIS – Location Based Routing – GF, GAF, GEAR, GPSR – Real Time routing Protocols – TEEN, APTEEN, SPEED, RAP - Data aggregation - data aggregation operations - Aggregate Queries in Sensor Networks - Aggregation Techniques – TAG, Tiny DB.

Module-4

EMBEDDED OPERATING SYSTEMS
Operating Systems for Wireless Sensor Networks – Introduction - Operating System Design Issues - Examples of Operating Systems – TinyOS – Mate – MagnetOS – MANTIS - OSPM - EYES OS – SenOS – EMERALDS – PicOS – Introduction to Tiny OS – NesC – Interfaces and Modules- Configurations and Wiring - Generic Components -Programming in Tiny OS using NesC, Emulator TOSSIM.

Module-5

APPLICATIONS OF WSN

WSN Applications - Home Control - Building Automation - Industrial Automation - Medical Applications - Reconfigurable Sensor Networks - Highway Monitoring - Military Applications - Civil and Environmental Engineering Applications - Wildfire Instrumentation - Habitat Monitoring - Nanoscopic Sensor Applications – Case Study: IEEE 802.15.4 LR-WPANs Standard - Target detection and tracking - Contour/edge detection - Field sampling.

Course outcomes:

At the end of the course the student will be able to:

- Know the basics , characteristics and challenges of Wireless Sensor Network
- Apply the knowledge to identify appropriate physical and MAC layer protocol
- Apply the knowledge to identify the suitable routing algorithm based on the network and user requirement
- Be familiar with the OS used in Wireless Sensor Networks and build basic modules
- Understand the applications of WSN in various fields

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have a sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbook/ Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Wireless Sensor Networks Technology, Protocols, and Applications	KazemSohraby, Daniel Minoli and TaiebZnati	John Wiley & Sons	2007
2	Protocols and Architectures for Wireless Sensor Network	Holger Karl and Andreas Willig	John Wiley & Sons, Ltd.	2005
Reference Books				
1	A survey of routing protocols in wireless sensor networks	K. Akkaya and M. Younis	Elsevier Ad Hoc Network Journal	Vol. 3, no. 3, pp. 325--349
2	TinyOS Programming	Philip Levis		
3	Wireless Sensor Network Designs	Anna Ha´c	John Wiley & Sons Ltd.	

PROJECT WORK PHASE – 1			
Course Code	20SCS34	CIE Marks	100
Number of contact Hours/Week	2	SEE Marks	--
Credits	02	Exam Hours	--

Course objectives:

- Support independent learning.
- Guide to select and utilize adequate information from varied resources maintaining ethics.
- Guide to organize the work in the appropriate manner and present information (acknowledging the sources) clearly.
- Develop interactive, communication, organisation, time management, and presentation skills.
- Impart flexibility and adaptability.
- Inspire independent and team working.
- Expand intellectual capacity, credibility, judgement, intuition.
- Adhere to punctuality, setting and meeting deadlines.
- Instil responsibilities to oneself and others.
- Train students to present the topic of project work in a seminar without any fear, face audience confidently, enhance communication skill, involve in group discussion to present and exchange ideas.

Project Phase-1 Students in consultation with the guide/s shall carry out literature survey/ visit industries to finalize the topic of the Project. Subsequently, the students shall collect the material required for the selected project, prepare synopsis and narrate the methodology to carry out the project work.

Seminar: Each student, under the guidance of a Faculty, is required to

- Present the seminar on the selected project orally and/or through power point slides.
- Answer the queries and involve in debate/discussion.
- Submit two copies of the typed report with a list of references.

The participants shall take part in discussion to foster friendly and stimulating environment in which the students are motivated to reach high standards and become self-confident.

Course outcomes:

At the end of the course the student will be able to:

- Demonstrate a sound technical knowledge of their selected project topic.
- Undertake problem identification, formulation, and solution.
- Design engineering solutions to complex problems utilising a systems approach.
- Communicate with engineers and the community at large in written an oral forms.
- Demonstrate the knowledge, skills and attitudes of a professional engineer.

Continuous Internal Evaluation

CIE marks for the project report (50 marks), seminar (30 marks) and question and answer (20 marks) shall be awarded (based on the quality of report and presentation skill, participation in the question and answer session by the student) by the committee constituted for the purpose by the Head of the Department. The committee shall consist of three faculty from the department with the senior most acting as the Chairperson.

MINI PROJECT			
Course Code	20SCS35	CIE Marks	40
Number of contact Hours/Week	2	SEE Marks	60
Credits	02	Exam Hours/Batch	03

Course objectives:

- To support independent learning and innovative attitude.
- To guide to select and utilize adequate information from varied resources upholding ethics.
- To guide to organize the work in the appropriate manner and present information (acknowledging the sources) clearly.
- To develop interactive, communication, organisation, time management, and presentation skills.
- To impart flexibility and adaptability.
- To inspire independent and team working.
- To expand intellectual capacity, credibility, judgement, intuition.
- To adhere to punctuality, setting and meeting deadlines.
- To instil responsibilities to oneself and others.
- To train students to present the topic of project work in a seminar without any fear, face audience confidently, enhance communication skill, involve in group discussion to present and exchange ideas.

Mini-Project: Each student of the project batch shall involve in carrying out the project work jointly in constant consultation with internal guide, co-guide, and external guide and prepare the project report as per the norms avoiding plagiarism.

Course outcomes:

At the end of the course the student will be able to:

- Present the mini-project and be able to defend it.
- Make links across different areas of knowledge and to generate, develop and evaluate ideas and information so as to apply these skills to the project task.
- Habituated to critical thinking and use problem solving skills.
- Communicate effectively and to present ideas clearly and coherently in both the written and oral forms.
- Work in a team to achieve common goal.
- Learn on their own, reflect on their learning and take appropriate actions to improve it.

CIE procedure for Mini - Project:

The CIE marks awarded for Mini - Project, shall be based on the evaluation of Mini - Project Report, Project Presentation skill and Question and Answer session in the ratio 50:25:25.The marks awarded for Mini - Project report shall be the same for all the batch mates.

Semester End Examination

SEE marks for the mini-project shall be awarded based on the evaluation of Mini-Project Report, Presentation skill and Question and Answer session in the ratio 50:25:25 by the examiners appointed by the University.

INTERNSHIP / PROFESSIONAL PRACTICE			
Course Code	20SCSI36	CIE Marks	40
Number of contact Hours/Week	2	SEE Marks	60
Credits	06	Exam Hours	03

Course objectives:

Internship/Professional practice provide students the opportunity of hands-on experience that include personal training, time and stress management, interactive skills, presentations, budgeting, marketing, liability and risk management, paperwork, equipment ordering, maintenance, responding to emergencies etc. The objective are further,

To put theory into practice.

To expand thinking and broaden the knowledge and skills acquired through course work in the field.

To relate to, interact with, and learn from current professionals in the field.

To gain a greater understanding of the duties and responsibilities of a professional.

To understand and adhere to professional standards in the field.

To gain insight to professional communication including meetings, memos, reading, writing, public speaking, research, client interaction, input of ideas, and confidentiality.

To identify personal strengths and weaknesses.

To develop the initiative and motivation to be a self-starter and work independently.

Internship/Professional practice: Students under the guidance of internal guide/s and external guide shall take part in all the activities regularly to acquire as much knowledge as possible without causing any inconvenience at the place of internship.

Seminar: Each student, is required to

- Present the seminar on the internship orally and/or through power point slides.
- Answer the queries and involve in debate/discussion.
- Submit the report duly certified by the external guide.
- The participants shall take part in discussion to foster friendly and stimulating environment in which the students are motivated to reach high standards and become self-confident.

Course outcomes:

At the end of the course the student will be able to:

- Gain practical experience within industry in which the internship is done.
- Acquire knowledge of the industry in which the internship is done.
- Apply knowledge and skills learned to classroom work.
- Develop a greater understanding about career options while more clearly defining personal career goals.
- Experience the activities and functions of professionals.
- Develop and refine oral and written communication skills.
- Identify areas for future knowledge and skill development.
- Expand intellectual capacity, credibility, judgment, intuition.
- Acquire the knowledge of administration, marketing, finance and economics.

Continuous Internal Evaluation

CIE marks for the Internship/Professional practice report (20 marks), seminar (10 marks) and question and answer session (10 marks) shall be awarded (based on the quality of report and presentation skill, participation in the question and answer session by the student) by the committee constituted for the purpose by the Head of the Department. The committee shall consist of three faculty from the department with the senior most acting as the Chairperson.

Semester End Examination

SEE marks for the internship report (30 marks), seminar (20 marks) and question and answer session (10 marks) shall be awarded (based on the quality of report and presentation skill, participation in the question and answer session) by the examiners appointed by the University.

PROJECT WORK PHASE -2			
Course Code	20SCS41	CIE Marks	40
Number of contact Hours/Week	4	SEE Marks	60
Credits	20	Exam Hours	03

Course objectives:

- To support independent learning.
- To guide to select and utilize adequate information from varied resources maintaining ethics.
- To guide to organize the work in the appropriate manner and present information (acknowledging the sources) clearly.
- To develop interactive, communication, organisation, time management, and presentation skills.
- To impart flexibility and adaptability.
- To inspire independent and team working.
- To expand intellectual capacity, credibility, judgement, intuition.
- To adhere to punctuality, setting and meeting deadlines.
- To instil responsibilities to oneself and others.
- To train students to present the topic of project work in a seminar without any fear, face audience confidently, enhance communication skill, involve in group discussion to present and exchange ideas.

Project Work Phase - II: Each student of the project batch shall involve in carrying out the project work jointly in constant consultation with internal guide, co-guide, and external guide and prepare the project report as per the norms avoiding plagiarism.

Course outcomes:

At the end of the course the student will be able to:

- Present the project and be able to defend it.
- Make links across different areas of knowledge and to generate, develop and evaluate ideas and information so as to apply these skills to the project task.
- Habituated to critical thinking and use problem solving skills
- Communicate effectively and to present ideas clearly and coherently in both the written and oral forms.
- Work in a team to achieve common goal.
- Learn on their own, reflect on their learning and take appropriate actions to improve it.

Continuous Internal Evaluation:

Project Report: 20 marks. The basis for awarding the marks shall be the involvement of the student in the project and in the preparation of project report. To be awarded by the internal guide in consultation with external guide if any.

Project Presentation: 10 marks.

The Project Presentation marks of the Project Work Phase -II shall be awarded by the committee constituted for the purpose by the Head of the Department. The committee shall consist of three faculty from the department with the senior most acting as the Chairperson.

Question and Answer: 10 marks.

The student shall be evaluated based on the ability in the Question and Answer session for 10 marks.

Semester End Examination

SEE marks for the project report (30 marks), seminar (20 marks) and question and answer session (10 marks) shall be awarded (based on the quality of report and presentation skill, participation in the question and answer session) by the examiners appointed by the University.

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI

B.E. in Computer Science and Engineering

Scheme of Teaching and Examinations2021

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

(Effective from the academic year 2021 - 22)

III SEMESTER

Sl. No	Course and Course Code	Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
				Theory Lecture	Tutorial	Practical/ Drawing	Self -Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	T	P	S					
1	BSC 21MAT31	Transform Calculus, Fourier Series and Numerical Techniques	Maths	3	0	0		03	50	50	100	3
2	IPCC 21CS32	Data Structures and Applications	Any CS Board Department	3	0	2		03	50	50	100	4
3	IPCC 21CS33	Analog and Digital Electronics		3	0	2		03	50	50	100	4
4	PCC 21CS34	Computer Organization and Architecture		3	0	0		03	50	50	100	3
5	PCC 21CSL35	Object Oriented Programming with JAVA Laboratory		0	0	2		03	50	50	100	1
6	UHV 21UH36	Social Connect and Responsibility	Any Department	0	0	1		01	50	50	100	1
7	HSMC 21KSK37/47	Samskrutika Kannada	TD and PSB: HSMC	1	0	0		01	50	50	100	1
	HSMC 21KBK37/47	Balake Kannada										
	OR											
	HSMC 21CIP37/47	Constitution of India and Professional Ethics										
8	AEC 21CS38X/21 CSL38X	Ability Enhancement Course - III	TD: Concerned department PSB: Concerned Board	If offered as Theory Course				01	50	50	100	1
				1	0	0						
				If offered as lab. course				02				
				0	0	2						
								Total	**400**	**400**	**800**	**18**

9	**Scheduled activities for III to VIII semesters**	NMDC 21NS83	National Service Scheme (NSS)	NSS	All students have to register for any one of the course namely National Service Scheme, Physical Education (PE) (Sports and Athletics) and Yoga with the concerned coordinator of the course during the first week of III semester. The activities shall be carried out from (for 5 semesters) between III semester to VIII semester. SEE in the above courses shall be conducted during VIII semester examinations and the accumulated CIE marks shall be added to the SEE marks. Successful completion of the registered course is mandatory for the award of the degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the colander prepared for the NSS, PE and Yoga activities.
		NMDC 21PE83	Physical Education (PE) (Sports and Athletics)	PE	
		NMDC 21YO83	Yoga	Yoga	

Course prescribed to lateral entry Diploma holders admitted to III semester B.E./B.Tech programs

1	NCMC 21MATDIP31	Additional Mathematics - I	Maths	02	02	--	--	---	100	---	100	0

Note: BSC: Basic Science Course, **IPCC:** Integrated Professional Core Course, **PCC:** Professional Core Course, **INT** –Internship, **HSMC:** Humanity and Social Science & Management Courses, **AEC**–Ability Enhancement Courses. **UHV:** Universal Human Value Course.
L –Lecture, **T –** Tutorial, P- Practical/ Drawing, **S –** Self Study Component, **CIE:** Continuous Internal Evaluation, **SEE:** Semester End Examination. **TD-**Teaching Department, **PSB**: Paper Setting department

21KSK37/47 Samskrutika Kannada is for students who speak, read and write Kannada and **21KBK37/47** Balake Kannada is for non-Kannada speaking, reading, and writing students.

Integrated Professional Core Course (IPCC): Refers to Professional Theory Core Course Integrated with Practical's of the same course. Credit for IPCC can be 04 and its Teaching–Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper. For more details, the regulation governing the Degree of Bachelor of Engineering /Technology (BE/B.Tech.) 2021-22 may be referred.

21INT49 Inter/Intra Institutional Internship: All the students admitted to engineering programs under the lateral entry category shall have to undergo a mandatory 21INT49 Inter/Intra Institutional Internship of 03 weeks during the intervening period of III and IV semesters. The internship shall be slated for CIE only and will not have SEE. The letter grade earned through CIE shall be included in the IV semester grade card. The internship shall be considered as a head of passing and shall be considered for vertical progression and for the award of degree. Those, who do not take up / complete the internship shall be declared fail and shall have to complete during subsequently after satisfying the internship requirements. The faculty coordinator or mentor shall monitor the students' internship progress and interact with them for the successful completion of the internship.

Non–credit mandatory courses (NCMC):

(A) Additional Mathematics I and II:

(1) These courses are prescribed for III and IV semesters respectively to lateral entry Diploma holders admitted to III semester of B.E./B.Tech., programs. They shall attend the classes during the respective semesters to complete all the formalities of the course and appear for the Continuous Internal Evaluation (CIE). In case, any student fails to register for the said course/fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have secured an F grade. In such a case, the student has to fulfill the course requirements during subsequent semester/s to earn the qualifying CIE marks. These courses are slated for CIE only and has no SEE.

(2) Additional Mathematics I and II shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses shall be mandatory for the award of degree.

(3) Successful completion of the courses Additional Mathematics I and II shall be indicated as satisfactory in the grade card. Non-completion of the courses Additional Mathematics I and II shall be indicated as Unsatisfactory.

(B) National Service Scheme/Physical Education (Sport and Athletics)/ Yoga:

(1) Securing 40 % or more in CIE,35 % or more marks in SEE and 40 % or more in the sum total of CIE + SEE leads to successful completion of the registered course.

(2) In case, students fail to secure 35 % marks in SEE, they have to appear for SEE during the subsequent examinations conducted by the University.

(3) In case, any student fails to register for NSS, PE or Yoga/fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have not completed the requirements of the course. In such a case, the student has to fulfill the course requirements during subsequent semester/s to earn the qualifying CIE marks.

(4) Successful completion of the course shall be indicated as satisfactory in the grade card. Non-completion of the course shall be indicated as Unsatisfactory.

(5) These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses shall be mandatory for the award of degree.

Ability Enhancement Course - III			
21CSL381	Mastering Office	21CS383	
21CS382	Programming IN c++	21CS384	

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI

B.E. in Computer Science and Engineering

Scheme of Teaching and Examinations 2021

Outcome-Based Education (OBE) and Choice Based Credit System (CBCS)

(Effective from the academic year 2021 - 22)

IV SEMESTER

Sl. No	Course and Course Code	Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
				Theory Lecture	Tutorial	Practical/ Drawing	Self -Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	T	P	S					
1	BSC 21CS41	Mathematical Foundations for Computing	Maths	2	2	0		03	50	50	100	3
2	IPCC 21CS42	Design and Analysis of Algorithms	Any CS Board Department	3	0	2		03	50	50	100	4
3	IPCC 21CS43	Microcontroller and Embedded SystemS		3	0	2		03	50	50	100	4
4	PCC 21CS44	Operating SystemS		2	2	0		03	50	50	100	3
5	AEC 21BE45	Biology For Engineers	BT, CHE, PHY	2	0	0		02	50	50	100	2
6	PCC 21CSL46	Python Programming Laboratory	Any CS Board Department	0	0	2		03	50	50	100	1
7	HSMC 21KSK37/47	Samskrutika Kannada	HSMC	1	0	0		01	50	50	100	1
	HSMC 21KBK37/47	Balake Kannada										
	OR											
	HSMC 21CIP37/47	Constitution of India & Professional Ethics										
8	AEC 21CS48X/21CSL48X	Ability Enhancement Course- IV	TD and PSB: Concerned department	If offered as theory Course: 1	0	0		01	50	50	100	1
				If offered as lab. course: 0	0	2		02				
9	UHV 21UH49	Universal Human Values	Any Department	1	0	0		01	50	50	100	1
10	INT 21INT49	Inter/Intra Institutional Internship	Evaluation By the appropriate authorities	Completed during the intervening period of II and III semesters by students admitted to first year of BE./B.Tech and during the intervening period of III and IV semesters by Lateral entry students admitted to III semester.				3	100	--	100	2
								Total	**550**	**450**	**1000**	**22**

Course prescribed to lateral entry Diploma holders admitted to III semester of Engineering programs

1	NCMC 21MATDIP41	Additional Mathematics - II	Maths	02	02	--	--	--	100	--	100	0

Note: BSC: Basic Science Course, IPCC: Integrated Professional Core Course, PCC: Professional Core Course, AEC –Ability Enhancement Courses, HSMC: Humanity and Social Science and Management Courses, UHV- Universal Human Value Courses.

L –Lecture, T – Tutorial, P- Practical/ Drawing, S – Self Study Component, CIE: Continuous Internal Evaluation, SEE: Semester End Examination.

21KSK37/47 Samskrutika Kannada is for students who speak, read and write Kannada and 21KBK37/47 Balake Kannada is for non-Kannada speaking, reading, and writing students.

Integrated Professional Core Course (IPCC): Refers to Professional Theory Core Course Integrated with Practical's of the same course. Credit for IPCC can be 04 and its Teaching – Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from practical part of IPCC shall be included in the SEE question paper. For more details the regulation governing the Degree of Bachelor of Engineering /Technology (BE/B.Tech.) 2021-22 may be referred.

Non – credit mandatory course (NCMC):

Additional Mathematics - II:

(1) Lateral entry Diploma holders admitted to III semester of B.E./B.Tech., shall attend the classes during the IV semester to complete all the formalities of the course and appear for the Continuous Internal Evaluation (CIE). In case, any student fails to register for the said course/fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have secured an F grade. In such a case, the student has to fulfil the course requirements during subsequent semester/s to earn the qualifying CIE marks. These courses are slated for CIE only and has no SEE.

(2) Additional Mathematics I and II shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses shall be mandatory for the award of degree.

(3) Successful completion of the course Additional Mathematics II shall be indicated as satisfactory in the grade card. Non-completion of the courses Additional Mathematics II shall be indicated as Unsatisfactory.

Ability Enhancement Course - IV

21CSL481	Web Programming	21CSL483	R Programming
21CS482	Unix Shell Programming	21CS484	

Internship of 04 weeks during the intervening period of IV and V semesters; 21INT68 Innovation/ Entrepreneurship/ Societal based Internship.

(1) All the students shall have to undergo a mandatory internship of 04 weeks during the intervening period of IV and V semesters. The internship shall be slated for CIE only and will not have SEE. The letter grade earned through CIE shall be included in the VI semester grade card. The internship shall be considered as a head of passing and shall be considered for vertical progression and for the award of degree. Those, who do not take up / complete the internship shall be considered under F (fail) grade and shall have to complete during subsequently after satisfying the internship requirements.

(2) Innovation/ Entrepreneurship Internship shall be carried out at industry, State and Central Government /Non-government organizations (NGOs), micro, small and medium enterprise (MSME), Innovation centers or Incubation centers. Innovation need not be a single major breakthrough; it can also be a series of small or incremental changes. Innovation of any kind can also happen outside of the business world.

Entrepreneurship internships offers a chance to gain hands on experience in the world of entrepreneurship and helps to learn what it takes to run a small entrepreneurial business by performing intern duties with an established company. This experience can then be applied to future business endeavours. Start-ups and small companies are a preferred place to learn the business tack ticks for future entrepreneurs as learning how a small business operates will serve the intern well when he/she manages his/her own company. Entrepreneurship acts as a catalyst to open the minds to creativity and innovation. Entrepreneurship internship can be from several sectors, including technology, small and medium-sized, and the service sector.

(3) Societal or social internship.

Urbanization is increasing on a global scale; and yet, half the world's population still resides in rural areas and is devoid of many things that urban population enjoy. Rural internship, is a work-based activity in which students will have a chance to solve/reduce the problems of the rural place for better living.

As proposed under the AICTE rural internship programme, activities under Societal or social internship, particularly in rural areas, shall be considered for 40 points under AICTE activity point programme.

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI

B.E. in Computer Science and Engineering

Scheme of Teaching and Examinations 2021

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

(Effective from the academic year 2021 - 22)

V SEMESTER

Sl. No	Course and Course Code	Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
				Theory Lecture	Tutorial	Practical/ Drawing	Self -Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	T	P	S					
1	BSC 21CS51	Automata Theory and compiler Design	Any CS Board Department	3	0	0		03	50	50	100	3
2	IPCC 21CS52	Computer Networks		3	0	2		03	50	50	100	4
3	PCC 21CS53	Database Management Systems		3	0	0		03	50	50	100	3
4	PCC 21CS54	Artificial Intelligence and Machine Learning		3	0	0		03	50	50	100	3
5	PCC 21CSL55	Database Management Systems Laboratory with Mini Project		0	0	2		03	50	50	100	1
6	AEC 21XX56	Research Methodology & Intellectual Property Rights	TD: Any Department PSB: As identified by university	2	0	0		02	50	50	100	2
7	HSMC 21CIV57	Environmental Studies	TD: Civil/ Environmental /Chemistry/ Biotech. PSB: Civil Engg	1	0	0		1	50	50	100	1
8	AEC 21CS58X/21 CS58LX	Ability Enhancement Course-V	Concerned Board	If offered as Theory courses: 1	0	0		01	50	50	100	1
				If offered as lab. courses: 0	0	2		02				
								Total	**400**	**400**	**800**	**18**

Ability Enhancement Course - IV

21CSL581	Angular JS and Node JS	21CS583	
21CS582	C# and .Net Framework	21CS584	

Note: BSC: Basic Science Course, PCC: Professional Core Course, IPCC: Integrated Professional Core Course, AEC –Ability Enhancement Course INT – Internship, HSMC: Humanity and Social Science & Management Courses.
L –Lecture, T – Tutorial, P- Practical/ Drawing, S – Self Study Component, CIE: Continuous Internal Evaluation, SEE: Semester End Examination.

Integrated Professional Core Course (IPCC): refers to Professional Theory Core Course Integrated with Practical of the same course. Credit for IPCC can be 04 and its Teaching – Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). Theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by CIE only and there shall be no SEE. For more details the regulation governing the Degree of Bachelor of Engineering /Technology (BE/B.Tech.) 2021-22 may be referred.

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VI SEMESTER

Sl. No	Course and Course Code	Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
				Theory Lecture	Tutorial	Practical/ Drawing	Self -Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	T	P	S					
1	HSMC 21CS61	Software Engineering & Project Management	Any CS Board Department	2	2	0		03	50	50	100	3
2	IPCC 21CS62	Fullstack Development		3	0	2		03	50	50	100	4
3	PCC 21CS63	Computer Graphics and Fundamentals of Image Processing		3	0	0		03	50	50	100	3
4	PEC 21XX64x	Professional Elective Course-I		3	0	0		03	50	50	100	3
5	OEC 21XX65x	Open Elective Course-I	Concerned Department	3	0	0		03	50	50	100	3
6	PCC 21CSL66	Computer Graphics and Image Processing Laboratory	Any CS Board Department	0	0	2		03	50	50	100	1
7	MP 21CSMP67	Mini Project		Two contact hours /week for interaction between the faculty and students.				--	100	--	100	2
8	INT 21INT68	Innovation/Entrepreneurship /Societal Internship	Completed during the intervening period of IV and V semesters.					--	100	--	100	3
								Total	**500**	**300**	**800**	**22**

Professional Elective - I

21CS641	Agile Technology	21CS643	Advanced Computer Architecture
21CS642	Advanced JAVA Programming	21CS644	Data science and Visualization

Open Electives – I offered by the Department to other Department students

21CS651	Introduction to Data Structures	21CS653	Introduction to Cyber Security
21CS652	Introduction to Database Management Systems	21CS654	Programming in JAVA

Note: HSMC: Humanity and Social Science & Management Courses, **IPCC:** Integrated Professional Core Course, **PCC:** Professional Core Course, **PEC:** Professional Elective Courses, OEC–Open Elective Course, **MP** –Mini Project, INT –Internship.
L –Lecture, T – Tutorial, P - Practical / Drawing, S – Self Study Component, CIE: Continuous Internal Evaluation, SEE: Semester End Examination.

Integrated Professional Core Course (IPCC): Refers to Professional Theory Core Course Integrated with Practical of the same course. Credit for IPCC can be 04 and its Teaching – Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by CIE only and there shall be no SEE. For more details, the regulation governing the Degree of Bachelor of Engineering /Technology (BE/B.Tech) 2021-22 may be referred.

Professional Elective Courses (PEC):
A professional elective (PEC) course is intended to enhance the depth and breadth of educational experience in the Engineering and Technology curriculum. Multidisciplinary courses that are added supplement the latest trend and advanced technology in the selected stream of engineering. Each group will provide an option to select one course out of five courses. The minimum students' strength for offering professional electives is 10. However, this conditional shall not be applicable to cases where the admission to the programme is less than 10.

Open Elective Courses:
Students belonging to a particular stream of Engineering and Technology are not entitled for the open electives offered by their parent Department. However, they can opt an elective offered by other Departments, provided they satisfy the prerequisite condition if any. Registration to open electives shall be documented under the guidance of the Program Coordinator/ Advisor/Mentor.
Selection of an open elective shall **not be allowed** if,

(i) The candidate has studied the same course during the previous semesters of the program.
(ii) The syllabus content of open electives is similar to that of the Departmental core courses or professional electives.
(iii) A similar course, under any category, is prescribed in the higher semesters of the program.

In case, any college is desirous of offering a course (not included in the Open Elective List of the University) from streams such as Law, Business

(MBA), Medicine, Arts, Commerce, etc., can seek permission, at least one month before the commencement of the semester, from the University by submitting a copy of the syllabus along with the details of expertise available to teach the same in the college.
The minimum students' strength for offering open electives is 10. However, this conditional shall not be applicable to cases where the admission to the programme is less than 10.

Mini-project work: Mini Project is a laboratory-oriented course which will provide a platform to students to enhance their practical knowledge and skills by the development of small systems/applications.
Based on the ability/abilities of the student/s and recommendations of the mentor, a single discipline or a multidisciplinary Mini- project can be assigned to an individual student or to a group having not more than 4 students.
CIE procedure for Mini-project:
(i) Single discipline: The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two faculty members of the Department, one of them being the Guide. The CIE marks awarded for the Mini-project work shall be based on the evaluation of project report, project presentation skill, and question and answer session in the ratio of 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.
(ii) Interdisciplinary: Continuous Internal Evaluation shall be group-wise at the college level with the participation of all the guides of the project.
The CIE marks awarded for the Mini-project, shall be based on the evaluation of project report, project presentation skill, and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.
No SEE component for Mini-Project.

VII semester Classwork and Research Internship /Industry Internship (21INT82)

Swapping Facility
Institutions can swap VII and VIII Semester Scheme of Teaching and Examinations to accommodate research internship/ industry internship after the VI semester**.**
(2) Credits earned for the courses of VII and VIII Semester Scheme of Teaching and Examinations shall be counted against the corresponding semesters whether VII or VIII semester is completed during the beginning of IV year or later part of IV year of the program.
Elucidation:
At the beginning of IV year of the programme i.e., after VI semester, VII semester classwork and VIII semester Research Internship /Industrial Internship shall be permitted to be operated simultaneously by the University so that students have ample opportunity for internship. In other words, a good percentage of the class shall attend VII semester classwork and similar percentage of others shall attend to Research Internship or Industrial Internship.
Research/Industrial Internship shall be carried out at an Industry, NGO, MSME, Innovation centre, Incubation centre, Start-up, Centers of Excellence (CoE), Study Centre established in the parent institute and /or at reputed research organizations / institutes. The internship can also be rural internship.
The mandatory Research internship /Industry internship is for 24 weeks. The internship shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not take up/complete the internship shall be declared fail and shall have to complete during the subsequent University examination after satisfying the internship requirements.

INT21INT82 Research Internship/ Industry Internship/Rural Internship
Research internship: A research internship is intended to offer the flavour of current research going on in the research field. It helps students get familiarized with the field and imparts the skill required for carrying out research.
Industry internship: Is an extended period of work experience undertaken by students to supplement their degree for professional development. It also helps them learn to overcome unexpected obstacles and successfully navigate organizations, perspectives, and cultures. Dealing with contingencies helps students recognize, appreciate, and adapt to organizational realities by tempering their knowledge with practical constraints.
Rural internship: A long-term goal, as proposed under the AICTE rural internship programme, shall be counted as rural internship activity.
The student can take up Interdisciplinary Research Internship or Industry Internship.
The faculty coordinator or mentor has to monitor the students' internship progress and interact with them to guide for the successful completion of the internship.
The students are permitted to carry out the internship anywhere in India or abroad. University shall not bear any expenses incurred in respect of internship.

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(Effective from the academic year 2021 - 22)

Swappable VII and VIII SEMESTER

VII SEMESTER

Sl. No	Course and Course Code	Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
				Theory Lecture	Tutorial	Practical/ Drawing	Self -Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	T	P	S					
1	PCC 21CS71	Big Data Analytics	Any CS Board Department	3	0	0		3	50	50	100	3
2	PCC 21CS72	Cloud Computing		2	0	0		3	50	50	100	2
3	PEC 21XX73X	Professional elective Course-II		3	0	0		3	50	50	100	3
4	PEC 21XX74X	Professional elective Course-III		3	0	0		3	50	50	100	3
5	OEC 21XX75X	Open elective Course-II	Concerned Department	3	0	0		3	50	50	100	3
6	Project 21CSP76	Project work		Two contact hours /week for interaction between the faculty and students.				3	100	100	200	10
								Total	**350**	**350**	**700**	**24**

VIII SEMESTER

Sl. No	Course and Course Code		Course Title	Teaching Department	Teaching Hours /Week				Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Self -Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	Seminar 21CS81		Technical Seminar		One contact hour /week for interaction between the faculty and students.				--	100	--	100	01
2	INT 21INT82		Research Internship/ Industry Internship		Two contact hours /week for interaction between the faculty and students.				03 (Batch wise)	100	100	200	15
3	NCMC	21NS83	National Service Scheme (NSS)	NSS	Completed during the intervening period of III semester to VIII semester.				--	50	50	100	0
		21PE83	Physical Education (PE) (Sports and Athletics)	PE									
		21YO83	Yoga	Yoga									
									Total	**250**	**150**	**400**	**16**

Professional Elective - II

21CS731	Object oriented Modelling and Design	21CS734	Blockchain Technology
21CS732	Digital Image Processing	21CS735	Internet of Things
21CS733	Cryptography and Network Security		

Professional Elective - III

21CS741	Software Architecture and Design Patterns	21CS744	Robotic Process Automation Design and Development
21CS742	Multiagent Systems	21CS745	NoSQL Data Base
21CS743	Deep Learning		

Open Electives - II offered by the Department to other Department students			
21CS751	Programming in Python	21CS754	Introduction to Data Science
21CS752	Introduction to AI and ML	21CS755	
21CS753	Introduction to Big Data		

Note: PCC: Professional Core Course, **PEC:** Professional Elective Courses, **OEC**–Open Elective Course, **AEC** –Ability Enhancement Courses.
L –Lecture, T – Tutorial, P- Practical / Drawing, S – Self Study Component, CIE: Continuous Internal Evaluation, SEE: Semester End Examination.

Note: VII and VIII semesters of IV year of the programme

(1) Institutions can swap VII and VIII Semester Scheme of Teaching and Examinations to accommodate research internship/ industry internship after the VI semester**.**

(2) Credits earned for the courses of VII and VIII Semester Scheme of Teaching and Examinations shall be counted against the corresponding semesters whether VII or VIII semester is completed during the beginning of IV year or later part of IV year of the programme.

PROJECT WORK (21XXP76): The objective of the Project work is

(i) To encourage independent learning and the innovative attitude of the students.
(ii) To develop interactive attitude, communication skills, organization, time management, and presentation skills.
(iii) To impart flexibility and adaptability.
(iv) To inspire team working.
(v) To expand intellectual capacity, credibility, judgment and intuition.
(vi) To adhere to punctuality, setting and meeting deadlines.
(vii) To instil responsibilities to oneself and others.
(viii) To train students to present the topic of project work in a seminar without any fear, face the audience confidently, enhance communication skills, involve in group discussion to present and exchange ideas.

CIE procedure for Project Work:

(1) Single discipline: The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide.

The CIE marks awarded for the project work, shall be based on the evaluation of project work Report, project presentation skill, and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

(2) Interdisciplinary: Continuous Internal Evaluation shall be group-wise at the college level with the participation of all guides of the college. Participation of external guide/s, if any, is desirable. The CIE marks awarded for the project work, shall be based on the evaluation of project work Report, project presentation skill, and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

SEE procedure for Project Work: SEE for project work will be conducted by the two examiners appointed by the University. The SEE marks awarded for the project work, shall be based on the evaluation of project work Report, project presentation skill, and question and answer session in the ratio 50:25:25.

TECHNICAL SEMINAR (21XXS81): The objective of the seminar is to inculcate self-learning, present the seminar topic confidently, enhance communication skill, involve in group discussion for exchange of ideas. Each student, under the guidance of a Faculty, shall choose, preferably, a recent topic of his/her interest relevant to the programme of Specialization.

(i) Carry out literature survey, systematically organize the content.
(ii) Prepare the report with own sentences, avoiding a cut and paste act.
(iii) Type the matter to acquaint with the use of Micro-soft equation and drawing tools or any such facilities.
(iv) Present the seminar topic orally and/or through PowerPoint slides.
(v) Answer the queries and involve in debate/discussion.
(**vi)** Submit a typed report with a list of references.

The participants shall take part in the discussion to foster a friendly and stimulating environment in which the students are motivated to reach high standards and become self-confident.

Evaluation Procedure:

The CIE marks for the seminar shall be awarded (based on the relevance of the topic, presentation skill, participation in the question and answer session, and quality of report) by the committee constituted for the purpose by the Head of the Department. The committee shall consist of three teachers from the department with the senior-most acting as the Chairman.

Marks distribution for CIE of the course:

Seminar Report:50 marks
Presentation skill:25 marks
Question and Answer: 25 marks. ■ No SEE component for Technical Seminar

Non – credit mandatory courses (NCMC):

National Service Scheme/Physical Education (Sport and Athletics)/ Yoga:

(1) Securing 40 % or more in CIE,35 % or more marks in SEE and 40 % or more in the sum total of CIE + SEE leads to successful completion of the registered course.

(2) In case, students fail to secure 35 % marks in SEE, they has to appear for SEE during the subsequent examinations conducted by the University.

(3) In case, any student fails to register for NSS, PE or Yoga/fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have not completed the requirements of the course. In such a case, the student has to fulfill the course requirements during subsequently to earn the qualifying CIE marks subject to the maximum programme period.

(4) Successful completion of the course shall be indicated as satisfactory in the grade card. Non-completion of the course shall be indicated as Unsatisfactory.

(5) These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses shall be mandatory for the award of degree.

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI.

Scheme of Teaching and Examinations and Syllabus

Master of Computer Applications (MCA)

(Effective from Academic year 2020 - 21)

VISVESVARAYA TECHNOLOGICAL UNIVERSITY
Scheme of Teaching and Examination

Master of Computer Applications

Under Outcome Based Education (OBE) and Choice Based Credit System (CBCS) Scheme

SEMESTER-I

S.No	Course Type	Course Code	Title	Teaching Hours/ Week			Examination				Credits
				L	P	T/S DA	Duration in hours	SEE Marks	CIE Marks	Total Marks	
1	PCC	20MCA11	Data Structures with Algorithms	04	-	-	03	60	40	100	04
2	PCC	20MCA12	Operating System with Unix	04	-	-	03	60	40	100	04
3	PCC	20MCA13	Computer Networks	04	-	-	03	60	40	100	04
4	PCC	20MCA14	Mathematical Foundation for Computer Applications	03	-	02	03	60	40	100	04
5	PCC	20MCA15	Research Methodology & IPR	02	-	02	03	60	40	100	02
6	PCC	**20MCA16**	**Data Structures with Algorithms Lab**	-	04		03	60	40	100	02
7	PCC	20MCA17	Unix Programming Lab	-	04		03	60	40	100	02
8	PCC	**20MCA18**	**Computer Networks Lab**	-	04		03	60	40	100	02
9	BC	20MCA19-BC*	Basics of Programming & CO	02	-	02	03	60	40	100	-
Total				**17**	**12**	**06**	**27**	**540**	**360**	**900**	**24**

***Only for non-computer science students**

Note: PCC- Professional Core Course; PCE- Professional Elective Course

Each Course (PCC/PCE) shall have case study discussion and may be considered as a part of assignment.

Theory courses internal assessment (CIE) shall be based on internal test (50% weightage), 50% weightage may be given to other continues assessment carried out during the teaching learning processes. Course coordinator may select suitable assessment techniques/tools for continues evaluation such as weekly Multiple Choice Questions (MCQ) quiz, higher order cognitive level questions as assignment, and case study questions/

any other assignment useful for learning with a minimum cognitive level at the application level. Average marks of three internal tests have to be considered for CIE along with other continues evaluations.

Laboratory courses internal assessment shall be based on internal test (**50**% weightage), remaining 50% weightage shall be given to continues evaluation of practical execution during regular laboratory hours. During regular laboratory hours students may be asked to solve the extended versions of the laboratory program/problem, and demonstrate higher order cognitive level such as analysis and design programming assignment. During the laboratory hours after the program execution, technical quiz may be conducted. Wherever laboratory is also having project work students may be asked to solve novel problems in their projects work.

Skill development activities (SDA):

Students and course instructor/s to involve either individually or in groups to interact together to enhance the learning and application skills.

The students should interact with industry (small, medium and large), understand their problems or foresee what can be undertaken for study in the form of research/ testing / projects, and for creative and innovative methods to solve the identified problem.

The students shall

1) Gain confidence in modelling of systems and algorithms.
2) Work on different software/s (tools) to Simulate, analyse and authenticate the output to interpret and conclude. Operate the simulated system under changed parameter conditions to study the system with respect to thermal study, transient and steady state operations, etc.
3) Handle advanced instruments to enhance technical talent.
4) Involve in case studies and field visits/ field work.
5) Accustom with the use of standards/codes etc., to narrow the gap between academia and industry.

All activities should enhance student's abilities to employment and/or self-employment opportunities, management skills, Statistical analysis, fiscal expertise, etc.

Tutorial:

Tutorial sessions may be conducted using cooperative Learning techniques. Tutorial sheets maintained should indicate date, problem (statement) addressed, and cooperative learning technique employed, solution to the problem. Course coordinator shall maintain document in specific format for tutorial / SDA.

In order to promote reinforcement of TLP, course coordinator to analyze the performance of the student after the execution of particular test and conduct remedial/ tutorial classes. It is recommended to make changes in delivery methods wherever required and give appropriate assignments/ study materials to fast/slow learners.

Note:

1) Four credit courses are designed for 50 hours of teaching and learning process

2) Three credit courses are designed for 40hours Teaching – Learning process.
3) Two credit courses are designed for 30hours Teaching – Learning process.

Research/Technical Seminar:

As a part of the course Research Methodology & IPR, presenting the seminar is mandatory. The CIE marks awarded for Resaerch/Technical Seminar shall be based on the evaluation of Seminar Report, Presentation skills and performance in Question and Answer session in the ratio 50:25:25. Seminar is to be considered for **20 marks. Remaining 20 marks is for internal tests.**

Students shall do the literature survey of existing work on contemporary topics and present. Student shall highlight on the research gap and propose solution. Seminar presentation and report have to be evaluated using rubrics.

Bridge course: 20MCA19-BC

20MCA19-BC: Bridge course is a non-credit course introduced to the students who admits into MCA program from non-computer science background. Students have to secure eligibility by scoring 50% marks in aggregate (CIE and SEE).

VISVESVARAYA TECHNOLOGICAL UNIVERSITY
Scheme of Teaching and Examination

Master of Computer Applications

Under Outcome Based Education (OBE) and Choice Based Credit System (CBCS) Scheme

SEMESTER-II

S.No.	Course Type	Course Code	Title	Teaching Hours/Week			Examination				Credits
				L	P	T/SDA	Duration in hours	SEE Marks	CIE Marks	Total Marks	
1	PCC	20MCA21	Database Management System	03	-	-	03	60	40	100	03
2	PCC	20MCA22	Object Oriented Programming with Java	03	-	-	03	60	40	100	03
3	PCC	20MCA23	Web Technologies	04	-	-	03	60	40	100	04
4	PCC	20MCA24	Software Engineering	03	-	02	03	60	40	100	04
5	PEC	20MCA25X	Elective-1	03	-	-	03	60	40	100	03
6	PEC	20MCA26X	Elective-2	03	-	-	03	60	40	100	03
7	PCC	20MCA27	DBMS Lab	-	04	-	03	60	40	100	02
8	PCC	20MCA28	Java Programming Lab.	-	04	-	03	60	40	100	02
9	PCC	20MCA29	Web Technologies Lab with Mini-project	-	04	-	03	60	40	100	02
Total				**19**	**12**	**02**	**27**	**540**	**360**	**900**	**26**

Elective-I		Elective-II	
20MCA251	Cybersecurity	20MCA261	Cryptography and Network Security
20MCA252	Data Mining and Business Intelligence	20MCA262	Artificial Intelligence
20MCA253	Enterprise Resource Planning	20MCA263	Mobile Application Development
20MCA254	User Interface Design	20MCA264	Distributed operating System
20MCA255	Optimization Techniques	20MCA265	Natural Language Processing

VISVESVARAYA TECHNOLOGICAL UNIVERSITY
Scheme of Teaching and Examination

Master of Computer Applications

Under Outcome Based Education (OBE) and Choice Based Credit System (CBCS) Scheme

SEMESTER-III

S.No	Course Type	Course Code	Title	Teaching Hours/Week			Examination				Credits
				L	P	T/SDA	Duration in hours	SEE Marks	CIE Marks	Total Marks	
1	**PCC**	**20MCA31**	**Data Analytics using Python**	**04**	**-**	**-**	**03**	**60**	**40**	**100**	**04**
2	PCC	20MCA32	IoT	04	-	-	03	60	40	100	04
3	PCC	20MCA33	Advances in Java	04	-	-	03	60	40	100	04
4	PEC	20MCA34X	Elective-II	03	-	-	03	60	40	100	03
5	PEC	20MCA35X	Elective-III	03	-	-	03	60	40	100	03
6	PCC	20MCA36	Data Analytics Lab with Mini-project	-	04		03	60	40	100	02
7	PCC	20MCA37	IoT Lab with Mini Project	-	04		03	60	40	100	02
8	PCC	20MCA38	Advances in Java Lab	-	04		03	60	40	100	02
	Total			**18**	**12**	**-**	**24**	**480**	**320**	**800**	**24**

Elective-III		**Elective-IV**	
20MCA341	Block chain Technology	20MCA351	Deep Learning
20MCA342	Cloud Computing	20MCA352	Big data Analytics
20MCA343	Digital Marketing	20MCA353	Wireless Ad Hoc Networks
20MCA344	Software Testing	20MCA354	Software Project Management
20MCA345	NOSQL	20MCA355	Software Defined Networks

VISVESVARAYA TECHNOLOGICAL UNIVERSITY
Scheme of Teaching and Examination

Master of Computer Applications

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SEMESTER-IV

S.No	Course Type	Course Code	Title	Teaching Hours/Week			Examination				Credits
				Lecture(L)	Tutorial(T)	Practical(P)\Seminar	Duration in hours	SEE Marks	CIE Marks	Total Marks	
1	PCC	20MCA41	Advances in Web Technologies	02	02		3	60	40	100	02
2	PCC	20MCA42	Programming using C#	02	02	-	03	60	40	100	02
3	PCC	20MCA43	Industry Internship (4 weeks in vacation of 3rd sem.)	-	-	-	-	-	100	100	02
4	PCC	20MCA44	Project work Phase 2 (During 4th Semester- min. of 4 Months)			02	03	60	40	100	20
Total				**4**	**4**	**02**	**09**	**180**	**220**	**400**	**26**

Internship:

All the students have to undergo mandatory internship of 4 weeks during the vacation of III semester. Internship shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not take-up/complete the internship shall be declared as fail in internship course and have to complete the same during the subsequent semester. After satisfying the internship requirements the degree will be awarded. However, student can carry out 4th semester project without completing the internship.

Project:

The candidate should carry out the project in any industry or R&D institution or educational institution under a guide/co-guide. The candidate has to present the work carried out before the examiners during the University examination. The work out carried out should be free from plagiarism. The

literature study may be clearly written which may be summary of existing project and highlight of what are the functionalities that are proposed to this project. Student shall indicate the different research papers, documents refereed as a part of the literature study. It is recommended to do prior art search as part of literature survey before submitting the synopsis for the projects.

This is an individual project for a duration of minimum of 4 months or duration of the semester. Rubrics have to be used for evaluation of projects which makes the evaluation transparent and valid. Paper publication in an indexed journal/conference is compulsory as part of the project work.

Project work evaluation

There shall be three project presentations each to be considered for 5 marks (5X3= 15 marks) and a final presentation for 15 marks. Presentation may be given using Power point presentation/demonstrations of the work. Synopsis submitted in a proper format is to be evaluated for 10 marks. Student has to publish a research paper in indexed journal / conference. Publications follow the Thesis. 10% weightage is given in SEE. Project report organization/contents can be similar to project report contents of 2018 scheme/syllabus .

Data Structures with Algorithms Choice Based Credit System

Semester:	I	CIE Marks:	40
Course Code:	20MCA11	SEE Marks:	60
Contact Hours (L:T:P):	4:0:0	Exam Hours:	03

Course Outcomes: At the end of the course students will be able to

1. CO1: Demonstrate different data structures, its operations using C programming.
2. CO2: Analyse the performance of Stack, Queue, Lists, Trees, Hashing, Searching and Sorting techniques.
3. CO3: Implement some applications of data structures in a high-level language such as C/C++
4. CO4: Design and apply appropriate data structures for solving computing problems.
5. CO5: Compute the efficiency of algorithms in terms of asymptotic notations for the given problem.

Module-1

Classification of Data Structures: Primitive and Non- Primitive, Linear and Nonlinear; Data structure Operations, Stack: Definition, Representation, Operations and Applications: Polish and reverse polish expressions, Infix to postfix conversion, evaluation of postfix expression, infix to prefix, postfix to infix conversion.

Module-2

Recursion - Factorial, GCD, Fibonacci Sequence, Tower of Hanoi. Queue: Definition, Representation, Queue Variants: Circular Queue, Priority Queue, Double Ended Queue; Applications of Queues. Programming Examples.

Module-3

Linked List:Limitations of array implementation, Memory Management: Static (Stack) and Dynamic (Heap) Memory Allocation, Memory management functions. Definition, Representation, Operations: getnode() and Freenode() operations, Types: Singly Linked List. Linked list as a data Structure, Inserting and removing nodes from a list, Linked implementations of stacks, Header nodes, Array implementation of lists.

Module-4

Introduction, Fundamentals of the Analysis of Algorithm Efficiency Notion of Algorithm, Fundamentals of Algorithmic Problem Solving, Important Problem Types, Analysis Framework, Asymptotic Notations and Basic efficiency classes, Mathematical analysis of Recursive and Non-recursive algorithms.

Module-5

Brute Force: Selection Sort and Bubble Sort, Sequential Search, Exhaustive search and String Matching. Divide-and-Conquer Mergesort, Quicksort, Binary Search, Binary tree Traversals and related properties. Decrease-and-Conquer Insertion Sort, Depth First and Breadth First Search, Topological sorting. Greedy Technique Prim's Algorithm, Kruskal's Algorithm, Dijkstra's Algorithm.

Question Paper Pattern:

- The Question paper will have TEN questions
- Each full question will be for 20 marks
- There will be 02 full questions (with maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting one full question from each module.

Textbooks

1. Introduction to the Design and Analysis of Algorithms. AnanyLevitin, Pearson Education, 2nd Edition.

2. Programming in ANSI C, Balaguruswamy, McGraw Hill Education .

3. Data Structures Using C and C++ by YedidyahLangsam and Moshe J. Augenstein and Aaron M Tenanbanum, 2nd Edition, Pearson Education Asia, 2002.

4. Introduction to Data Structure and Algorithms with C++ by Glenn W. Rowe.

Operating System with UNIX

Semester: I	**I**	**CIE Marks:**	**40**
Course Code:	**20MCA12**	**SEE Marks:**	**60**
Contact Periods (L:T:P):	**4-0-0**	**Exam Hours:**	**3**

Course Outcomes:

1. CO1:Analyse the basic Operating System Structure and concept of Process Management
2. CO2: Analyse the given Synchronization/ Deadlock problem to solve and arrive at valid conclusions.
3. CO3: Analyse OS management techniques and identify the possible modifications for the given problem context.
4. CO4:Demonstrate the working of basic commands of Unix environment including file processing
5. CO5: : Demonstrate the usage of different shell commands, variable and AWK filtering to the given problem

Module-1

Introduction to Operating Systems, Computer System Architecture; Operating System Operations; ; Operating System Structure: Operating System Services; System Calls; Types of System Calls; System Programs;; Virtual Machines; System boot.

Process Management Process Scheduling: Basic Concepts, Scheduling Criteria, Scheduling Algorithms, Multiple Processor Scheduling. Process Synchronization

Module-2

Deadlocks: System model; Deadlock Characterization, Methods for handling deadlocks; Deadlock Prevention; Deadlock Avoidance; Deadlock Detection and Recovery from deadlock. Memory Management: Memory Management Strategies: Background, Swapping; Contiguous Memory Allocation; Paging; Segmentation; Virtual Memory Management; Demand Paging; Page Replacement; Allocation of Frames; Thrashing.

Module-3

The File System: The File, What's in a File name? The Parent-Child Relationship, The HOME Variable: The Home Directory, pwd, cd, mkdir, rmdir, Absolute Pathnames, Relative Pathnames, The Unix File System. The vi Editor: vi Basics, Input Mode, ex Mode and Command Mode.

Basic File Attributes: ls options, File Ownership, File Permissions, chmod, Directory Permissions, Changing the File Ownership More File Attributes: File Systems and Inodes, Hard Links, Symbolic Links, The Directory, umask, Modification and Access Times, find. **The Shell:** The Shell's Interpretive Cycle, Shell Offerings, Pattern Matching-The Wild-cards, Escaping and Quoting, Redirection: The Three Standard Files, Two Special Files: /dev/null and /dev/tty, pipes, tee: Creating a Tee, Command Substitution**.**

Module-4

The Process: Process Basics, ps: Process Status, System Processes, Mechanism of Process Creation, Internal and External Commands, Running Jobs in Background, Killing Processes with Signals, Job Control, at and batch, cron.

Essential Shell Programming: Shell Variables, Environment Variables, Shell Scripts, read, Using Command Line Arguments, exit and exit status of command, The Logical Operators, The if Conditional, using test and [] to Evaluate Expression, The case Conditional, expr, while: looping, for: looping with a list, set and shift, trap, Debugging Shell Scripts with set – x.

Module-5

AWK and Advanced Shell Programming

Simple AWK Filtering, Splitting a Line into Fields, printf, the Logical and Relational Operators, Number Processing, Variables, The –f option, BEGIN and END positional Parameters, getline, Built-invariables, Arrays, Functions, Interface with the Shell, Control Flow. The sh command, export Command, Conditional Parameter Substitution, Merging Streams, Shell Functions, eval, Exec Statement and Examples

Question Paper Pattern:

- The Question paper will have TEN questions
- Each full question will be for 20 marks
- There will be 02 full questions (with maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting one full question from each module.

Text books

1. Sumitabha Das: UNIX Concepts and Applications, 4th Edition, Tata McGraw Hill, 2006.
2. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne: Operating Systems Principles, 8th Edition, Wiley – India.

References

1. UNIX: The Complete Reference: Kenneth Roson et al, Osborne/McGraw Hill, 2000.
2. Using UNIX: Steve Montsugu, 2ndEdition, Prentice Hall India, 1999.
3. UNIX and Shell Programming: M G Venkateshmurthy, Pearson Education Asia, 2005
4. Behrouz A Forouzan and Richard F Gilberg
5. 4.D M Dhamdhere: Operating Systems – A Concept Based Approach, 2nd Edition, Tata McGraw – Hill, 2002.
6. P C P Bhatt: Operating Systems, 2ndEdition, PHI, 2006.
7. 6. Harvey M Deital: Operating Systems, 3rdEdition, Addison Wesley, 1990.

Computer Networks Choice Based Credit System

Semester: I	CIE Marks:40
Course code:20MCA13	SEE Marks:60
Contact Hours (L: T:P):4-0-0	Exam Hours:03

Course Outcomes: At the end of the course, the student will be able to

1. CO1: Apply the basic concepts of networking and to analyse different parameters such as bandwidth, delay, throughput of the networks for the given problem.
2. CO2: Apply different techniques to ensure the reliable and secured communication in wired and wireless communication
3. CO3: Analyse the networking concepts of TCP/IP for wired and wireless components
4. CO4: Identify the issues of Transport layer to analyse the congestion control mechanism
5. CO5: Design network topology with different protocols and analyse the performance using NS2

Module-1

Applications, Requirements, Network Architecture, Implementing Network Software, Performance.

Module-2

Perspectives on Connecting, Encoding (NRZ, NRZI, Manchester, 4B/5B), Framing, Error Detection, Reliable Transmission, Ethernet and Multiple Access Networks (802.3), Wireless.

Module-3

Internetworking and Advanced Internetworking Switching and Bridging, Basic Internetworking (IP), Routing, The Global Internet, Routing among Mobile Devices.

Module-4

End-to-End Protocols and Congestion Control Simple Demultiplexer (UDP), Reliable Byte Stream (TCP), Queuing Disciplines, TCP Congestion Control, Congestion-Avoidance Mechanisms.

Module-5
Network Security and Applications Cryptographic Building Blocks, Key Pre-distribution, Firewalls, Traditional Applications, Infrastructure Services.
Question Paper Pattern: • The Question paper will have TEN questions • Each full question will be for 20 marks • There will be 02 full questions (with maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer FIVE full questions, selecting one full question from each module.
Text books
1. " Computer Networks A Systems Approach" by Larry L Peterson and Bruce S Davie, 5th Edition, MKP – 2012 – (1, 2 ,3.1,3.2,3.3, 3.4,4.1, 5.1,5.2 , 6.2,6.36.4, 8.1,8.2,8.5, 9.1,9.3)
References
1. James F. Kurose, Keith W. Ross, "Computer Networking – A Top-Down Approach Featuring the Internet", Fifth Edition, Pearson Education, 2009. 2. Nader. F. Mir, "Computer and Communication Networks", Pearson Prentice Hall Publishers, 2010. 3. Ying-Dar Lin, Ren-Hung Hwang, Fred Baker, "Computer Networks: An Open Source Approach", Mc Graw Hill Publisher, 2011. 4. Behrouz A. Forouzan, "Data Communication and Networking", Fourth Edition, Tata McGraw – Hill, 2011.

Mathematical Foundation for Computer Applications

Choice Based Credit System

Semester: I	CIE Marks:40
Course Code:20MCA14	SEE Marks:60
Contact Hours(L: T:P)::3-2-0	Exam Hours:03

Course Outcomes: At the end of the course student will be to

1. CO1: Apply the fundamentals of set theory and matrices for the given problem.
2. CO2: Apply the types of distribution, evaluate the mean and variance for the given case study/ problem.
3. CO3: solve the given problem by applying the Mathematical logic concepts
4. CO4: Model the given problem by applying the concepts of graph theory.
5. CO5: Design strategy using gaming theory concepts for the given problem.
6. CO6: Identify and list the different applications of discrete mathematical concepts in computer science.

Module-1
Set Theory and Matrices

Sets, Operations on sets, Cardinality of sets, inclusion-exclusion principle, pigeonhole principle, matrices, finding Eigen values and Eigen vectors.

Module-2

Mathematical Logic

Propositional Logic, Applications of Propositional Logic, Propositional Equivalences

Predicates and Quantifiers, Nested Quantifiers, Rules of Inference Introduction to Proofs

Module-3

Relations

Relations and Their Properties, n-ary Relations and Their Application, Representing Relations, Closures of Relations,Equivalence Relations, Partial Orderings

Module-4

Random variable and probability distribution

Concept of random variable, discrete probability distributions, continuous probability distributions, Mean, variance and co-variance and co-variance of random variables. Binomial and normal distribution, Exponential and normal distribution with mean and variables and problems

Module-5

Graph Theory

Graphs and Graphs models, Graph Terminology and Special Types of Graphs, Representing Graphs and Graph Isomorphism, Connectivity, Euler and Hamilton Paths, Shortest-Path Problems, Planar Graphs, Graph Coloring

Question Paper Pattern:

- The Question paper will have TEN questions
- Each full question will be for 20 marks
- There will be 02 full questions (with maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting one full question from each module.

Text book

1. Kenneth H Rosen, "Discrete Mathematics and its Applications", McGraw Hill publications, 7th edition. (Chapters 2.1,2.2,2.5, 2.6,6.2,8.5,8.6,10.1 to 10.8)
2. Wolpole Myers Ye "Probability and Statistics for engineers and Scientist" Pearson Education, 8th edition.

References

1. 1.Richard A Johnson and C.B Gupta "Probability and statistics for engineers" Pearson Education.
2. 2.J.K Sharma "Discrete Mathematics", Mac Millian Publishers India, 3rd edition,2011.

Research Methodology and IPR Choice Based Credit System

Semester: I	CIE Marks:40
Course Code:20MCA15	SEE Marks:60
Contact Hours (L: T:P):2:2:0	Exam Hours:03

Course Outcomes: At the end of the course students will be able to

1. CO1: Identify the suitable research methods and articulate the research steps in a proper sequence for the given problem.
2. CO2: Carry out literature survey, define the problem statement and suggest suitable solution for the given problem and present in the format of the research paper (IEEE).
3. CO3: Analyse the problem and conduct experimental design with the samplings.
4. CO4:Perform the data collection from various sources segregate the primary and secondary data
5. CO5: Apply some concepts/section of Copy Right Act /Patent Act /Cyber Law/ Trademark to the given case and develop –conclusions

Module-1

Research Methodology: Introduction, Meaning of Research, Objectives of Research, Motivation in Research, Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Importance of Knowing How Research is Done, Research Process, Criteria of Good Research, and Problems Encountered by Researchers in India.

Module-2

Defining the Research Problem: Research Problem, Selecting the Problem, Necessity of Defining the Problem, Technique Involved in Defining a Problem, An Illustration.

Reviewing the literature: Place of the literature review in research, Bringing clarity and focus to your research problem, Improving research methodology, Broadening knowledge base in research area, Enabling contextual findings, How to review the literature, searching the existing literature, reviewing the selected literature, Developing a theoretical framework, Developing a conceptual framework, Writing about the literature reviewed.

Module-3

Research Design: Meaning of Research Design, Need for Research Design, Features of a Good Design, Important Concepts Relating to Research Design, Different Research Designs, Basic Principles of Experimental Designs, Important Experimental Designs. Design of Sample Surveys: Introduction, Sample Design, Sampling and Non-sampling Errors, Sample Survey versus Census Survey, Types of Sampling Designs

Module-4

Data Collection: Experimental and Surveys, Collection of Primary Data, Collection of

Secondary Data, Selection of Appropriate Method for Data Collection, Case Study Method.

Interpretation and Report Writing: Meaning of Interpretation, Technique of Interpretation, Precaution in Interpretation, Significance of Report Writing, Different Steps in Writing Report, Layout. Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Precautions for Writing Research Reports.

Module-5

Intellectual Property (IP) Acts:Introduction to IP: Introduction to Intellectual Property (IP), different types of IPs and its importance in the present scenario, Patent Acts: Indian patent acts 1970.Design Act: Industrial Design act 2000. Copy right acts: Copyright Act 1957. Trade Mark Act, 1999

Question Paper Pattern:

- The Question paper will have TEN questions
- Each full question will be for 20 marks
- There will be 02 full questions (with maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting one full question from each module.

Text books

1. Research Methodology: Methods and Techniques, C.R. Kothari, Gaurav Garg New Age International 4th Edition, 2018.
2. Research Methodology a step-by- step guide for beginners. (For the topic Reviewing the literature under module 2) Ranjit Kumar SAGE Publications Ltd 3rd Edition, 2011 Study Material.
3. Intelectual property, Debirag E. Bouchoux, Cengage learning, 2013.

References

1. 1.Research Methods: the concise knowledge base Trochim, Atomic Dog Publishing, 2005.
2. 2.Conducting Research Literature Reviews: From the Internet to Paper Fink A Sage Publications, 2009.

Data Structures with Algorithms Lab

Semester: II	CIE Marks: 40
Course Code:20MCA16	SEE Marks:60
Contact Hours (L:T:P): 0:0:4	Exam Hours:03

Course Outcomes: At the end of the course, Students will be able to

1. CO1: Implement sorting / searching techniques, and validate input/output for the given problem.
2. CO2: Implement data structures (namely Stacks, Queues, Circular Queues, Linked Lists, and Trees), its operations and algorithms.
3. CO3: Implement the algorithm to find whether the given graph is connected or not and conclude on the performance of the technique implemented.
4. CO4: Design and apply appropriate data structures for solving computing problems
5. CO5: Implement the techniques for evaluating the given expression.

1. Write a C program to Implement the following searching techniques a. Linear Search b. Binary Search.
2. Write a C program to implement the following sorting algorithms using user defined functions: a. Bubble sort (Ascending order) b. Selection sort (Descending order).
3. Write a C Program implement STACK with the following operations
   a. Push an Element on to Stack b. Pop an Element from Stack
4. Implement a Program in C for converting an Infix Expression to Postfix Expression.
5. Implement a Program in C for evaluating an Postfix Expression.
6. Write a C program to simulate the working of a singly linked list providing the following operations: a. Display & Insert b. Delete from the beginning/end
   c. Delete a given element
7. Obtain the Topological ordering of vertices in a given graph with the help of a c programming.
8. Check whether a given graph is connected or not using DFS method using C programming.
9. From a given vertex in a weighted connected graph, find shortest paths to other vertices Using Dijkstra's algorithm (C programming)
10. Find Minimum Cost Spanning Tree of a given undirected graph using Kruskal's algorithm (C programming)

Unix Programming Lab

Choice Based Credit System

Semester:I	CIE Marks:40
Course Code: 20MCA17	SEE Marks:60
Contact Hours (L: T:P): 0:0:4	Exam Hours:03

Course Outcomes: At the end of the course students will be able to

1. CO1:Demonstrate the working of basic commands of Unix environment including file processing
2. CO2: Apply Regular expression to perform pattern matching using utilities like grep,sed and awk.
3. CO3: Implement unix commands/ system calls to demonstrate process management
4. CO4: Demonstrate the usage of different shell commands, variable and AWK filtering to the given problem.
5. CO5:Develop shell scripts for developing the simple applications to the given problem.

Laboratory Experiments:

(a) Explore Unix Environment.
(b) Explore vi- editor with Vim tutor. Perform the following operations using vi editor, but not limited to:

1. Insert character, delete character, replace character.
2. Save File and continue working.
3. Save File and exit editor.
4. Quit the editor.
5. Quit without saving the file.
6. Rename a file.
7. Insert lines, delete line.
8. Setline numbers.
9. Search for a pattern.
10. 10. Move forward and backward.

1a. Write a shell script that takes a valid directory name as a argument recursively descend all the sub-directors, find the maximum length of any file in that hierarchy and writ the maximum value to the standard output.

1b. Write a shell script that accepts a path name and creates all the components in that path name as directories. For example, if the script is named as mpc, then the command mpc a/b/c/d should create sub-directories a, a/b, a/b/c, a/b/c/d.

2a. Write a shell script that accepts two filenames as arguments, checks if the permissions for these files are identical and if the permissions are identical, output common permissions otherwise output each filename followed by its permissions.

2b. Write a shell script which accepts valid log-in names as arguments and prints their

corresponding home directories, if no arguments are specified, print a suitable error message.
3a. Create a script file called file properties that reads a filename entered and outputs it properties. 3b. Write a shell script to implement terminal locking (Similar to the lock command). It should prompt for the user for a password. After accepting the password entered by the user, it must prompt again for the matching password as confirmation and if match occurs, it must lock the keyword until a matching password is entered again by the user. Note the Script must be written to disregard BREAK, control-D. No time limit need be implemented for the lock duration.
4a. Write a shell script that accept one or more file names as argument and convert all of them to uppercase, provided they exists in current directory. 4b. Write a shell script that displays all the links to a file specified as the first argument to the script. The second argument, which is optional, can be used to specify in which the search is to begin. If this second argument is not present, the search is to begin in the current working directory. In either case, the starting directory as well as its subdirectories at all levels must be searched. The script need not include error checking.
5a. Write a shell script that accepts filename as argument and display its creation time if file exist and if does not send output error message. 5b. Write a shell script to display the calendar for the current month with current date replaced by * or ** depending whether the date is one digit or two digit.
6a. Write s a shell script to find a file/s that matches a pattern given as command line argument in the home directory, display the contents of the file and copy the file into the directory ~/mydir. 6b. Write a shell script to list all the files in a directory whose filename is at least 10 characters. (use expr command to check the length).
7a. Write a shell script that gets executed and displays the message either “Good Morning” or “Good Afternoon” or “Good Evening” depending upon time at which the user logs in. 7b. Write a shell script that accepts a list of filenames as its argument, count and report occurrence of each word that is present in the first argument file on other argument files.
8a. Write a shell script that determine the period for which as specified user is working on a system and display appropriate message. 8b. Write a shell script that reports the logging on of as specified user within one minute after he/she login. The script automatically terminates if specified user does not login during

specified in period of time.

9a. Write a shell script that accepts the filename, starting and ending line number as an argument and display all the lines between the given line number.

9b. Write a shell script that folds long lines into 40 columns. Thus any line that exceeds 40 characters must be broken after 40th, a "/" is to be appended as the indication of folding and processing is to be continued with the residue. The input is to be supplied through a text file created by the user.

10a. Write an awkscript that accepts date argument in the form of dd-mm-yy and display it in the form month, day and year. The script should check the validity of the argument and in the case of error, display a suitable message.

10b. Write an awkscript to delete duplicated line from a text file. The order of the original lines must remain unchanged.

11a. Write an awk script to find out total number of books sold in each discipline as well as total book sold using associate array down table as given below.

Electrical	34
Mechanical	67
Electrical	80
Computer Science	43
Civil	98
Mechanical	65
Computer Science	64

11b. Write an awkscript to compute gross salary of an employee accordingly to rule given below.

If basic salary < 10000 then HRA=15% of basic & DA=45% of basic.

If basic salary is >=1000 then HRA=20% of basic & DA=50% of basic.

Computer Networks Lab Choice Based Credit System	
Semester:I	CIE Marks:40
Course Code:**20MCA18**	SEE Marks:60
Contact Hours(L:T:P):0:0:4	Exam Hours:03

Course Outcomes: At the end of the course, the students will be able to

1. CO1: Apply the basic concepts of networking and to analyse different parameters such as bandwidth, delay, throughput of the networks for the given problem.
2. CO2:Apply different techniques to ensure the reliable and secured communication in wired and wireless communication
3. CO3:Analyse the networking concepts of TCP/IP for wired and wireless components
4. CO4:Identify the issues of Transport layer to analyse the congestion control mechanism
5. CO5:Design network topology with different protocols and analyse the performance using any simulator

PART-A

Implement the following Computer Networks concepts using C/C++

1. Write a program for distance vector algorithm to find suitable path for transmission.
2. Using TCP/IP sockets, write a client-server program to make the client send the file name and to make the server send back the contents of the requested file if present.
3. Write a program for Hamming code generation for error detection and correction.
4. Write a program for congestion control using leaky bucket algorithm.

PART-B

(Simulate the following Computer Networks concepts using any network simulators)

1. Simulate a three nodes point — to — point network with duplex links between them. Set the queue size and vary the bandwidth and find the number of packets dropped.
2. Simulate the network with five nodes n0, n1, n2, n3, n4, forming a star topology. The node n4 is at the centre. Node n0 is a TCP source, which transmits packets to node n3 (a TCP sink) through the node n4. Node n1 is another traffic source, and sends UDP packets to node n2 through n4. The duration of the simulation time is 10 seconds.
3. Simulate to study transmission of packets over Ethernet LAN and determine the number of packets drop destination.
4. **Simulate working of multicasting routing protocol and analyse the throughput of the network/protocol.**
5. Simulate the different types of internet traffic such as FTP and TELNET over a wired network and analyze the packet drop and packet delivery ratio in the network.

Note 1: In the practical exam student has to execute one program from part-A and one from part-B(equal weightage of marks). For simulation of Part B problems any network simulator (either Graphical user interface or script based)can be used.

Bridge Course: Basics of Programming and Computer Organisation

Choice Based Credit System

Semester: I	CIE Marks:40
Course Code: 20MCA19-BC	SEE Marks:60
Contact Hours(L:T:P): 2: 2:0	Exam Hours:03

Course Outcomes: At the end of the course students will be able to

1. CO1: Demonstrate the key concepts introduced in C programming by writing and executing the programs.
2. CO2: Demonstrate the concepts of structures and pointers for the given application/problem.
3. CO3: Implement the single/multi-dimensional array for the given problem.
4. CO4: Demonstrate the application of logic gates in solving some societal/industrial problems.
5. CO5: Analyse how memory organization, operations, instruction sequencing and interrupts are useful in executing the given program.

Module-1

C Programming: decision making, control structures and arrays

C Structure, Data Types, Input-Output Statements, Decision making with if statement, simple if statement, the if..else statement, nesting of if..else statements, the else.if ladder, the switch statement, the ?: operator, the goto statement, the break statement, programming examples. The while statement, the do...while statement, the for statement, nested loops, jumps in loops, the continue statement, programming examples. One dimensional and two dimensional arrays, declaration and initialization of arrays, reading, writing and manipulation of above types of arrays.

Module-2

Structures

Defining a structure, declaring structure variables, accessing structure members, structure initialization, copying and comparing structure variables, operations on individual members, array of structures, structures within structures, structures and functions, Unions, size of structures.

Module-3

Pointers

Pointers in C, Declaring and accessing pointers in C, Pointer arithmetic, Functions , Call by value, Call by reference, Pointer as function arguments, recursion, Passing arrays to functions, passing strings to functions, Functions returning pointers, Pointers to functions, Programming Examples

Module-4

Binary Systems and Combinational Logic

Digital Computers and Digital Systems, Binary Numbers, Number Base Conversion, Octal and Hexadecimal Numbers, subtraction using r's and r-1 complements, Binary Code, Binary Storage and Registers, Binary Logic, Integrated Circuits, Digital Logic Gates

Module-5

Basic Structure of Computer Hardware and Software

Computer Types, Functional Units, Basic Operational Concepts, Bus structure, Software, Performance, Multiprocessing and Multi computers, Machine Instruction: Memory Locations and Addresses, Memory Operations, Instructions and Instruction Sequencing, Addressing Modes, Interrupts.

Question Paper Pattern:

- The Question paper will have TEN questions
- Each full question will be for 20 marks
- There will be 02 full questions (with maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting one full question from each module.

Textbooks

1. Programming in ANSI C,Balaguruswamy, 7th Edition, McGraw Hill Education

2.C : The Complete Reference, Herbert Schild,4th Edition, McGraw Hill Education

3. Let us C, YashwantKanetkar, BPB Publications

4.M.Morris Mano, "Digital Logic and Computer Design", Pearson, 2012.

5.Carl Hamacher, ZvonkoVranesicSafwatZaky, "Computer Organization", 5th edition, Tata McGraw-Hill, 2011

Database Management System

Choice Based Credit System

Semester: II	CIE Marks:40
Course Code: 20MCA21	SEE Marks: 60
Contact Hours(L:T:P): 3:0:0	Exam Hours:03

Course Outcomes: At the end of the course students will be able to

1. CO1: Apply the basic concepts of database management in designing the database for the given problem.
2. CO2: Design entity-relationship diagrams to the given problem to develop database application with appropriate fields and validations.
3. CO3: Implement a database schema for the given problem domain.

4. CO4: Formulate and execute SQL queries to the given problem.
5. CO5: Apply normalization techniques to improve the database design to the given problem.

Module-1

Characteristics of Database approach, Actors on the Scene, Workers behind the scene, Advantages of using DBMS approach, A Brief History of Database Applications, Data models, schemas and instances, Three-schema architecture and data independence, Database languages and interfaces, the database system environment, Centralized and client-server architectures, Classification of Database Management systems.

Module-2

Structure of Relational Databases, Database Schema, Keys, Relational Query Languages, Relational Operations.

Entity-Relationship Model: Conceptual Database using high level conceptual data models for Database Design, A Sample Database Application, Entity types, Entity sets Attributes and Keys Relationship types, Relationship Sets

Functional Dependencies, Normal Forms based on Primary

Module-3

SQL data definition and data types, specifying constraints in SQL, basic retrieval queries in SQL, Insert, update and delete statements in SQL, aggregate functions in SQL, group by and having clauses.

Module-4

Introduction to triggers in SQL, views in SQL, schema change statements in SQL, stored procedures and functions.

Module-5

Introduction to transaction processing, transaction and system concepts, desirable properties of transactions, transaction support in SQL.

Concurrency control techniques: two-phase locking techniques, concurrency control based on timestamp ordering, multiversion concurrency control techniques, validation concurrency control techniques.

Recovery techniques: recovery concepts, recovery in multidatabase systems, database backup and recovery from catastrophic failures.

Question Paper Pattern:

- The Question paper will have TEN questions
- Each full question will be for 20 marks
- There will be 02 full questions (with maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting one full question from

each module.

Text Books

1. Elmasri and Navathe: Fundamentals of Database Systems, 5th Edition, Addison -Wesley, 2011.
2. Silberschatz, Korth and Sudharshan Data base System Concepts, 6th Edition, Tata McGraw Hill, 2011.

References

1. C.J. Date, A. Kannan, S. Swamynatham: An Introduction to Database Systems, 8th Edition, Pearson education, 2009.
2. Raghu Ramakrishnan and Johannes Gehrke: Database Management Systems, 3rd Edition, McGraw-Hill, 2003.

Object Oriented Programming with Java

Choice Based Credit System(CBCS)

Semester: I	**CIE Marks:40**
Course Code:20MCA22	**SEE Marks:60**
Contact Periods (L:T:P):3-0-0	**Exam Hours:03**

Course Outcomes:

1. CO1: Demonstrate the basic programming constructs of Java and OOP concepts to develop Java programs for a given scenario.
2. CO2: Illustrate the concepts of generalization and run time polymorphism applications to develop reusable components.
3. CO3: Demonstrate the usage of Packages, Interfaces, Exceptions and Multithreading in building given applications.
4. CO4: Apply Enumerations, Wrappers, Auto boxing, Collection framework and I/O operations for effective coding to the given problem.
5. CO5: Implement the concepts of Applets, and networking using Java network classes for developing the distributed applications to the given problem.

Module-1

Java Programming Fundamentals

The Java Language, The Key Attributes of Object-Oriented Programming, The Java Development Kit, A First Simple Program, The Java Keywords, Identifies in Java, The Java Class Libraries.

Introducing Data Types and Operators

Java's Primitive Types, Literals, A Closer Look at Variables, The Scope and Lifetime of Variables, operators, Shorthand Assignments, Type conversion in Assignments, Using Cast.

Program Control Statements

Input characters from the Keyword, if statement, Nested ifs, if-else-if Ladder, Switch Statement, Nested switch statements, for Loop, Enhanced for Loop, While Loop, do-while Loop, Use break,

Use continue, Nested Loops.

Introducing Classes, Objects and Methods

Class Fundamentals, How Objects are Created, Reference Variables and Assignment, Methods, Returning from a Method, Returning Value, Using Parameters, Constructors, Parameterized Constructors, The new operator Revisited, Garbage Collection and Finalizers, The this Keyword.

More Data Types and Operators

Arrays, Multidimensional Arrays, Alternative Array Declaration Syntax, Assigning Array References, Using the Length Member, The For-Each Style for Loop, Strings,

String Handling

String Fundamentals, The String Constructors, Three String-Related Language Features, The Length() Method, Obtaining the characters within a string, String comparison, using indexOf() and lastIndexOf(), Changing the case of characters within a string, StringBuffer and String Builder.

Module-2

A Closer Look at Methods and Classes:

Controlling Access to Class Members, Pass Objects to Methods, How Arguments are passed, Returning Objects, Method Overloading, Overloading Constructors, Recursion, Understanding Static, Introducing Nested and Inner Classes, Varargs: Variable-Length Arguments.

Inheritance:

Inheritance Basics, Member Access and Inheritance, Constructors and Inheritance, Using super to Call Superclass constructors, Using super to Access Superclass Members, Creating a Multilevel Hierarchy, When are Constructors Executed, Superclass References and Subclass Objects, Method Overriding, Overridden Methods support polymorphism, Why Overridden Methods, Using Abstract Classes, Using final, The Object Class.

Module-3

Interfaces

InterfaceFundamentals,CreatinganInterface,Implementingan Interface,Using InterfaceReferences,ImplementingMultipleInterfaces,Constantsin Interfaces, Interfacescanbeextended,NestedInterfaces,FinalThoughtsonInterfaces.

Packages

Package Fundamentals, Packages andMember Access, Importing Packages, Static Import

ExceptionHandling

TheExceptionHierarchy,ExceptionHandlingFundamentals,The Consequencesof an Uncaught Exception, Exceptions Enable you to handle errors gracefully, using Multiple catch clauses, Catching subclass Exceptions, try blocks can be nested, ThrowinganException,A

CloserlookatThrowable,usingfinally,usingthrows,Java's Built-inExceptions,NewExceptionfeaturesaddedbyJDK7, CreatingException Subclasses.

Module-4

MultithreadedProgramming

Multithreadingfundamentals,The ThreadClassandRunnableInterface,Creating Thread, Creating Multiple Threads, Determining When a Thread Ends, Thread Priorities,Synchronization,using SynchronizationMethods,TheSynchronized Statement,ThreadCommunicationusingnotify(),wait()and notifyAll(),suspending, ResumingandstoppingThreads.

Enumerations,AutoboxingandAnnotations

Enumerations, Java Enumeration are class types, The Values() and Valueof() Methods,Constructors,methods,instancevariablesand enumerations,Autoboxing, Annotations(metadata)

Module-5

NetworkingwithJava.net

Networkingfundamentals, TheNetworkingclassesandInterfaces,TheInetAddressclass,The SocketClass,TheURLclass,TheURLConnectionClass,The HttpURLConnectionClass.

The collections Framework: Collections Overview, Recent Changes to Collections, The Collection Interfaces, The Collection Classes, Accessing a collection Via an Iterator, Storing User Defined Classes in Collections, The Random Access Interface, Working With Maps, Comparators, The Collection Algorithms, Why Generic Collections?, The legacy Classes and Interfaces, Parting Thoughts on Collections.

Question Paper Pattern:

- The Question paper will have TEN questions
- Each full question will be for 20 marks
- There will be 02 full questions (with maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting one full question from each module.

Textbooks

1.JavaFundamentals,AcomprehensiveIntroductionbyHerbertSchildt,DaleSkrien.TataMcGrawHill Edition2013.(Chapters:1,2,3,4,5,6,7,8,9,10,11,12,13,15,22,23,24,25,26)

2. Herbert Schildt: JAVA the Complete Reference, 7th/9th Edition, Tata McGraw Hill, 2007. (Chapter 17)

References

1.JavaProgrammingbyHariMohanPandey,PearsonEducation,2012.

2.Java6 Programming,BlackBook,KoGenT, DreamtechPress,2012.

3.Java2Essentials,CayHortsmann,secondedition,Wiley

Web Technologies

Choice Based Credit System

Semester: II	CIE Marks:40
Course Code:20MCA23	SEE Marks:60
Contact Hours(L:T:P): 4:0:0	Exam Hours:03

Course outcomes

1. CO1: Apply the features JQuery for the given web based problem.
2. CO2: Demonstrate the development of XHTML documents using JavaScript and CSS.
3. CO3: Illustrate the use of CGI and Perl programs for different types of server side applications.
4. CO4: Design and implement user interactive dynamic web based applications.
5. CO5:Demonsrtae applications of Angular JS and JQuery for the given problem

Module-1

Web browsers, web servers, MIME, URL, HTTP Introduction to XHTML5 tags, Basic syntax and structure, text markups, images, lists, tables,progress, Media tags-audio and video ,forms, frames.

Module-2

Introduction to CSS, Levels of CSS, Selectors, Font, color and Text Properties, BOX Model, Span and Div tags. Introduction to Javascript, controls statements, Arrays and functions, pattern matching, Element Access, Event Handling.

Module-3

Introduction to Bootstrap, First example, containers, Bootstrap elements: colors, tables, images, buttons, button groups, progress bars, Forms, utilities, Classes, alerts, custom forms, Grid System.

Module-4

Introduction to JQuery, Syntax, selectors, events, JQuery HTML, JQuery Effects, JQuery CSS.

Module-5

Introduction to Angular JS, Directives, Expressions, Directives, Controllers, Filters, Services, Events, Forms, Validations, Examples.

Question Paper Pattern:

- The Question paper will have TEN questions
- Each full question will be for 20 marks

- There will be 02 full questions (with maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting one full question from each module.

Textbooks

1. **Web Programming By Chris Bates , Wiley Publications**
2. **HTML5 Black Book by Dreamtech**
3. **Angular JS By Krishna Rungta**
4. **Bootstrap essentials by Snig by Packt-open source**

Software Engineering

Choice Based Credit System

Semester:II	CIE Marks:40
Course Code:20MCA24	SEE Marks:60
Contact Hours(L:T:P): 3:2:0	Exam Hours:03

Course Outcomes: Students will be able to

CO1: Identify and define different requirements for the given problem and present in the IEEE format.

CO2: Use modern tool to create dynamic diagrams to represent the design for the given problem.

CO3: Draw class diagram , analyse the different types of association that exists as per the given problem and represent them using UML notations.

CO4: Analyse the given system to identify actors, use cases to design use case diagrams for the given problem using RSA/open source tool.

CO5: Design the static/dynamic models to meet application requirements of the given system and generate code (skeleton) using the modern tool.

Module-1

Introduction: Professional Software Development Attributes of good software, software engineering diversity, IEEE/ACM code of software engineering ethics, case studies.

Software Process and Agile Software Development

Software Process models: waterfall, incremental development, reuses oriented, Process activities; coping with change, The Rational Unified Process. Agile Methods, Plan-Driven and Agile Development, Extreme Programming, Agile Project Management, scaling agile

methods.

Module-2

Requirement Engineering: Functional and non-functional requirements, The Software requirements document, Requirements specification, Requirements engineering processes, Requirement elicitation and analysis, Requirement validation, Requirement management.

Module-3

What is object orientation? What is OO development? OO themes; Evidence for usefulness of OO development; OO modelling history, modeling as design Technique: Modelling; abstraction; the three models. Object and class concepts; Link and associations concepts; Generalization and inheritance; A sample class model; Navigation of class models; Practical tips. Advanced objects and class concepts; Associations ends; N-array association; Aggregation, Abstract class; Multiple inheritance; Metadata; Reification; Constraints; Derived data; packages; practical tips.

Module-4

State modelling: Events, States, Transitions and Conditions; State Diagram; State diagram behaviour; Practical tips. Advanced State Modeling: Nested state diagram; Nested states; Signal generalization; Concurrency; A sample state model, Relation of class and state models; practical. Interaction modelling: Use Case models, Sequence models, Activity models, Use case relationships; Procedural sequence models, special constructs for activity models.

Module-5

Project Design and planning:

Process planning, Effort estimation, project scheduling and staffing, Software configuration Management plan, Quality plan, Risk Management, Project Monitoring plan Design: Design concepts, Function oriented design, detailed design, verification, Metrics.

Question Paper Pattern:

- The Question paper will have TEN questions
- Each full question will be for 20 marks
- There will be 02 full questions (with maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting one full question from each module.

Textbooks

1. Ian Sommerville: Software Engineering, 9th Edition, Pearson Education Ltd, 2011

2. Pankaj Jalote, Software Engineering, Wiley India Pvt Ltd (2010) Paul C Jorgensen Software Testing A CraftMan's Approach, 2nd edition, CRC Press.

3. MichelBlaha, James Rumbaugh: Object-Oriented Modelling and Design with UML, 2nd edition, Pearson, 2007.

References
1. Stephan R. Schach, "Object oriented software engineering", Tata McGrawHill,2008 2. Craig Larman, Applying UML and Patterns, 3rd ed, Pearson Education,2005.

Cyber Security

Choice Based Credit System

Semester:II	CIE Marks:40
Course Code:20MCA251	SEE Marks:60
Contact Hours(L:T:P):3:0:0	Exam Hours:03

Course Outcomes: At the end of the course students will be able to

CO1: Apply IT ACT (Cyber law) to the given case/problem and infer from the given case and analyze the gap if exists.

CO2: Analyze the working of cyber security principles in designing the system.

CO3: Analyze the given problem (cybercrime, vulnerability, threat), develop a strategy (physical, logical or administrative controls) to mitigate the problem and articulate consequences on Society and National Economy.

CO4: Examine relevant network defence / web application tool to solve given cyber security problem and evaluate its suitability.

CO5: Evaluate provisions available in Indian cyber law to handle infringement of intellectual property rights that happens on the cyber platform.

Module-1

Introduction to Cybercrime and Laws

Introduction, Cybercrime: Definition and Origins of the word, Cybercrime and information Security, Who are Cybercriminals? Classifications of Cybercrimes. How Criminals Plan Them – Introduction, How Criminals Plan the Attacks, Cybercafé and Cybercrimes, Botnets, Attack Vector, The Indian IT ACT 2000 and amendments.

Module-2

Tools and Methods used in Cybercrime

Introduction, Proxy Server and Anonymizers, Password Cracking, Key loggers and

Spyware, Virus and Warms, Trojan and backdoors, Steganography, DOS and DDOS attack, SQLinjection, Buffer Overflow.

Module-3

Phishing and Identity Theft

Introduction, Phishing – Methods of Phishing, Phishing Techniques, Phishing Toolkits andSpy Phishing. Identity Theft – PII, Types of Identity Theft, Techniques of ID Theft. Digital Forensics Science, Need for Computer Cyber forensics and Digital Evidence, Digital Forensics Life Cycle.

Module-4

Cybercrime: Mobile and Wireless devices, Introduction, proliferation of mobile and wireless devices, Trends in Mobility, credit card frauds in Mobile and wireless computing, Attacks on Mobile/cell phones.

Module-5

Network Defense tools and block chain technology

Firewalls and Packet Filters: Firewall Basics, Packet Filter Vs Firewall, How a Firewall Protects a Network, Packet Characteristic to Filter, Stateless Vs Stateful Firewalls, Network Address Translation (NAT) and Port Forwarding, the basic of Virtual Private Networks, Linux Firewall, Windows Firewall, Snort: Intrusion Detection System, introduction to block chain technology (definition, tools used for implementation) and its applications.

Question Paper Pattern:

- The Question paper will have TEN questions
- Each full question will be for 20 marks
- There will be 02 full questions (with maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting one full question from each module.

Textbooks

Text Books:

1. Anti-Hacker Tool Kit (Indian Edition) by Mike Shema, Publication McGraw Hill. (Chapters: 2, 7, 8, 11)
2. Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives by Nina
Godbole and SunitBelpure, Publication Wiley. (Chapters: 1.1, 1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 2.5, 2.6, 2.7, 6.4,
5.2.1, 5.2.2, 5.2.5, 5.3.1, 5.3.2, 5.3.3, 4.2,
4.4, 4.5, 4.6, 4.7, 4.8, 4.9, 4.10, 4.11)

References

1. Marjie T. Britz - Computer Forensics and Cyber Crime: An Introduction - Pearson
2. Chwan-Hwa (John) Wu,J. David Irwin - Introduction to Computer Networks and Cyber securityCRCPress
3. Bill Nelson, Amelia Phillips, Christopher Steuart - Guide to Computer Forensics and InvestigationsCengage Learning

DataMining with Business Intelligence **Choice Based Credit System**	
Semester:II	CIE Marks:40
Course Code:20MCA252	SEE Marks:60
Contact Hours(L:T:P):3:0:0	Exam Hours:03

Course Outcomes: At the end of the course, students will be able to

CO1: Analyse the concept of data warehouse, Business Intelligence and OLAP

CO2: Demonstrate data pre-processing techniques and application of association rule mining algorithms

CO3: Apply various classification algorithms and evaluation of classifiers for the given problem

CO4: Analyse data mining for various business intelligence applications for the given problem

CO5: Apply classification and regression techniques for the given problem.

Module-1

Overview and concepts Data Warehousing and Business Intelligence:

Why reporting and Analysing data, Raw data to valuable information-Lifecycle of Data - What is Business Intelligence - BI and DW in today's perspective - What is data warehousing - The building Blocks: Defining Features - Data warehouses and data 1marts - Overview of the components - Metadata in the data warehouse - Need for data warehousing - Basic elements of data warehousing - trends in data warehousing.

The Architecture of BI and DW

BI and DW architectures and its types - Relation between BI and DW - OLAP (Online analytical processing) definitions - Difference between OLAP and OLTP - Dimensional analysis - What are cubes? Drill-down and roll-up - slice and dice or rotation - OLAP models - ROLAP versus MOLAP - defining schemas: Stars, snowflakes and fact constellations.

Module-2

Introduction to data mining (DM):

Motivation for Data Mining - Data Mining-Definition and Functionalities – Classification of DM Systems - DM task primitives - Integration of a Data Mining system with a Database or a Data Warehouse - Issues in DM – KDD Process

Data Pre-processing:Why to pre-process data? - Data cleaning: Missing Values, Noisy Data - Data Integration and transformation - Data Reduction: Data cube aggregation, Dimensionality reduction - Data Compression - Numerosity Reduction - Data Mining Primitives - Languages and System Architectures: Task relevant data - Kind of Knowledge to be mined - Discretization and Concept Hierarchy.

Module-3

Concept Description and Association Rule Mining

What is concept description? - Data Generalization and summarization-based characterization - Attribute relevance - class comparisons Association Rule Mining: Market basket analysis - basic concepts - Finding frequent item sets: Apriori algorithm - generating rules – Improved Apriori algorithm – Incremental ARM – Associative Classification – Rule Mining.

Module-4

Classification and prediction:

What is classification and prediction? – Issues regarding Classification and prediction: Classification methods: Decision tree, Bayesian Classification, Rule based, CART, Neural Network Prediction methods: Linear and nonlinear regression, Logistic Regression. Introduction of tools such as DB Miner /WEKA/DTREG DM Tools.

Module-5

Data Mining for Business Intelligence Applications:

Data mining for business Applications like Balanced Scorecard, Fraud Detection, Clickstream Mining, Market Segmentation, retail industry, telecommunications industry, banking & finance and CRM etc., Data Analytics Life Cycle: Introduction to Big data Business Analytics - State of the practice in analytics role of data scientists Key roles for successful analytic project - Main phases of life cycle - Developing core deliverables for stakeholders.

Question Paper Pattern:

- The Question paper will have TEN questions
- Each full question will be for 20 marks
- There will be 02 full questions (with maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting one full question from each module.

Textbook

1. J. Han, M. Kamber, "Data Mining Concepts and Techniques", Morgan Kaufmann

2. M. Kantardzic, "Data mining: Concepts, models, methods and algorithms, John Wiley &Sons Inc.

3. PaulrajPonnian, "Data Warehousing Fundamentals", John Willey.

4. M. Dunham, "Data Mining: Introductory and Advanced Topics", Pearson Education.

5. G. Shmueli, N.R. Patel, P.C. Bruce, "Data Mining for Business Intelligence: Concepts, Techniques, and Applications in Microsoft Office Excel with XLMiner", Wiley India

Enterprise Resource Planning

Choice Based Credit System

Semester: II	CIE Marks:40
Course Code:20MCA253	SEE Marks:60
Contact Hours (L: T:P): 3:0:0	Exam Hours:03

Course Outcomes: At the end of the course students will be able to

CO1: Analyse the essentials of supply chain management in ERP.

CO2: Analyse the implementation of ERP in the context of business of the different organization.

CO3: Analyse and apply ERP for different business modules for the given problem.

CO4: Analyse the given case study of ERP marketing.

CO5: Analyse the design of ERP with future E-commerce and internet.

Module-1

Introduction to Supply Chain Management: Supply chain – objectives – importance – decision phases – process view – competitive and supply chain strategies – achieving strategic fit – supply chain drivers – obstacles – framework – facilities – inventory – transportation – information – sourcing – pricing.

Module-2

ERP Implementation: Implementation of Life Cycle, Implementation Methodology, Hidden Costs, Organizing Implementation, Vendors, Consultants and Users, Contracts, Project Management and Monitoring

Module-3

Business Modules: Business Modules in an ERP Package, Finance, Manufacturing, Human Resource, Plant Maintenance, Materials Management, Quality Management, Sales and Distribution

Module-4

ERP Market: ERP Market Place, SAP AG, People Soft, Baan Company, JD Edwards World Solutions Company, Oracle Corporation, QAD, System Software Associates.

Module-5

ERP–Present And Future: Turbo Charge the ERP System, EIA, ERP and E–Commerce, ERP and Internet, Future Directions in ERP.

Question Paper Pattern:

- The Question paper will have TEN questions
- Each full question will be for 20 marks
- There will be 02 full questions (with maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting one full question from each module.

Textbooks

1. Sunil Chopra and Peter Meindl, Supply Chain Management – Strategy, Planning and Operation, Pearson/PHI, 3rd Edition, 2007

2. Alexis Leon, "ERP Demystified", Tata McGraw Hill, 1999.

3. Joseph A. Brady, Ellen F. Monk, Bret J. Wangner, "Concepts in Enterprise Resource Planning", Thomson Learning, 2001.

Reference

1.Vinod Kumar Garg and N.K .Venkata Krishnan, "Enterprise Resource Planning concepts and Planning", Prentice Hall, 1998.

2. Jose Antonio Fernandz, " The SAP R /3 Hand book", Tata McGraw Hill

User Interface Design

Choice Based Credit System

Semester: II	CIE Marks:40
Course code:20MCA254	SEE Marks:60
Contact Hours (L:T:P): 3:0:0	Exam Hours:3

Course Outcomes: At the end of the course, students will be able to

CO1:Analyse the new technologies that provide interactive devices and interfaces.

CO2: Apply the guidelines to develop the UID and evaluate for the given problem.

CO3: Apply the development methodologies with an analysis of the social impact and legal issuesUnderstand Direct Manipulation and Virtual Environment

CO4: Discuss the command, natural languages and issues in design for maintaining QoS

CO5: Demonstrate techniques for information search and visualization for the given problem.

Module-1

Introduction

Usability of Interactive Systems: Introduction, Usability Goals and Measures, Usability Motivation, Universal Usability, Goals for our profession. Guideline, principles, and theories: Introduction, Guidelines, principles, Theories.

Module-2

Development Processes

Managing Design Processes: Introduction, Organizational Design to support Usability, The Four Pillars of Design, Development methodologies: Ethnographic Observation, Participatory Design, Scenario Development, Social Impact statement for Early Design Review, Legal Issues.

Evaluating Interface Design

Introduction, Expert Reviews, Usability Testing and Laboratories, Survey Instruments, Acceptance tests, Evaluation during Active Use, Controlled Psychologically Oriented Experiments

Module-3

Direct Manipulation and Virtual Environments:

Introduction, Examples of Direct Manipulation, Discussion of direct manipulation, 3D Interfaces, Tele-operation, Virtual and Augmented Reality Menu Selection, Form Filling and Dialog Boxes: Introduction, Task-Related Menu Organization, Single Menus, Combination of Multiple Menus, Content Organization, Fast Movement Through Menus, Data Entry With Menus, Form Filling, Dialog Boxes and Alternatives, Audio Menus and Menus for Small Displays

Module-4

Command and Natural Languages

Introduction, Command-organization functionality strategies and structure, Naming and Abbreviations, Natural Language in computing. Interaction Devices: Introduction, Keyboards and Keypads, Pointing Devices, Speech and Auditory interfaces, Displays-Small and Large

Design Issues

Quality of Service: Introduction, Models of Response-Time Impacts, Expectations and Attitudes, User Productivity, Variability in Response time, Frustrating Experiences Balancing Function and Fashion: Introduction, Error Messages, Nonanthropomorphic Design, Display design, web page design, Window Design, Color

Module-5

User Documentation and Online Help :

Introduction, Online versus paper documentation, Reading from paper versus Displays, Shaping the content of the Manuals, Accessing the Documentation, Online Tutorials and animated demonstrations, Online Communities for User Assistance, The Development Process.

Information Search and Visualization

Introduction, Search in Textual Documents and Database Querying, Multimedia document searches, Advanced filtering and Search Interfaces, Information Visualization: Introduction, Data tyoe by task taxonomy, Challenges for information visualization.

Question Paper Pattern:

- The Question paper will have TEN questions
- Each full question will be for 20 marks
- There will be 02 full questions (with maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting one full question from each module.

Textbooks

1.BenShneiderman, Plaisant, Cohen, Jacobs: Designing the User Interface, 5th Edition, Pearson ,Education, 2010.

References

1 Alan Dix, Janet Finalay, Gregory D AbiwdmRusselBealel: Human-Computer Interaction, III Edition, Pearson , Education, 2008.
2 Eberts: User Interface Design, Prentice Hall, 1994
3 Wilber O Galitz: The Essential Guide to User Interface Design- An Introduction to GUI Design, Principles and Techniques, Wiley-Dreamtech India Pvt Ltd, 2011

Optimization Techniques

Choice Based Credit System

Semester: II	CIE Marks:40
Course Code: 20MCA255	SEE Marks:60
Contact Hours (L:T:P):3:0:0	Exam Hours:03
Course Outcomes: At the end of the course, students will be able to	

CO1: Apply problem solving techniques through OR approaches.

CO2: Formulate the problem using linear programming technique.

CO3: Analyze the optimal solution for the given problem by applying Transportation problems.

CO4: Analyze the strategies with different players through game theory approach.

CO5: Analyze the sequence of jobs to be executed by machines for the given problem.

Module-1

Linear programming problem(LPP): introduction, structure of linear programming model, advantages, general model of Linear programming problem(LPP), examples of LP formulation, graphical solutions of LP problem and Solution of LPP by simplex method:

Module-2

Linear programming problem(LPP):Artificial variables-two-phase method, Big M method. Duality in linear programming, formulation of dual linear programming and examples.

Module-3

Transportation and Assignment Problems: Mathematical model of transportation problem, methods of finding initial solution (Northwest corner rule, Least cost method, Vogel's approximation method), test for optimality in TP using MODI Method. Mathematical model of assignment problem, Hungarian method for solving assignment problem.

Module-4

Theory of games: introduction, two-person zero sum games, pure strategies (MinMax and MaxMin principles), mixed strategies. The rules of principles of dominance, algebraic method to solve games without saddle point, graphical methods to solve games.

Module-5

Network Analysis: PERT and CPM, Network construction anddetermination of critical path, Calculation of ES, EF, LS, LF, TF, FFand IF, Crashing of a project, Scheduling of a project and resourcelevelling.

Question Paper Pattern:

- The Question paper will have TEN questions
- Each full question will be for 20 marks
- There will be 02 full questions (with maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting one full question from each module.

Text books

1. Operations Theory and Applications, J.K. Sharma, 5th edition, MacMillan publisher India(Chapter 1,2,3,4,5,910,11,12,20).

2. Operations Research S.D Sharma, Kedarnath, Ramnath and Co, 2002.

References

1. Operations Research – An Introduction Taha H A- Low price edition 7th edition,2006.
2. Introduction to operation Research, Hiller and Liberman, Mc GRawHill , 5th edition ,2001.
3. Operation Research, Prem Kumar Gupta, D S Heera, S Chand Pub., New Delhi, 2007.

Cryptography and Network Security

Choice Based Credit System

Semester: II	CIE Marks:40
Course Code:20MCA261	SEE Marks:60
Contact Hours(L:T:P): 3:0:0	Exam Hours:03

Course Outcomes: At the of the course students will be able to

CO1: Apply encryption techniques for the given problem and analyse the results.

CO2: Design the Cipher technique and analyse the functioning of Cipher for the given problem.

CO3: Implement the Public and Private key based cryptography algorithms and investigate the results of algorithm based on output.

CO4: Design and implement the cryptographic algorithms using programming languages/ tools for the given problem/context.

CO5: Design the security planning for the given case study for data classification, access control and propose technical solution, and submit the detailed report with plagiarism check.

Module-1

Introduction:OSI Security Architecture, Security Attacks, Security Services, Security Mechanism, model for Network Security.

Classical Encryption Technique: Symmetric Cipher Model, Substitution Techniques, Transposition Techniques.

Module-2

Data Encryption and advanced encryption techniques:

Block Ciphers, Data Encryption Standard and Advanced Encryption Standard

Block Cipher Principles, The Data Encryption Standard, Block Cipher Design Principles and Modes of operation, Evaluation Criteria for AES, AES Cipher-Encryption and Decryption, Data Structure, Encryption Round.

Public Key Cryptography and Key Management: Principles of Public Key Cryptosystem, RSA algorithm, Key management, Diffie Hellman Key exchange.

Module-3

Message Authentication and Hash Function: Authentication Requirement, Authentication Functions, Message Authentication Code, Hash Functions, Digital Signatures, Digital Signature Standard.

Authentication Applications: Kerberos, X.509 Authentication Service

Module-4

Electronic Mail Security: Pretty Good Privacy (PGP), S/MIME

IP Security:IP Security Overview;IP Security Architecture; Authentication Header; Encapsulating SecurityPayload; Combining Security Associations; Key Management.

Module-5

Web Security: Web security Considerations; Secure Socket layer (SSL) and Transport layer Security (TLS); Secure Electronic Transaction (SET).

System Security: Intruders, Intrusion Detection, Firewall Design Principles- Characteristics, Types of Firewall and Firewall Configuration.

Question Paper Pattern:

- The Question paper will have TEN questions
- Each full question will be for 20 marks
- There will be 02 full questions (with maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting one full question from each module.

Text books

1. William Stallings, "Cryptography and Network Security – Principles and Practices", 4th Edition, Pearson Education, 2009. (Chapters: 1, 2.1-2.3, 3.1,3.2,3.5, 5.1,5.2, 6.2, 9.1,9.2, 10.1,10.2, 11.1- 11.4, 13.1, 13.3, 14.1, 4.2, 15.1, 15.2, 16.1-16.6, 17.1-17.3, 18.1, 18.2, 20.1; Exclude the topic not mentioned in the syllabus)

References

1. Behrouz A. Forouzan and DebdeepMukhopadhyay: "Cryptography and Network Security", 2nd Edition, Tata McGraw-Hill, 2010.
2. AtulKahate, "Cryptography and Network Security" 2nd Edition TMH.

Artificial Intelligence

Choice Based Credit System

Semester: II	CIE Marks:40
Course Code:20MCA262	SEE Marks:60
Contact Hours (L: T:P): 3:0:0	Exam Hours:03

Course Outcomes: at the end of the course students will be able to:

CO1: Identify problems that are amenable to solution by AI methods.

CO2: Identify appropriate AI methods to solve a given problem.

CO3: Formalize a given problem in the language/framework of different AI methods.

CO4: Implement basic AI algorithms for the given problem.

CO5: Design and carry out an empirical evaluation of different algorithms on a problem formalisation, and state the conclusions that the evaluation supports.

Module-1

INTRODUCTION TO Al AND PRODUCTION SYSTEMS

Introduction to AI-Problem formulation, Problem Definition -Production systems, Control strategies, Search strategies. Problem characteristics, Production system characteristics - Specialized productions system- Problem solving methods – Problem graphs, Matching, Indexing and Heuristic functions -Hill Climbing-Depth first and Breath first, Constraints satisfaction – Related algorithms, Measure of performance and analysis of search algorithms.

Module-2

REPRESENTATION OF KNOWLEDGE

Game playing – Knowledge representation, Knowledge representation using Predicate logic, Introduction to predicate calculus, Resolution, Use of predicate calculus, Knowledge representation using other logic-Structured representation of knowledge.

Module-3

KNOWLEDGE INFERENCE

Knowledge representation -Production based system, Frame based system. Inference – Backward chaining, Forward chaining, Rule value approach, Fuzzy reasoning – Certainty factors, Bayesian Theory-Bayesian Network-Dempster – Shafer theory.

Module-4

PLANNING AND MACHINE LEARNING

Basic plan generation systems – Strips -Advanced plan generation systems – K strips -

Strategic explanations -Why, Why not and how explanations. Learning- Machine learning, adaptive Learning.

Module-5

EXPERT SYSTEMS

Expert systems – Architecture of expert systems, Roles of expert systems – Knowledge Acquisition – Meta knowledge, Heuristics. Typical expert systems – MYCIN, DART, XOON, Expert systems shells.

Question Paper Pattern:

- The Question paper will have TEN questions
- Each full question will be for 20 marks
- There will be 02 full questions (with maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting one full question from each module.

Text books

1. Kevin Night and Elaine Rich, Nair B., "Artificial Intelligence (SIE)", Mc Graw Hill- 2008. (Units-I,II,VI & V)

2. Dan W. Patterson, "Introduction to AI and ES", Pearson Education, 2007. (Unit-III).

Reference books

1. Peter Jackson, "Introduction to Expert Systems", 3rd Edition, Pearson Education, 2007.

2. Stuart Russel and Peter Norvig "AI – A Modern Approach", 2nd Edition, Pearson Education 2007.

3. Deepak Khemani "Artificial Intelligence", Tata Mc Graw Hill Education 2013.

4. http://nptel.ac.in

Mobile Applications Development

Choice Based Credit System

Semester: II	CIE Marks:40
Course Code:20MCA263	SEE Marks:60
Contact Hours(L:T:P):3:0:0	Exam Hours:03

Course Outcomes:

CO1: Develop effective user interfaces that leverage evolving mobile devices

CO2: Develop applications using software development kits (SDKs), frameworks and toolkits. CO3: Implement suitable methods to integrate database and server-side technologies CO4: Design and develop open source software based mobile application to the given problem. CO5:Build and deploy competent mobile application to solve the societal/industrial problems.
Module-1
Introduction : Preliminary Considerations – Cost of Development – Importance of Mobile Strategies in the Business World – Effective use of Screen Real Estate – Understanding Mobile Applications: Understanding Mobile Applications Users – Understanding Mobile Information Design – Understanding Mobile Platforms – Using the Tools of Mobile Interface Design.
Module-2
Getting Started with Android Programming **What is Android – Obtaining the required tools– Anatomy of an Android Application – Components of Android Applications – Activities – Fragments – Utilizing the Action Bar**
Module-3
Android UI Design and Location Based Services **Views and View Groups – Basic Views – Fragments – Displaying Maps – Getting Location Data – Publishing for Publishing – Deploying APK Files**
Module-4
Android Messaging and Networking **SMS Messaging – Sending Email – Networking – Downloading Binary Data, Text files – Accessing Web Services – Performing Asynchronous Call – Creating your own services – Communicating between a service and an activity – Binding activities to services**
Module-5
Feedback and Oscillator Circuits **iOS – Obtaining the tools and SDK – Components of XCODE – Architecture of iOS – Building Derby App in iOS – Other useful iOS things – Windows Phone: Getting the tools you need – Windows Phone 7 Project** **Building Derby App in Windows Phone 7 – Distribution – Other useful Windows Phone Thing**
Question Paper Pattern: • The Question paper will have TEN questions • Each full question will be for 20 marks • There will be 02 full questions (with maximum of four sub questions) from each

module.

- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting one full question from each module.

Text books

1. **Jeff McWherter and Scott Gowell, "Professional Mobile Application Development", 1st Edition, 2012, ISBN: 978-1-118-20390-3**
2. **Wei-Meng Lee, "Beginning Android Application Development", Wiley 2011.**

References

1. Reto Meier, " Professional Android 4 Application Development ", Wrox Publications 2012.

Distributed Operating System

Choice Based Credit System

Semester: II	CIE Marks:40
Course Code:20MCA264	SEE Marks:60
Contact Hours(L:T:P):3:0:0	Exam Hours:03

Course Outcomes: At the end of the course, students will be able to:

CO1: Analyse design issues and different message passing techniques in DOS, distributed systems

CO2: Analyse RPC implementation and its performance in DOS

CO3: Analyse the major security issues associated with distributed systems and evaluate techniques available for increasing system security

CO3: Apply the concepts of distributed shared memory and resource management for the given problem/ case study.

CO4: Analyse distributed file systems and evaluate the performance in terms of fault tolerance, file replication as major factors

CO5:Apply modification to the existing algorithms to improve the performance of DOS.

Module-1

Fundamentals: What is Distributed Computing Systems? Evolution of Distributed Computing System; Distributed Computing System Models; What is Distributed Operating System? Issues in Designing a Distributed Operating System; Introduction to Distributed

ComputingEnvironment(DCE).**Message Passing:** Introduction, Desirable features of a Good Message Passing System, Issues in PC by Message Passing, Synchronization, Buffering, Multi-datagram Messages, Encoding and Decoding of Message Data, Process Addressing, Failure Handling, Group Communication, Case Study: 4.3 BSD UNIX IPC Mechanism.

Module-2

Remote Procedure Calls: Introduction, The RPC Model, Transparency of RPC, Implementing RPC Mechanism, Stub Generation, RPC Messages, Marshaling Arguments and Results, Server Management, Parameter-Passing Semantics, Call Semantics, Communication Protocols for RPCs, Complicated RPCs, Client-Server Binding, Exception Handling, Security, Some Special Types of RPCs, RPC in Heterogeneous Environments, Lightweight RPC, Optimization for Better Performance, Case Studies: Sun RPC.

Module-3

Distributed Shared Memory: Introduction, General Architecture of DSM systems, Design and Implementation Issues of DSM, Granularity, Structure of Shared Memory Space, Consistency Models, Replacement Strategy, Thrashing, Other approaches to DSM, Heterogeneous DSM, Advantages of DSM. Synchronization: Introduction, Clock Synchronization, Event Ordering, Mutual Exclusion, Dead Lock, Election Algorithms

Module-4

Resource Management: Introduction, Desirable Features of a Good Global Scheduling Algorithm, Task Assignment Approach, Load – Balancing Approach, Load – Sharing Approach **Process Management:** Introduction, Process Migration, Threads.

Module-5

Distributed File Systems: Introduction, Desirable Features of a Good Distributed File System, File models, File–Accessing Models, File – Sharing Semantics, File – Caching Schemes, File Replication, Fault Tolerance, Atomic Transactions and Design Principles.

Question Paper Pattern:

- The Question paper will have TEN questions
- Each full question will be for 20 marks
- There will be 02 full questions (with maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting one full question from each module.

Text books

1. Pradeep. K. Sinha: Distributed Operating Systems: Concepts and Design, PHI, 2007.

References

1. Andrew S. Tanenbaum: Distributed Operating Systems, Pearson Education, 2013.
2. Ajay D. Kshemkalyani and MukeshSinghal, Distributed Computing: Principles, Algorithms and Systems, Cambridge University Press, 2008
3. SunitaMahajan, Seema Shan, " Distributed Computing", Oxford University

Press,2015

Natural Language Processing

Choice Based Credit System

Semester:II	CIE Marks:40
Course Code:20MCA265	SEE Marks:60
Contact Hours(L:T:P):3:0:0	Exam Hours:03

Course Outcomes:

CO1: Apply parsing technique to the given problem and verify the output and give valid conclusions

CO1: Illustrate the approaches to syntax and semantics in NLP.

CO3: Formulate solutions for a range of natural language components using existing algorithms, techniques and frameworks, including part-of-speech tagging, language modelling, parsing and semantic role labelling.

CO4. Evaluate NLP solutions of the given problem and arrive at valid conclusions.

CO5: Illustrate information retrieval techniques.

Module-1

Introduction, Morphology: Knowledge in Speech & Lang Processing, Ambiguity, Models & Algorithms, Language, Thought & Understanding, Some Brief History, The State of the Art & Near-Term Future, Summary Morphology and Finite State Transducers: Survey of English Morphology, Finite state Morphological Parsing, Lexicon-Free FST: The Porter Stemmer, Human Morphological Parsing, Summary, Combining FST Lexicon and Rules.

Module-2

N-Grams: Counting Words in Corpora, Simple N-Grams, Smoothing, Back off, Deleted Interpolation, N-Grams for Spelling and Pronunciation, Entropy, Summary. Word Classes and Part-of- Speech Tagging: English Word Classes, Tag sets for English, Part-of-Speech Tagging.

Module-3

Context-Free Grammars and Predicate Calculus for English: Constituency, Context-Free Rules and Trees, Sentence Level Constructions, Coordination, Agreement, The Verb Phrase Sub Categorization, Auxiliaries, Spoken Language Syntax, Grammar Equivalence and Normal Form, Finite –State and Context- Free Grammars, Grammars and Human Processing, The Early Algorithm, Finite-State Parsing Method, Summary Representing Meaning:

Module-4

Semantic Analysis: Syntax-Driven Semantic Analysis, Attachments for a Fragment of English, Integrating Semantic Analysis into the Earley Parser, Idioms and Compositionality,

Robust Semantic Analysis, Summary. Lexical Semantics: Relations Among Lexemes and Their Senses, WordNet: A Database of Lexical Relations, The Internal Structure of Words, Creativity and the Lexicon, Summary Word Sense Disambiguation and Information

Module-5

Retrieval: Selection Restriction Based Disambiguation, Robust Word Sense Disambiguation, Information Retrieval, Other Retrieval Tasks, and Summary. Case Study of Simple Text Recognition or Content Based Text Extraction System. Evolving Explanatory Novel Patterns for Semantically-Based Text Mining: Related Work, A Semantically Guided Model for Effective Text Mining.

Question Paper Pattern:

- The Question paper will have TEN questions
- Each full question will be for 20 marks
- There will be 02 full questions (with maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting one full question from each module.

Text books

1.DanielJurafsky and James H Martin, "Speech and Language Processing: An introduction to Natural Language Processing, Computational Linguistics and Speech Recognition", 2nd Edition, Prentice Hall, 2009.

References

1. Christopher D.Manning and HinrichSchutze, "Foundations of Statistical Natural LanguageProcessing", MIT Press, 1999.

2.TanveerSiddiqui, U.S. Tiwary, "Natural Language Processing and Information Retrieval", Oxford University Press, 2008.

3.Anne Kao and Stephen R. Poteet (Eds), "Natural Language Processing and Text Mining", Springer Verlag London Limited 2007.

DataBase Management Systems Laboratory

Choice Based Credit System

Semester: II	CIE Marks:40
Course Code:20MCA27	SEE Marks :60
Contact Hours (L:T:P):0:0:4	Exam Hours:03

Course Outcomes: at the end of the course students will be able to

CO1: Design entity-relationship diagrams to solve given database applications

CO2: Implement a database schema for a given problem.

CO3: Formulate SQL queries in Oracle for the given problem.

CO4: Apply normalization techniques to improve the database design for the given problem.

CO5: Build database and verify for its appropriate normalization for any given problem

Instructions for the Exercises:

1. Draw ER diagram based on given scenario with various Constraints.

2. Create Relational Database Schema based on the scenario using Mapping Rules.

3. Perform the given queries using any RDBMS Environment.

4. Suitable tuples have to be entered so that queries are executed correctly.

5. The results of the queries may be displayed directly.

1. Create the following tables with properly specifying Primary keys, Foreign keys and solve the following queries.

BRANCH (Branchid, Branchname, HOD)

STUDENT (USN, Name, Address, Branchid, sem)

BOOK (Bookid, Bookname, Authorid, Publisher, Branchid)

AUTHOR (Authorid, Authorname, Country, age)

BORROW (USN, Bookid, Borrowed_Date)

Execute the following Queries:

i.List the details of Students who are all studying in 2nd sem MCA.

ii.List the students who are not borrowed any books.

iii.Display the USN, Student name, Branch_name, Book_name, Author_name, Books_Borrowed_Date of 2nd sem MCA Students who borrowed books.

iv.Display the number of books written by each Author.

v.Display the student details who borrowed more than two books.

vi.Display the student details who borrowed books of more than one Author.

vii.Display the Book names in descending order of their names.

viii.List the details of students who borrowed the books which are all published by the same publisher.

2. Consider the following schema:

STUDENT (USN, name, date_of_birth, branch, mark1, mark2, mark3, total, GPA)

Execute the following queries:

i. Update the column total by adding the columns mark1, mark2, mark3.

ii. Find the GPA score of all the students.

iii. Find the students who born on a particular year of birth from the date_of_birth column.

iv. List the students who are studying in a particular branch of study.

v. Find the maximum GPA score of the student branch-wise.

vi. Find the students whose name starts with the alphabet "S".

vii. Find the students whose name ends with the alphabets "AR".

viii. Delete the student details whose USN is given as 1001.

3. Design an ER-diagram for the following scenario, Convert the same into a relational model and then solve the following queries.

Consider a Cricket Tournament "ABC CUP" organized by an organization. In the tournament there are many teams are contesting each having a Teamid,Team_Name, City, a coach. Each team is uniquely identified by using Teamid. A team can have many Players and a captain. Each player is uniquely identified by Playerid, having a Name, and multiple phone numbers,age. A player represents only one team. There are many Stadiums to conduct matches. Each stadium is identified using Stadiumid, having a stadium_name,Address (involves city,area_name,pincode). A team can play many matches. Each match played between the two teams in the scheduled date and time in the predefined Stadium. Each match is identified uniquely by using Matchid. Each match won by any of the one team that also wants to record in the database. For each match man_of_the match award given to a player.

Execute the following Queries:

i. Display the youngest player (in terms of age) Name, Team name, age in which he belongs of the tournament.

ii. List the details of the stadium where the maximum number of matches were played.

iii. List the details of the player who is not a captain but got the man_of _match award at least in two matches.

iv. Display the Team details who won the maximum matches.

v. Display the team name where all its won matches played in the same stadium.

4. Design an ER-diagram for the following scenario, Convert the same into a relational model, normalize Relations into a suitable Normal form and then solve the following queries. A country can have many Tourist places . Each Tourist place is identified by using tourist_place_id, having a name, belongs to a state, Number of kilometers away from the

capital city of that state,history. There are many Tourists visits tourist places every year. Each tourist is identified uniquely by using Tourist_id, having a Name, age, Country and multiple emailids. A tourist visits many Tourist places, it is also required to record the visted_date in the database. A tourist can visit a Tourist place many times at different dates. A Tourist place can be visited by many tourists either in the same date or at different dates.

Queries:

i. List the state name which is having maximum number of tourist places.

ii. List details of Tourist place where maximum number of tourists visited.

iii. List the details of tourists visited all tourist places of the state "KARNATAKA".

iv. Display the details of the tourists visited at least one tourist place of the state, but visited all states tourist places.

v. Display the details of the tourist place visited by the tourists of all country.

5. A country wants to conduct an election for the parliament. A country having many constituencies. Each constituency is identified uniquely by Constituency_id, having the Name, belongs to a state,Number_of_voters. A constituency can have many voters. Each voter is uniquely identified by using Voter_id, having the Name, age, address (involves Houseno,city,state,pincode). Each voter belongs to only one constituency. There are many candidates contesting in the election. Each candidates are uniquely identified by using candidate_id, having Name, phone_no, age, state. A candidate belongs to only one party.Thereare many parties. Each party is uniquely identified by using Party_id, having Party_Name,Party_symbol. A candidate can contest from many constituencies under a same party. A party can have many candidates contesting from different constituencies. No constituency having the candidates from the same party. A constituency can have many contesting candidates belongs to different parties. Each voter votes only one candidate of his/her constituencty.

Queries:

i. List the details of the candidates who are contesting from more than one constituencies

which are belongs to different states.

ii. Display the state name having maximum number of constituencies.

iii. Create a stored procedure to insert the tuple into the voter table by checking the voter age. If voter's age is at least 18 years old, then insert the tuple into the voter else display the "Not an eligible voter msg" .

iv. Create a stored procedure to display the number_of_voters in the specified constituency. Where the constituency name is passed as an argument to the stored procedure.

v. Create a TRIGGER to UPDATE the count of " Number_of_voters" of the respective

constituency in "CONSTITUENCY" table , AFTER inserting a tuple into the "VOTERS" table.

Java Programming Lab Choice Based Credit System	
Semester:II	CIE Marks:40
Course Code:20MCA28	SEE Marks:60
Contact Hours (L: T:P):0:0:4	Exam Hours:03

Course Outcomes: at the end of the course the students will be able to

CO1: Demonstrate the fundamental data types and constructs of Java Programming by writing executable/interpretable programs.

CO2: Illustrate the object oriented principles with the help of java programs.

CO3: Develop reusable and efficient applications using inheritance and multi-threading concepts of java.

CO4: Apply client-side programming and networking concepts to develop distributed applications.

CO5: Write java programs to demonstrate the concepts of interfaces, inner classes and I/O streams.

1. Write a JAVA program to demonstrate Constructor Overloading and Method Overloading.

2. Write a JAVA program to implement Inner class and demonstrate its Access protection.

3. Write a program in Java for String handling which performs the following:
   a. Checks the capacity of String Buffer objects.
   b. Reverses the contents of a string given on console and converts the resultant string in upper case.
   c. Reads a string from console and appends it to the resultant string of (ii).

4. Write a JAVA program to demonstrate Inheritance.

Simple Program on Java for the implementation of Multiple inheritance using interfaces to calculate the area of a rectangle and triangle.

5. Write a JAVA program which has:
   a. A Class called Account that creates account with Rs. 500 minimum balance, a deposit() method to deposit amount, a withdraw() method to withdraw amount and also throws LessBalanceException if an account holder tries to withdraw money which makes the balance become less than Rs. 500.
   b. A Class called Less_Balance_Exception which returns the statement that says withdraw amount (Rs.) is not valid.
   c. A Class which creates 2 accounts, both account deposit money and one account tries to withdraw more money which generates a Less Balance Exception take appropriate action for the same.

6. Write a JAVA program using Synchronized Threads, which demonstrates Producer Consumer concept.

7. Write a JAVA program to implement a Queue using user defined Exception Handling (also make use of throw, throws).
   a. Complete the following:
   b. Create a package named shape.
   c. Create some classes in the package representing some common shapes like Square, Triangle, and Circle.
   d. Import and compile these classes in other program.
8. Write a JAVA program to create an enumeration Day of Week with seven values SUNDAY through SATURDAY. Add a method isWorkday() to the DayofWeek class that returns true if the value on which it is called is MONDAY through FRIDAY. For example, the call DayOfWeek.SUNDAY.isWorkDay () returns false.
9. Write a JAVA program which has:
   a. An Interface class for Stack Operations
   b. A Class that implements the Stack Interface and creates a fixed length Stack.
   c. A Class that implements the Stack Interface and creates a Dynamic length Stack.
   d. A Class that uses both the above Stacks through Interface reference and does the Stack
   e. Operations that demonstrates the runtime binding.
10. Write a JAVA program which uses FileInputStream / FileOutPutStream Classes.
11. Write JAVA programs which demonstrate utilities of Linked List Class.

Web Technologies Laboratory **Choice Based Credit System**	
Semester: II	CIE Marks:40
Course Code:20MCA29	SEE Mark :60
Contact Hours(L:T:P) 0:0:4	Exam Hours:03

Course Outcomes: at the end of the course students will be able to

CO1: Apply the concept and usages web based programming techniques.

CO2: Learning and Developing XHTML documents using JavaScript and CSS.

CO3: To be familiar in the use of CGI and Perl programs for different types of server side applications.

CO4: Design and implement user interactive dynamic web based applications.

CO5: Evaluate the given wed application and enhance it using latest web technologies.

Part - A

1.Create an XHTML page that provides information about your department. Your XHTML page must use the following tags:

a) Text Formatting tags

b) Horizontal rule

c) Meta element

d) Links

e) Images

f) Tables (Use of additional tags encouraged).

2.Develop and demonstrate the usage of inline, external and internal style sheet using CSS. Use XHTML page that contains at least three paragraphs of text, listed elements and a table with four rows and four columns.

3.Develop and demonstrate a XHTML file that includes Javascript script for the following problems: a) Input : A number n obtained using prompt Output : The first n Fibonacci numbers b) Input : A number n obtained using prompt Output : A table of numbers from 1 to n and their squares using alert

4.Develop, test and validate an XHTML document that has checkboxes for apple (59 cents each), orange (49 cents each), and banana (39 cents each) along with submit button. Each check boxes should have its own onclick event handler. These handlers must add the cost of their fruit to a total cost. An event handler for the submit button must produce an alert window with the message 'your total cost is $xxx', where xxx is the total cost of the chose fruit, including 5 percent sales tax. This handler must return 'false' (to avoid actual submission of the form data). Modify the document to accept quantity for each item using textboxes.

5. a) Develop and demonstrate, a HTML document that collects the USN (the valid format is : A digit from 1 to 4 followed by two upper-case characters followed by two digits followed by three upper-case characters followed by two digits; (no embedded spaces are allowed) from the user. Use JavaScript that validate the content of the document. Suitable messages should be display in the alert if errors are detected in the input data. Use CSS and event handlers to make your document appealing.b) Modify the above program to get the current semester also(restricted to be a number from 1 to 6)

6. Develop and demonstrate a HTML file which includes JavaScript that uses functions for the following problems:

a. Parameter: A string Output: The position in the string of the left-most vowel. b. Parameter: A number Output: The number with its digits in the reverse order.

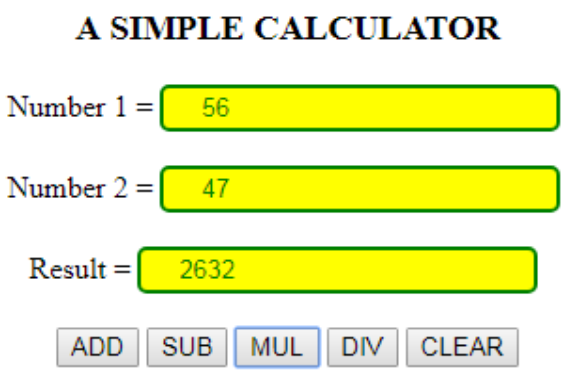
7.Develop and demonstrate a HTML5 page which contains

a) Dynamic Progressive bar.

b) Display Video file using HTML5 video tag.

8.Develop and demonstrate, using JavaScript script, a XHTML document that contains three short paragraphs of text, stacked on top of each other, with only enough of each showing so that the mouse cursor can be placed over some part of them. When the cursor is placed over the exposed part of any paragraph, it should rise to the top to become completely visible. Modify the above document so that when a text is moved from the top stacking position, it returns to its original position rather than to the bottom.

9.Develop a simple calculator to perform arithmetic (addition, subtraction, multiplication and division) operations on given two numbers. Use an HTML tag that allows the user to input two numbers and to display the result of arithmetic operation. Write suitable HTML and JavaScript and CSS to your simple calculator. The following figure show sample document display.



10.Develop and demonstrate using jQuery to solve the following:

a) Limit character input in the text area including count.

b) Based on check box, disable/enable the form submit button.

11.Develop and demonstrate using jQuery to solve the following:

a) Fade in and fade out all division elements.

b) Animate an element, by changing its height and width.

Part-B

Develop a web application (mini-project) using the languages and concepts learnt in the theory and exercises listed in part A with a good look and feel effects. Database connection needs to be implemented.

Note:

1. A team of two students must develop the mini project. However during the examination, each student must demonstrate the project individually.

2. Each students has to execute one program picked from Part-A during the semester end examination.
3. The team must submit a brief project report (20-25 pages) that must include the following

   a. Introduction b. Requirement Analysis c Software Requirement Specification

   d. Analysis and Design, e. Implementation f. Testing

4. Brief synopsis not more than two pages to be submitted by the team as per the format given. It was recommended that students to do prior art search as part of literature survey before submitting the synopsis for the Mini/Major projects.
5. Rubrics may be used to evaluate the Mini-Project.

Data Analytics using Python	
Semester: III	CIE Marks : 40
Subject Code : 20MCA31	SEE Marks : 60
Contact Hours(L:P:T) : 4-0-0	Exam Hours : 03

Course Outcomes:

- CO1: Demonstrate basic data analytics principles and techniques
- CO2: Apply control structures the concepts of inheritance and overloading for a given problem.
- CO3: Perform essential operations using Numpy and Pandas
- CO4: Structuring the data in the dataset for a given problem.
- CO5: Demonstrate the concepts of data visualization.

Module 1 : Python Basic Concepts and Programming

Keywords, Statements and Expressions, Variables, Operators, Precedence and Associativity, Data Types, Indentation, Comments, Reading Input, Print Output, Type Conversions, The type( ) Function and Is Operator, Control Flow Statements, The if Decision Control Flow Statement, The if…else Decision Control Flow Statement, The if…elif…else Decision Control Statement, Nested if Statement, The while Loop, The for Loop, The continue and break Statements, Built-In Functions, Commonly Used Modules, Function Definition and Calling the Function, The return Statement and void Function, Scope and Lifetime of Variables, Default Parameters, Keyword Arguments, *args and **kwargs, Command Line Arguments.

Module 2: Python Collection Objects, Classes

Strings- Creating and Storing Strings, Basic String Operations, Accessing Characters in String by Index Number, String Slicing and Joining, String Methods, Formatting Strings, Lists-Creating Lists, Basic List Operations, Indexing and Slicing in Lists, Built-In Functions Used on Lists, List Methods. Sets, Tuples and Dictionaries. Files: reading and writing files. Class Definition – Constructors – Inheritance – Overloading

Module 3: Introduction to Numpy and Pandas

Numpy:-Understanding datatypes in python, basics of NumPy arrays, computation on NumPy arrays: universal functions. (*refer chapter 2 from python datascience handbook)*

Pandas:-Introducing to pandas data structures, essential functionality, summarizing and computing descriptive statistics, handling missing data. (*refer chapter 5 from python for data Analysis*)

Module 4: Data Loading and Data Wrangling

Reading and writing data in text format, interacting with databases, combining and merging data sets, reshaping and pivoting, data transformation, string manipulation (*refer chapter 6 and 7 from python for data Analysis*

Module 5: Visualization with Matplotlib and Seaborn

General Matplotlib tips, simple line plots, simple scatter plots, visualizing errors, density and contour plots, histograms, binning, and density, customizing plot legends and colorbars, customizing matplotlib, visualization with seaborn.

(*refer chapter 4 from python datascience handbook)*

Text Books:

1. Allen B. Downey, “Think Python: How to Think Like a Computer Scientist‘‘, 2nd edition,Updated for Python 3, Shroff/O‘Reilly Publishers, 2016 (http://greenteapress.com/wp/thinkpython/)
2. Mark Lutz, “Programming Python”, O'Reilly Media, 4th edition, 2010.
3. Jake Vander plas, “Python Data Science Handbook: Essential tools for working with data”, O‘Reilly Publishers, I Edition.
4. Wes Mc Kinney, “Python for Data Analysis”, O'Reilly Media, 2012Mark Lutz, “Programming Python”, O'Reilly Media, 4th edition, 2010.

Reference books:

1. Tim Hall and J-P Stacey, “Python 3 for Absolute Beginners”, Apress, 1st edition, 2009.
2. Magnus Lie Hetland, “Beginning Python: From Novice to Professional”, Apress, Second Edition, 2005.
3. Shai Vaingast, “Beginning Python Visualization Crafting Visual Transformation Scripts”, Apress, 2nd edition, 2014.

Internet of Things

Choice Based Credit System

Semester: III	CIE Marks:40
Subject Code:20MCA32	SEE Marks:60
Contact Hours(L:T:P):4:0:0	Exam Hours:03

CO**1:** Analyse the IoT architecture and design along with functional/compute stack and data management.

CO**2:** Apply IOT architecture for a given problem

CO**3:** Analyse the application protocol, transport layer methods for the given business case.

CO**4:** Analyse the application of data analytics for IOT for a given

CO5: Analyse the architecture and develop programming using modern tools for the given use case

Module-1

What is IoT, Genesis of IoT, IoT and Digitization, IoT Impact, Convergence of IT and IoT, IoT Challenges, IoT Network Architecture and Design, Drivers Behind New Network Architectures, Comparing IoT Architectures, A Simplified IoT Architecture, The Core IoT Functional Stack, IoT Data Management and Compute Stack

Module-2

Smart Objects: The "Things" in IoT, Sensors, Actuators, and Smart Objects, Sensor Networks, Connecting Smart Objects, Communications Criteria, IoT Access Technologies.

Module-3

IP as the IoT Network Layer, The Business Case for IP, The need for Optimization, Optimizing IP for IoT, Profiles and Compliances, Application Protocols for IoT, The Transport Layer, IoT Application Transport Methods.

Module-4

Data and Analytics for IoT, An Introduction to Data Analytics for IoT, Machine Learning, Big Data Analytics Tools and Technology, Edge Streaming Analytics, Network Analytics, Securing IoT, A Brief History of OT Security, Common Challenges in OT Security, How IT and OT Security Practices and Systems Vary, Formal Risk Analysis Structures: OCTAVE and FAIR, The Phased Application of Security in an Operational Environment

Module-5

IoT Physical Devices and Endpoints - Arduino UNO: Introduction to Arduino, Arduino UNO, Installing the Software, Fundamentals of Arduino Programming. IoT Physical Devices and Endpoints - RaspberryPi: Introduction to RaspberryPi, About the RaspberryPi Board: Hardware Layout, Operating Systems on RaspberryPi, Configuring RaspberryPi, Programming

RaspberryPi with Python, Wireless Temperature Monitoring System Using Pi, DS18B20 Temperature Sensor, Connecting Raspberry Pi via SSH, Accessing Temperature from DS18B20 sensors, Remote access to RaspberryPi, Smart and Connected Cities, An IoT Strategy for Smarter Cities, Smart City IoT Architecture,Smart City Security Architecture, Smart City Use-Case Examples.

Question Paper Pattern:

- The Question paper will have TEN questions
- Each full question will be for 20 marks
- There will be 02 full questions (with maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting one full question from each module.

Textbooks

1.David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry,"IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the 2. Internet of Things", 1stEdition, Pearson Education (Cisco Press Indian Reprint). (ISBN: 9789386873743) 2. Srinivasa K G, "Internet of Things",CENGAGE Leaning India, 2017

References

1.Vijay Madisetti and ArshdeepBahga, "Internet of Things (A Hands-on-Approach)", 1stEdition, VPT, 2014. (ISBN: 978-8173719547)

2. Raj Kamal, "Internet of Things: Architecture and Design Principles", 1st Edition, McGraw Hill Education, 2017. (ISBN: 978-9352605224)

Advances in Java

Choice Based Credit System

Semester: III	CIE Marks:40
Subject Code:20MCA33	SEE Exam:60
Contact Hours(L:T:P):4:0:0	Exam Hours:03

Course Outcomes:

CO1: Apply the concept of Servlet and its life cycle to create web application.

CO2: Apply JSP tags and its services to web application.

CO3: Create packages and interfaces in the web application context.

CO4: Build Database connection for the web applications.

CO5: Develop enterprise applications using Java Beans concepts for the given problem.

Module-1

Servlet Structure, Servlet packaging, HTML Building utilities, Lifecycle, Single Thread Model Interface, Handling Client request: Form Data, HTTP Request Headers.

Generating Server Response: HTTP Status Codes, HTTP Response Headers, Handling Cookies, Session Tracking.

Module-2

Introduction to JSP:

Overview of JSP: JSP Technology, Need of JSP, Benefits of JSP, Advantages of JSP, Basic Syntax, Invoking Java code with JSP Scripting Elements, Creating Template Text, Invoking Java Code form JSP, Limiting Java Code in JSP, Using JSP Expressions, Comparing Servlets And JSP, Writing Scriptlets. For Example: Using Scriplets to make parts of JSP Conditional, Using declarations, Declaration Examples.

Module-3

Controlling the structure, Structure of generated Servlets and Java Beans, Controlling the structure of generated Servlets: The JSP Page directive, Import Attribute, Session Attribute, isElignore attribute, Buffer and Autoflush Attribute, Info Attribute, errorPage, and iserrorPage Attributes, isThreadSafe Attribute, extends Attribute, language Attribute, Including Files and Applets in JSP Pages using Java Beans components in JSP documents.

JAR File, Manifest file, Working with Java Beans. Introspection, Customisers, Bean Properties: Simple properties, Design pattern events, Creating bound properties, Bean Methods, Beaninfo class, Persistence.

Module-4

Annotations and JDBC

Annotations: Built-in Annotations with examples, Custom Annotation. Talking to Database, Immediate Solutions, Essentials JDBC program, using prepared statement object, and Interactive SQL tool. JDBC in Action Result sets, Batch updates, Mapping, Basic JDBC data types, Advanced JDBC data types, immediate solutions.

Module-5

EJB and Server Side Components Models

Introduction to EJB: The Problem domain, Breakup responsibilities, Code Smart not hard, the enterprise java bean specification, Components Types.

Server Side Component Types: session Beans, MessageDriven Beans, Entity Beans, The Java Persistence Model. Container services: Dependency Injection, Concurrency, Instance pooling n caching, Transactions, security, Timers, Naming and object stores, Interoperability, Life Cycle Callbacks, Interceptors, platform integration. Developing your first EJB, Models: The Stateless Session Bean, The Stateful Session Bean, the Singleton Session Bean, Message-Driven Beans. EJB and Persistence. Persistence Entity Manager Mapping persistence objects, Entity Relationships.

Question Paper Pattern:

- The Question paper will have TEN questions
- Each full question will be for 20 marks
- There will be 02 full questions (with maximum of four sub questions) from each module.

- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting one full question from each module.

TextBooks

1. Marty Hall,Larry Brown Core Servlets and Java server pages. Vol 1: Core Technologies. 2nd Edition. (Chapter 3,4,5,6,7,8,9,10,11,12,13,14)

2. Java 6 Programming Black Book, Dreamtech press 2012(Chapter 17,18,19,20,21,22,27,28,29,30)

3. Andrew LeeRubinger, Bill Burke. Development Enterprise Java Components. Enterprise JavaBeans 3.1. O'reilly (Chapters 1,2,3,4,5,6,7,8,9,10,11)

References

1. Michel Siklora, EJB 3 Developer Guide, A Practical Guide For Developers And Architects to the Enterprise Java Beans Standard,Shroff Publishers and Distributers Private Limited July2008.

2. Herbert Schildt The Java Complete Reference, 8th Edition, Comprehensive coverage of the Java Language, Tata Mc Graw Hill Edition

Block Chain Technology

Choice Based Credit System(CBCS)

Semester: III	**CIE Marks:40**
Course Code:20MCA341	**SEE Marks:60**
Contact Periods (L:T:P):3-0-0	**Exam Hours:03**

Course Out Comes:

CO1: Demonstrate the basics of Block chain concepts using modern tools/technologies.
CO2: Analyze the role of block chain applications in different domains including cybersecurity.
CO3: Evaluate the usage of Block chain implementation/features for the given problem.
CO4: Exemplify the usage of bitcoins and its impact on the economy.
CO5: Analyze the application of specific block chain architecture for a given problem

Module-1

Introduction to Blockchain, How Blockchain works, Blockchain vs Bitcoin, Practical applications, public and private key basics, pros and cons of Blockchain, Myths about Bitcoin.

Module-2

Blockchain :Architecture , versions ,variants , use cases, Life use cases of blockchain, Blockchain vs shared Database, Introduction to cryptocurrencies, Types, Applications.

Module-3

Concept of Double Spending, Hashing, Mining, Proof of work.
Introduction to Merkel tree, Privacy , payment verification , Resolving Conflicts , Creation of Blocks

Module-4
Introduction to Bitcoin, key concepts of Bitcoin, Merits and De Merits Fork and Segwits, Sending and Receiving bitcoins, choosing bitcoin wallet, Converting Bitcoins to Fiat Currency.
Module-5
Introduction to Ethereum, Advantages and Disadvantages, Ethereum vs Bitcoin, Introduction to Smart contracts, usage, application, working principle , Law and Regulations. Case Study.
Question Paper Pattern: • The Question paper will have TEN questions • Each full question will be for 20 marks • There will be 02 full questions (with maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer FIVE full questions, selecting one full question from each module.
Textbooks
1. Beginning Blockchain: A Beginner's Guide to Building Blockchain Solutions by ArshdeepBikramaditya Signal, GautamDhameja (PriyansuSekhar Panda., APress. 2. Blockchain Applications: A Hands-On Approach by Bahga, Vijay Madisetti 3. Blockchain by Melanie Swan, OReilly
References
1. Bitcoin and Cryptocurrency Technologies by Aravind Narayan. Joseph Bonneau, princton 2. Bitcoin and Blockchain Basics: A non-technical introduction for beginners by Arthu.T Books.

Cloud Computing

Choice Based Credit System(CBCS)

Semester: III	**CIE Marks:40**
Course Code:20MCA342	**SEE Marks:60**
Contact Periods (L:T:P):3-0-0	**Exam Hours:03**

Course Outcomes:

CO1: Demonstrate the system & software models and mechanisms that support cloud computing

CO2: Classify various cloud services and their providers

CO3: Compare various cloud deployment models

CO4: Differentiate various types of computing environments

CO5: Identify enabling technologies of cloud computing.

Module-1
Introduction to Cloud Computing: Eras of computing, The vision of Cloud Computing, Defining a cloud, A closer look, Cloud computing reference model, Historical developments: Distributed systems, Virtualization, Web 2.0; Service oriented computing; Utility oriented computing.
Module-2
Architectures for parallel and distributed computing: Parallel Vs Distributed computing, Elements of distributed computing, Technologies for distributed computing.
Module-3
Virtualization: Introduction, Characteristics of virtualized environments, Taxonomy of virtualization techniques, Virtualization and cloud computing, Pros and cons of virtualization, Technology examples: Xen: Para virtualization, VmWare: Full virtualization, Microsoft Hyper – V.
Module-4
Cloud computing architecture: Introduction, Cloud reference model: Architecture, IaaS, PaaS, SaaS, Types of Clouds: Public, Private, Hybrid and Community clouds, Economics of the cloud, Open challenges.
Module-5
Cloud Tools and Applications: Aneka PaaS; Open stack: Introduction to open stack; Components of open stack; Amazon web services; Google AppEngine; Microsoft Azure; Scientific applications: Healthcare; Biology; Geo-Science, Business and Consumer applications: ARM & ERP; Productivity; Social networking.
Question Paper Pattern: • The Question paper will have TEN questions • Each full question will be for 20 marks • There will be 02 full questions (with maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer FIVE full questions, selecting one full question from each module.
Textbooks
1. RjkumarBuyya, Christian Vecchiola, and ThamaraiSelci, Mastering Cloud Computing, Tata McGraw Hill, New Delhi, India, 2013.
References
1. Cloud Computing for Dummies by Judith Hurwitz, R.Bloor, M. Kanfman, F.Halper (Wiley India Edition) 2. Cloud Computing: A Practical Approach by J.Vette, Toby J. Vette, Robert Elsenpeter (Tata McGraw Hill)

Digital Marketing

Choice Based Credit System(CBCS)

Semester: III	**CIE Marks:40**
Course Code:20MCA343	**SEE Marks:60**
Contact Periods (L:T:P):3-0-0	**Exam Hours:03**

Course Outcomes:

CO1: Demonstrate the key concepts related to e-marketing for the given case.

CO2: Demonstrate the use of different electronic media for designing marketing activities.

CO3: Analyze the role of search engine in improving digital marketing

CO4: Analyze role of social media marketing for the given problem

CO5: Analyze technical solutions to overcome social media threats

Module-1

Introduction to Digital Marketing Evolution of Digital Marketing from traditional to modern era, Role of Internet; Current trends, Info-graphics, implications for business & society; Emergence of digital marketing as a tool; Drivers of the new marketing environment; Digital marketing strategy; P.O.E.M. framework, Digital landscape, Digital marketing plan, Digital marketing models.

Module-2

Internet Marketing and Digital Marketing Mix – Internet Marketing, opportunities and challenges; Digital marketing framework; Digital Marketing mix, Impact of digital channels on IMC; Search Engine Advertising: - Pay for Search Advertisements, Ad Placement, Ad Ranks, Creating Ad Campaigns, Campaign Report Generation Display marketing: - Types of Display Ads - Buying Models - Programmable Digital Marketing - Analytical Tools - YouTube marketing.

Module-3

Social Media Marketing – Role of Influencer Marketing, Tools & Plan– Introduction to social media platforms, penetration & characteristics; Building a successful social media marketing strategy Facebook Marketing: - Business through Facebook Marketing, Creating Advertising Campaigns, Adverts, Facebook Marketing Tools Linkedin Marketing: - Introduction and Importance of Linkedin Marketing, Framing Linkedin Strategy, Lead Generation through Linkedin, Content Strategy, Analytics and Targeting Twitter Marketing: - Introduction to Twitter Marketing, how twitter Marketing is different than other forms of digital marketing, framing content strategy, Twitter Advertising Campaigns Instagram and Snapchat: - Digital Marketing Strategies through Instagram and Snapchat Mobile Marketing: - Mobile Advertising, Forms of Mobile Marketing, Features, Mobile Campaign Development, Mobile Advertising Analytics Introduction to social media metrics

Module-4

Introduction to SEO, SEM, Web Analytics, Mobile Marketing, Trends in Digital Advertising– - Introduction and need for SEO, How to use internet & search engines; search engine and its working pattern, On-page and off-page optimization, SEO Tactics - Introduction to SEM Web Analytics: - Google Analytics & Google AdWords; data collection for web analytics, multichannel attribution, Universal analytics, Tracking code Trends in digital advertising

Module-5

Social Media Channels: Introduction, Key terms and concepts, Traditional media vs Social media. Social media channels: Social networking. Content creation, Bookmarking & aggregating and

Location & social media. Tracking social media campaigns. Social media marketing: Rules of engagement. Advantages and challenges.

Social Media Strategy: Introduction, Key terms and concepts. Using social media to solve business challenges. Step-by-step guide to creating a social media strategy. Documents and processes. Dealing with opportunities and threats. Step-by-step guide for recovering from an online brand attack. Social media risks and challenges

Question Paper Pattern:

- The Question paper will have TEN questions
- Each full question will be for 20 marks
- There will be 02 full questions (with maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting one full question from each module.

Textbooks

1. Seema Gupta "Digital Marketing" Mc-Graw Hill 1st Edition – 2017

References

1. Ian Dodson "The Art of Digital Marketing" Wiley Latest Edition
2. Puneet Singh Bhatia "Fundamentals of Digital Marketing" Pearson 1st Edition – 2017
3. Prof. Nitin C. Kamat, Mr.Chinmay Nitin Kamat Digital Social Media Marketing Himalaya Publishing House Pvt. Ltd. Latest Edition

Software Testing

Choice Based Credit System(CBCS)

Semester: III	**CIE Marks:40**
Course Code:20MCA344	**SEE Marks:60**
Contact Periods (L:T:P):3-0-0	**Exam Hours:03**

Course Outcomes:

CO1: Acquire knowledge of basic principles and knowledge of software testing and debugging and test cases.

CO2: Will be able to understand the perceptions on testing like levels of testing, generalized pseudo code and with related examples.

CO3: To study the various types of testing.

CO4: Differentiate between functional testing and structural testing.

CO5: Analyze the performance of fault based testing, planning and Monitoring the process, Documentation testing.

Module-1

Basics of Software Testing, Basic Principles, Test case selection and Adequacy

Humans, Errors and Testing, Software Quality; Requirements, Behavior and Correctness, Correctness Vs Reliability; Testing and Debugging; Test Metrics; Software and Hardware Testing; Testing and Verification; Defect Management; Execution History; Test Generation Strategies; Static Testing; Test Generation from Predicates. Sensitivity, Redundancy, Restriction, Partition, Visibility and Feedback, Test Specification and cases, Adequacy Criteria, Comparing

Criteria
Module-2
A perspective on Testing Basic definitions, Test cases, Insights from a Venn diagram, Identifying test cases, Error and fault taxonomies, Level of testing, Examples: Generalized pseudo code, The triangle problem, the Next Date function, The commission problem, The SATM (Simple Automation Teller Machine) problem, The currency converter, Saturn windshield wiper
Module-3
Boundary value testing, Equivalence class testing, Decision table based testing Boundary value analysis, Robustness testing, Worst-case testing, special value testing, Examples, Random testing, Equivalence classes, Equivalence test cases for triangle problem, Next Date function and commission problem, Guidelines and observations, Decision tables, Test cases for triangle problem
Module-4
Path Testing, Data flow testing, Levels of Testing, Integration Testing DD Paths, Test coverage metrics, Basis path testing, guidelines and observations, Definition Use testing, Slice based testing, Guidelines and observations. Traditional view of testing levels, Alternative life cycle models, the SATM systems, separating integration and system testing, Guidelines and observations.
Module-5
Fault Based Testing, Planning and Monitoring the Process, Documenting Analysis and Test Assumptions in fault-based testing, Mutation Analysis, Fault-based Adequacy Criteria; Variations on mutation Analysis; From Test case specification to Test Cases, Scaffolding, Generic vs. specific Scaffolding, Test Oracles, Self checks as oracles, Capture and Replay. Quality and Process, Test and Analysis strategies and plans, Risk Planning, Monitoring the Process, Improving the process, The quality team, Organizing documents, Test strategy document, Analysis and test plan, Test design specifications documents, Test and analysis reports.
Question Paper Pattern: • The Question paper will have TEN questions • Each full question will be for 20 marks • There will be 02 full questions (with maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer FIVE full questions, selecting one full question from each module.
Textbooks
1. AdithyaP.Mathur " Foundations of Software Testing – Fundamental Algorithms and Techniques", Pearson Education India, 2011 2. Mauro Pezze, Michael Young, Software testing and Analysis- Process, Principles and Techniques, Wiley India, 2012 3. Paul C Jorgensen, "Software Testing A Craftsman's Approach", Auerbach publications, 3rd edition, 2011.
References
1. KshirasagaraNaik, PriyadarshiTripathy: Software Testing and Quality Assurance, Wiley India

2012
2. M.G.Limaye: Software Testing-Principles, Techniques and Tools – McGraw Hill, 2009

NOSQL

Choice Based Credit System(CBCS)

Semester: III	**CIE Marks:40**
Course Code:20MCA345	**SEE Marks:60**
Contact Periods (L:T:P):3-0-0	**Exam Hours:03**

Course outcomes: The students will be able to:

CO1: Demonstrate the concepts of unstructured data

CO2: Analyse and Manage the Data using CRUD operations

CO3: Develop the applications using NoSQL

CO4: Realize the concept of Map Reduce its applicability in the real world application development

CO5: Analyze the framework of NOSQL

Module-1

Introduction to NoSQL
Definition of NoSQL, History of NoSQL and Different NoSQL products.
Exploring NoSQL
Exploring Mongo DB Java/Ruby/Python, Interfacing and Interacting with NoSQL.

Module-2

NoSQL Basics :NoSQL Storage Architecture, CRUD operations with Mongo DB, Querying, Modifying and Managing.

Data Storage in NoSQL: NoSQL Data Stores, Indexing and ordering datasets (MongoDB/CouchDB/Cassandra)

Module-3

Advanced NoSQL, NoSQL in Cloud, Parallel Processing with Map Reduce, Big Data with Hive.

Module-4

Working with NoSQL, Surveying Database Internals, Migrating from RDBMS to NoSQL, Web Frameworks and NoSQL, using MySQL as a NoSQL.

Module-5

Developing Web Application with NOSQL and NOSQL Administration

Php and MongoDB, Python and MongoDB, Creating Blog Application with PHP.

Question Paper Pattern:

- The Question paper will have TEN questions

• Each full question will be for 20 marks • There will be 02 full questions (with maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer FIVE full questions, selecting one full question from each module.
Textbooks
1.Professional NOSQL Shashank Tiwari WROX Press
References
2. The Definitive Guide to Mongo DB, The NOSQL Database for cloud and Desktop Computing EelcoPlugge, Peter Membreyand Tim Hawkins APress

Deep Learning **Choice Based Credit System(CBCS)**	
Semester: III	**CIE Marks:40**
Course Code:20MCA351	**SEE Marks:60**
Contact Periods (L:T:P):3-0-0	**Exam Hours:03**
Course Outcomes: 1. Demonstrate the basics of deep learning for a given context. 2. Implement various deep learningmodels for the given problem 3. Realign high dimensional data using reductiontechniques for the given problem 4. Analyze optimization and generalization techniques of deeplearning for the given problem. 5. Evaluate the given deep learningapplication and enhance by applying latest techniques.	
Module-1	
Introduction to machine learning- Linear models (SVMs and Perceptron's, logistic regression)- Intro to Neural Nets: What a shallow network computes- Training a network: loss functions, back propagation and stochastic gradient descent- Neural networks as universal function approximates	
Module-2	
DEEP NETWORKS : History of Deep Learning- A Probabilistic Theory of Deep Learning- Backpropagation and regularization, batch normalization- VC Dimension and Neural Nets-Deep Vs Shallow NetworksConvolutional Networks- Generative Adversarial Networks (GAN), Semi-supervised Learning	
Module-3	
DIMENTIONALITY REDUCTION : Linear (PCA, LDA) and manifolds, metric learning - Auto encoders and dimensionality reduction in networks - Introduction to Convnet - Architectures – AlexNet, VGG, Inception, ResNet - Training a Convnet: weights initialization, batch normalization, hyperparameter optimization	
Module-4	
OPTIMIZATION AND GENERALIZATION Optimization in deep learning– Non-convex optimization for deep networks- Stochastic Optimization Generalization in neural networks- Spatial Transformer Networks- Recurrent networks, LSTM - Recurrent Neural Network	

Language Models- Word-Level RNNs & Deep Reinforcement Learning - Computational & Artificial Neuroscience

Module-5

CASE STUDY AND APPLICATIONS Imagenet- Detection-Audio Wave Net-Natural Language Processing Word2Vec - Joint Detection BioInformatics- Face Recognition- Scene Understanding-Gathering Image Captions

Question Paper Pattern:

- The Question paper will have TEN questions
- Each full question will be for 20 marks
- There will be 02 full questions (with maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting one full question from each module.

Textbooks :

1. CosmaRohillaShalizi, Advanced Data Analysis from an Elementary Point of View,2015.

References:

1. Deng & Yu, Deep Learning: Methods and Applications, Now Publishers,2013.
2. Ian Goodfellow, YoshuaBengio, Aaron Courville, Deep Learning, MIT Press,2016.

Michael Nielsen, Neural Networks and Deep Learning, Determination Press,2015.

Big data Analytics

Choice Based Credit System(CBCS)

Semester: III	**CIE Marks:40**
Course Code:20MCA352	**SEE Marks:60**
Contact Periods (L:T:P):3-0-0	**Exam Hours:03**

Course Outcomes:

CO1: Identify the business problem for a given context and frame the objectives to solve it through data analytics tools.

CO2: Apply various algorithms for handling large volumes of data.

CO3: Illustrate the architecture of HDFS and explain functioning of HDFS clusters.

CO4: Analyse the usage of Map-Reduce techniques for solving big data problems.

CO5: Conduct experiment with various datasets for analysis / visualization and arrive at valid conclusions.

Module-1

Big Data and Analytics

Example Applications, Basic Nomenclature, Analysis Process Model, Analytical Model Requirements , Types of Data Sources, Sampling, Types of Data Elements, Data Exploration, Exploratory Statistical Analysis, Missing Values, Outlier Detection and Treatment, Standardizing Data Labels, Categorization

Module-2

Big Data Technology

Hadoop's Parallel World, Data discovery, Open source technology for Big Data Analytics, Cloud and Big Data, Predictive Analytics, Mobile Business Intelligence and Big Data, Crowd Sourcing

Analytics, Inter- and Trans-Firewall Analytics.

Module-3

Meet Hadoop

Data, Data Storage and Analysis, Comparison with Other Systems, RDBMS, Grid Computing, Volunteer Computing, A Brief History of Hadoop, Apache Hadoop and the Hadoop Ecosystem Hadoop Releases Response.

Module-4

The Hadoop Distributed File system

The Design of HDFS, HDFS Concepts, Blocks, Namenodes and Datanodes, HDFS Federation, HDFS High-Availability, The Command-Line Interface, Basic Filesystem Operations, Hadoop Filesystems Interfaces, The Java Interface, Reading Data from a Hadoop URL, Reading Data Using the FileSystem API, Writing Data, Directories, Querying the Filesystem, Deleting Data, Data Flow Anatomy of a File Read, Anatomy of a File Write, Coherency Model, Parallel Copying with distcp Keeping an HDFS Cluster Balanced, Hadoop Archives.

Module-5

A Weather Dataset ,Data Format, Analysing the Data with Unix Tools, Analyzing the Data with Hadoop, Map and Reduce, Java MapReduce, Scaling Out, Data Flow, Combiner functions, Running a Distributed MapReduce Job, Hadoop Streaming, Hadoop Pipes, Compiling and Running, Developing a MapReduce Application, The Configuration API, Combining Resources, Variable Expansion, Configuring the Development Environment, Managing Configuration, GenericOptionsParser, Tool and ToolRunner, Writing a Unit Test, Mapper, Reducer, Running Locally on Test Data, Running a Job in a Local Job Runner, Testing the Driver, Running on a Cluster, Packaging, Launching a Job, The MapReduce Web UI, Retrieving the Results, Debugging a Job, Hadoop Logs, Remote Debugging.

Question Paper Pattern:

- The Question paper will have TEN questions
- Each full question will be for 20 marks
- There will be 02 full questions (with maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting one full question from each module.

Textbooks

1. Bart Baesens, “Analytics in a Big Data World: The Essential Guide to Data Science and its Applications” Wiley.

2. Michael Minelli, Michehe Chambers, “Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today’s Businesses”, 1st Edition, Michael Minelli, Michele Chambers, AmbigaDhiraj, Wiley CIO Series, 2013.

3. Tom White, “Hadoop: The Definitive Guide”, 3rd Edition, O’reilly, 2012.

References

1.Boris Lublinsky, Kevin T. Smith, Alexey Yakubovich, “Professional Hadoop Solutions”, Wiley, ISBN: 9788126551071, 2015.

2. Chris Eaton, Dirk deroos et al., “Understanding Big data”, McGraw Hill, 2012.

3. Vignesh Prajapati, “Big Data Analytics with R and Haoop”, Packet Publishing 2013.

4. Tom Plunkett, Brian Macdonald et al, “Oracle Big Data Handbook”, Oracle Press, 2014.

Choice Based Credit System (CBCS) and Outcome Based Education(OBE)
SEMESTER – III

Wireless Ad Hoc Networks

Course Code : 20MCA353	**CIE Marks : 40**
Contact Periods (L:T:P): 3:0:0	**SEE Marks : 60**
Credits : 03	**Exam Hours : 03**

Course outcomes

CO1: Analyze the issues of ad-hoc wirelessnetwork
CO2 : Evaluate the existing network and improve its quality ofservice
CO3 : Choose appropriate protocol for variousapplications and design the architecture
CO4: Examine security measures present at differentlevels and identify the possible improvements for the latest version of the ad hoc network IEEE standard
CO5 : Analyze energy consumption andmanagement in ad-hoc wirelessnetworks

Module-1

Ad-hoc Wireless Networks Introduction, Issues in Ad-hoc Wireless Networks, Ad-hoc Wireless Internet; MAC Protocols for Ad-hoc Wireless Networks: Introduction, Issues in Designing a MAC Protocol, Design Goals of MAC Protocols, Classification of MAC protocols, Contention- Based Protocols, Contention-Based Protocols with Reservation Mechanisms, Contention-Based Protocols with Scheduling Mechanisms, MAC Protocols that Use Directional Antennas.

Module -2

Routing Protocols for Ad-hoc Wireless Networks Introduction, Issues in Designing a Routing Protocol for Ad-hoc Wireless Networks; Classification of Routing Protocols; Table Driven Routing Protocols; On-Demand Routing Protocols, Hybrid Routing Protocols, Hierarchical Routing Protocols and Power-Aware Routing Protocols.

Module – 3

Multicast Routing in Ad-hoc Wireless Networks Introduction, Issues in Designing a Multicast Routing Protocol, Operation of Multicast Routing Protocols, An Architecture Reference Model for Multicast Routing Protocols, Classifications of Multicast Routing Protocols, Tree-Based Multicast Routing Protocols and Mesh-Based Multicast Routing Protocols.

Module-4

Transport Layer and Security Protocols for Ad-hoc Networks: Introduction, Issues in Designing a Transport Layer Protocol; Design Goals of a Transport Layer Protocol; Classification of Transport Layer Solutions; TCP over Transport Layer Solutions; Other Transport Layer Protocols for Ad-hoc Networks; Security in Ad-hoc Wireless Networks, Issues and Challengesin Security Provisioning, Network Security Attacks, Key Management and Secure Touting Ad-hoc Wireless Networks.

Module-5

Quality of Service and Energy Management in Ad-hoc Wireless Networks: Introduction, Issues and Challenges in Providing QoS in Ad-hoc Wireless Networks, Classification of QoS Solutions, MAC Layer Solutions, Network Layer Solutions; Energy Management in Ad-hoc Wireless Networks: Introduction, Need for Energy Management in Ad-hoc Wireless Networks, Classification of Energy Management Schemes, Battery Management Schemes, Transmission Management Schemes, System Power Management Schemes.
Question Paper Pattern: • The Question paper will have TEN questions • Each full question will be for 20 marks • There will be 02 full questions (with maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer FIVE full questions, selecting one full question from each module.
Textbook
1. Ad-hoc Wireless Networks, C. Siva Ram Murthy& B. S. Manoj, Pearson Education, 2nd Edition, 2011
Reference Books
1. Ad-hoc Wireless Networks, Ozan K. Tonguz and John Wiley, 2007 ,Gianguigi Ferrari
2. Ad-hoc Wireless Networking. Xiuzhen Cheng, Xiao Hung, Ding-Zhu Du, Kluwer Academic Publishers, 2004
3. Ad-hoc Mobile Wireless Networks- Protocols and Systems, C.K. Toh, Pearson Education, 2002

Software Project Management

Choice Based Credit System(CBCS)

Semester: III	**CIE Marks:40**
Course Code:20MCA354	**SEE Marks:60**
Contact Periods (L:T:P):3-0-0	**Exam Hours:03**

Course Out Comes:
CO1:Apply thepracticesandmethodsforsuccessfulsoftwareprojectmanagement
CO2:Identifytechniquesforrequirements,policiesanddecisionmakingforeffectiveresource management
CO3:Illustratetheevaluationtechniquesforestimatingcost,benefits,scheduleandrisk
CO4:Deviseaframeworkforsoftwareprojectmanagementplanforactivities,risk,monitoring andcontrol
CO5:Designaframeworktomanagepeople

Module-1

INTRODUCTIONTOSOFTWAREPROJECTMANAGEMENT
Introduction,WhyisSoftwareProjectManagementimportant?Whatisa Project?, ContractManagement,ActivitiesCoveredbySoftwareProjectManagement, Plans, MethodsandMethodologies,Somewaysof categorizingsoftwareprojects, Stakeholders,SettingObjectives,BusinessCase,ProjectSuccessandFailure,Whatis Management? Management Control, Traditional versus Modern Project ManagementPractices

Module-2

PROJECTEVALUATION&FINANCE

Evaluationof IndividualProjects,CostBenefitEvaluationTechniques,RiskEvaluation, ProgrammeManagement,Managingallocationof ResourceswithinProgrammes, FinancialAccounting–Anoverview– Accountingconcepts,Principles&Standards, Ledgerposting,Trialbalance,ProfitandLossaccountBalancesheet
Module-3
ACTIVITYPLANNING ObjectivesofActivityPlanning,Whento Plan,ProjectSchedules,Sequencingand SchedulingActivities,NetworkPlanningModels,ForwardPass– BackwardPass, Identifyingcriticalpath,ActivityFloat,ShorteningProjectDuration,Activityon Arrow Networks RiskManagement,NatureofRisk,CategoriesofRisk,Aframeworkfordealingwith Risk, Risk Identification, Risk analysis and prioritization, risk planning and risk monitoring
Module-4
MONITORINGANDCONTROL CreatingtheFramework,CollectingtheData,Review,ProjectTerminationReview, VisualizingProgress,CostMonitoring,EarnedValueAnalysis,PrioritizingMonitoring, GettingProjectBackToTarget,ChangeControl,SoftwareConfiguration Management
Module-5
MANAGINGPEOPLEANDWORKINGINTEAMS Introduction,UnderstandingBehavior,OrganizationalBehavior:A Background, SelectingtheRightPersonfortheJob,InstructionintheBestMethods,Motivation, TheOldham–HackmanJobCharacteristicsModel,Stress–HealthandSafety WorkingInTeams,BecomingaTeam,DecisionMaking,Leadership.
Question Paper Pattern: • The Question paper will have TEN questions • Each full question will be for 20 marks • There will be 02 full questions (with maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer FIVE full questions, selecting one full question from each module.
Textbooks
1.BobHughes, MikeCotterell, RajibMall, "Software Project Management", Fifth Edition,TataMcGrawHill,2011. 2."AccountingforManagement"JawaharLal,5th Edition,WheelerPublications,Delhi.
References
1.JackMarchewka," Information Technology-Project Management", Wiley Student Version,4th Edition,2013. 2.JamesPLewis,"ProjectPlanning,Scheduling&Control",McGrawHill,5th Edition, 2011. 3.Pankaj Jalote," Software Project Management in Practise", Pearson Education, 2002.

Software Defined Networks **Choice Based Credit System(CBCS)**	
Semester: III	**CIE Marks:40**
Course Code:20MCA355	**SEE Marks:60**
Contact Periods (L:T:P):3-0-0	**Exam Hours:03**

Course Outcomes:
CO1: Apply the fundamentals of Software Defined Networks for the given problem
CO2: Illustrate the basics of Software Defined Networks Operations and Data flow
CO3: Apply different Software Defined Network Operations and Data Flow
CO4: Analyse alternative definitions of Software Defined Networks
CO5: Apply different Software Defined Network Operations in real world problem

Module-1

Introduction to SDN

Understanding the SDN, Understanding the SDN technology, Control Plane, Data Plane, Moving information between planes, separation of the control and data planes, Distributed control planes, Load Balancing, Creating the MPLS Overlay, Centralized control planes.

Module-2

Working of SDN

Evaluation of Switches and Control planes, SDN Implications, Data centre Needs, Forerunner of SDN, Software Defines Networks is Born, Sustain SDN interoperability, Open source contribution, Fundamental Characteristics of SDN, SDN Operations, SDN Devices, SDN Controllers, SDN Applications, Alternate SDN methods.

Module-3

The Open Flow Specifications

Open Flow Overview, Open Flow Basics, Open Flow 1.0 additions, Open Flow 1.1 additions, Open Flow 1.2 additions, Open Flow 1.3 additions, Open Flow limitations.

Module-4

SDN via APIS, SDN via Hypervisor-Based Overlays, SDN via Opening up the device, Network function virtualization, Alternative Overlap and Ranking.

Module-5

Data centres definition, Data centres demand, tunnelling technologies for Data centres Path technologies in data centres, Ethernet fabrics in Data centres, SDN use case in Data centres.

Question Paper Pattern:

- The Question paper will have TEN questions
- Each full question will be for 20 marks
- There will be 02 full questions (with maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting one full question from each module.

Textbooks

1. Software Defined Networking by Thomas D Nadeau and Ken Gray.
2. Software Define Networks, A Comprehensive Approach, Paul Goransson, Chuck Black. MK Publications.

References

1. Software Defined Networking for Dummies brought you by cisco, Brian Underdahl and Gary Kinghorn.

Data Analytics Lab

Choice Based Credit System

Semester:III	CIE Marks:40
Subject Code:20MCA36	SEE Marks:60
Contact Hours(L:T:P):0:0:4	Exam Hours:03

Course Outcomes:

1.Develop python program to perform search/sort on a given data set

2.Demonstrate object oriented principles

3. Demonstrate data visualization using Numpy for a given problem

4. Demonstrate regression model for a given problem

5.Deign and develop an application for the given problem

1.Write a Python program to perform linear search

2.Write a Python program to insert an element into a sorted list

3.Write a python program using object oriented programming to demonstrate encapsulation, overloading and inheritance

4.Implement a python program to demonstrate

1) Importing Datasets 2) Cleaning the Data 3) Data frame manipulation using Numpy

5.Implement a python program to demonstrate the following using NumPy

a) Array manipulation, Searching, Sorting and splitting.

b) broadcasting and Plotting NumPy arrays

6. Implement a python program to demonstrate

Data visualization with various Types of Graphs using Numpy

7.Write a Python program that creates a mxn integer arrayand Prints its attributes using matplotlib

8.Write a Python program to demonstrate the generation of linear regression models.

9.Write a Python program to demonstrate the generation of logistic regression models using Python.

10.Write a Python program to demonstrate Timeseries analysis with Pandas.

11.Write a Python program to demonstrate Data Visualization using Seaborn.

Part-B

6. Students shall carry out a mini project using python/pandas to demonstrate the data analysis.
7. A team of two students must develop the mini project. However during the examination, each student must demonstrate the project individually.
8. The team must submit a brief project report (20-25 pages) that must include the following

a. Introduction b. Requirement Analysis c Software Requirement Specification
d. Analysis and Design, e. Implementation f. Testing

9. Brief synopsis not more than two pages to be submitted by the team as per the format given. It is recommended that students to do prior art search as part of literature survey before submitting the synopsis for the Mini/Major projects.
10. Rubrics may be used to evaluate the Mini-Project

Each students has to execute one program picked from Part-A during the semester end examination. In SEE Part-A and Part-B shall be given 50% weightage each.

Mini project with IOT Lab

Choice Based Credit System

Semester :III	CIE Marks:40
Subject Code:20MCA37	SEE Exam:60
Contact Hours(L:T:P)0:0:4	Exam Hours:03

Course Outcomes:

CO**1:** Demonstrate theIoT architecture design for a given problem

CO**2:** Apply IOT techniques for a given problem

CO**3:** Analyse the application protocol, transport layer methods for the given business case.

CO**4:** .Design and develop an application for the given problem for the societal/industrial problems

CO5: Develop python program by applying suitable feature for the given problem and verify the output

1.Run some python programs on Pi like: Read your name and print Hello message with name Read two numbers and print their sum, difference, product and division.Word and character count of a given string Area of a given shape (rectangle, triangle and circle) reading shape and appropriate values from standard input Print a name 'n' times, where name and n are read from standard input, using for and while loops. Handle Divided by Zero Exception. Print current time for 10 times with an interval of 10 seconds.

Read a file line by line and print the word count of each line.

2.Get input from two switches and switch on corresponding LEDs

3.Flash an LED at a given on time and off time cycle, where the two times are taken from a file.

4.Switch on a relay at a given time using cron, where the relay's contact terminals are connected to a load.

5.Access an image through a Pi web cam

6.Control a light source using web page.

7.Implement an intruder system that sends an alert to the given email.

8.Get the status of a bulb at a remote place (on the LAN) through web.
9.Get an alarm from a remote area (through LAN) if smoke is detected. The student should have hands on experience in using various sensors like temperature, humidity, smoke, light, etc. and should be able to use control web camera, network, and relays connected to the Pi.
Part-B
1. A team of two students must develop the mini project. However during the examination, each student must demonstrate the project individually. 2. The team must submit a brief project report (20-25 pages) that must include the following a. Introduction b. Requirement Analysis c Software Requirement Specification d. Analysis and Design, e. Implementation f. Testing 3. Brief synopsis not more than two pages to be submitted by the team as per the format given. It is recommended that students to do prior art search as part of literature survey before submitting the synopsis for the Mini/Major projects. 4. Rubrics may be used to evaluate the Mini-Project Each students has to execute one program picked from Part-A during the semester end examination. In SEE Part-A and Part-B shall be given 50% weightage each.

Advances in Java Lab **Choice Based Credit System**	
Semester: III	CIE Marks:40
Subject Code:20MCA38	SEE Marks:60
Contact Hours(L:T:P):0:0:4	Exam Hours:03
Course Outcomes: at the end of the course students will be able to CO1: Apply the concept of Servlet and its life cycle to create web application. CO2: Apply JSP tags and its services to web application. CO3: Create packages and interfaces in the web application context. CO4: Build Database connection for the web applications. CO5: Develop application programs using beans concept.	
1.Write a JAVA Servlet Program to implement a dynamic HTML using Servlet (user name and	

Password should be accepted using HTML and displayed using a Servlet).
2.Write a JAVA Servlet Program to Auto Web Page Refresh (Consider a webpage which is displaying Date and time or stock market status. For all such type of pages, you would need to refresh your web page regularly; Java Servlet makes this job easy by providing refresh automatically after a given interval).
3.Write a JAVA Servlet Program to implement and demonstrate GET and POST methods (Using HTTP Servlet Class).
4.Write a JAVA Servlet Program using cookies to remember user preferences.
5.Write a JAVA Servlet program to track HttpSession by accepting user name and password using HTML and display the profile page on successful login.
6.Write a JSP Program which uses jsp:include and jsp:forward action to display a Webpage.
7.Write a JSP Program which uses tag to run an applet
8.Write a JSP Program to get student information through a HTML and create a JAVA Bean class, populate Bean and display the same informationthrough another JSP
9. Write a JSP program to implement all the attributes of page directive tag.
10.Write a JAVA Program to insert data into Student DATA BASE and retrieve info based on particular queries (For example update, delete, search etc…).
11.An EJB application that demonstrates Session Bean (with appropriate business logic).
12.An EJB application that demonstrates MDB (with appropriate business logic).
13. An EJB application that demonstrates persistence (with appropriate business logic).

Semester-IV

Sl. No.	Course Type	Course Code	Title	Teaching Hours/Week			Examination				Credits
				Tutorial (T)	Lecture (L)	Practical (P) / Seminar (S)	Duration (in Hrs.)	CIE Marks	SEE Marks	Total Marks	
1.	PCC	20MCA41	Advances in web technologies	2	2	-	3	40	60	100	2
2.	PCC	20MCA42	Programming using C#	2	2	-	3	40	60	100	2
	PCC	20MCA43	Industry Internship (4 weeks)	-	-	-	-	100	-	100	2
3.	PCC	20MCA44	Project Work (16 Weeks)	-	-	2*	3	40	60	100	20
			TOTAL	4	4	2	-	220	180	400	26

**** Two hours per week is allocated to the faculty members in order to review the progress of the students' projects. The students will present the progress to the faculty member or discuss about the further direction of project work during the allocated hours. Students shall maintain diary where in he/she records the weekly work done duly signed by internal/external guides.***

Advances in Web Technologies

Choice Based Credit System

Semester: IV	CIE Marks:40
Course Code:20MCA41	SEE Marks:60
Contact Hours (L:T:P): 2:2:0	Exam Hours:03

Course Outcomes: At the end students will be able to

CO1: Build the Web Applications using JQuery, PHP, XML for the given problem

CO2: Design the Web Pages using AJAX for the given problem.

CO3: Analyse the advances in Web2.0 and demonstrate its usage for the problem considered.

CO4 Analyse the web services and demonstrate its usage for the problem considered.

CO5: Design responsive web applications using Bootstrap for the given problem.

Module-1

Module 1:

Introduction to PHP: Origins and uses of PHP, Overview of PHP, General syntactic characteristics, Primitives, operations andexpressions, Output, Control statements, Arrays, Functions, Pattern matching.

Building Web applications with PHP:

Form handling, Files, Tracking users, cookies, sessions, Using databases, Handling XML.

Module-2

Introduction to Ruby and Introduction to Rails:

Origins and uses of Ruby, Scalar types and their operations ,Simple input and output, Controlstatements, Arrays, Hashes, Methods, Classes, Codeblocks and iterates, Pattern matching.

Overview of Rails, Document requests, Processing forms, Layouts. Rails applications with Databases.

Module-3

Rich Internet Applications With Ajax: Limitations of Classic Web application model, AJAX principles,Technologies behind AJAX, Examples of usage of AJAX; Asynchronous communication and AJAXapplication model.

Ajax with XMLHTTP object: Part 1

Creating Ajax Applications: An example, Analysis of example ajax.html, Creating the JavaScript, Creatingand opening the XMLHttpRequest object, Data download, Displaying the fetched data, Connecting tothe server, Adding Server-side programming, Sending data to the server using GET and POST.

Module-4

Ajax with XMLHTTP object: Part 2

Handling multiple XMLHttpRequest objects in the same page, Using two XMLHttpRequest objects, Usingan array of XMLHttpRequestobjects,AJAX Patterns – Predictive Fetch, Multi-stage download, PeriodicRefresh and Fallback patterns, Submission throttling.

Module-5

Introduction to Bootstrap:

What Is Bootstrap? Bootstrap File Structure, Basic HTML Template, Global Styles, Default Grid System,Basic Grid HTML, Offsetting Columns, Nesting Columns, Fluid Grid System, Container Layouts,Responsive Design. Typography, Emphasis Classes, Lists, Code, Tables, Optional Table Classes, Table RowClasses, Forms, Buttons, Images, Icons.

Question Paper Pattern:

- The Question paper will have TEN questions
- Each full question will be for 20 marks
- There will be 02 full questions (with maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting one full question from each module.

Textbooks

1. RobertW.Sebesta: Programming the Worldwide Web, 4thEdn, Pearson, 2012
2. Professional AJAX – Nicholas C Zakas et al, Wrox publications, 2008.
3. Steven Holzner: Ajax: A Beginner's Guide, Tata McGraw Hill, 2014.
4. Jake Spurlock: "Bootstrap: Responsive Web Development", O'Reilly Media, 2014.

Reference books

1. Thomas A. Powel: Ajax The Complete reference, McGraw Hill,2008.
2. AravindShenoy, Ulrich Sossou: Learning Bootstrap, Packt, Dec 2014.
3. Dana Moore, Raymond Budd, Edward Benson: Professional Rich Internet Applications: AJAX andBeyond, Wiley 2012.

Programming using C#

Choice Based Credit System(CBCS)

Semester: IV	**CIE Marks:40**
Course Code:20MCA42	**SEE Marks:60**
Contact Periods (L:T:P): 2:2:0	**Exam Hours:03**

Course Out Comes:

CO1:Analyse C#andclient-serverconceptsusing.NetFrameWork Components.

CO2:Applydelegates,eventandexceptionhandlingtoincorporatewithASP,WinForm, ADO.NET.

CO3:Analyzetheuseof.NetComponentsdependingontheproblemstatement.

CO4:Implement&developawebbasedandConsolebasedapplicationwithDatabase connectivity

CO5: Implement & develop a web based application with Databaseconnectivity

Module-1

Gettingstartedwith.NETFramework4.0andC#

Understanding PreviousTechnologies, Benefitsof.NETFramework,Architecture of.NETFramework 4.0,.NET Execution Engine, Components of.NET Framework 4.0: CLR,CTS,MetadataandAssemblies,.NETFrameworkClassLibrary,WindowsForms, ASP.NETand ASP.NETAJAX,ADO.NET,WindowsworkflowFoundation,Windows PresentationFoundation,WindowsCommunicationFoundation,WidowsCardSpace andLINQ.

IntroducingC#

Creating aSimple C# Console Application, Identifiers and Keywords. System DataTypes,Variablesand Constants:ValueTypes,ReferenceTypes,UnderstandingType Conversions,BoxingandUnBoxing.Namespaces,TheSystemnamespace,.NETArray Types.

Module-2

Classes,ObjectsandObjectOrientedProgramming

Classes and Objects: Creating a Class, Creating an Object, Using this Keyword, CreatinganArrayofObjects,UsingtheNestedClasses,DefiningPartialClassesand Method,ReturningaValuefroma MethodandDescribingAccessModifiers.Static Classes and StaticMembers, Properties: Read-only Property, Static Property, Indexers,Structs:SyntaxofastructandAccessModifiersforstructs,System.ObjectClass

Encapsulation: Encapsulation using accessors and mutators, Encapsulation using Properties. Inheritance: Inheritanceand Constructors, Sealed Classes and Sealed Methods,Extensionmethods.

Polymorphism:Compiletime Polymorphism/Overloading,RuntimePolymorphism/ Overriding.Abstraction:Abstractclasses,Abstract methods.Interfaces:Syntaxof Interfaces,ImplementationofInterfacesandInheritance.

Module-3

Delegates,Events,ExceptionHandlingandADO.NET

Delegates:CreatingandusingDelegates,MuticastingwithDelegates. Events:Event Sources,EventHandlers,EventsandDelegates,MultipleEventHandlers.

Exception Handling: The try/catch/throw/finally statement, Custom Exception.System.Exception, HandlingMultipleException.\

DataAccesswithADO.NET:UnderstandingADO.NET:DescribingtheArchitectureof ADO.NET,ADO.NET,ADO.NETEntityFramework.CreatingConnectionStrings:Syntax forConnectionStrings.Creatinga Connectiontoa Database:SQLServerDatabase,

OLEDBDatabase,ODBCDataSource.Creatinga CommandObject.Workingwith DataAdapters:CreatingDataSetfromDataAdapter.
Module-4
GraphicalUserInterfacewithWindowsFormsandWPF WindowsForms:Introduction,WindowsForms,EventHandling:A SimpleEvent- Driven GUI, Control Properties and Layout, Labels, TextBoxesand Buttons, GroupBoxesand Panels,CheckBoxesand RadioButtons,ToolTips,Mouse-Event Handling, Keyboard-Event Handling. Menus, Month Calendar Control, LinkLabelControl,ListBoxControl, ComboBoxControl,TreeViewControl,ListViewControl, TabControlandMultipleDocumentInterface(MDI)Windows. WPF:New WPF Controls,WPF Architecture:PresentationFramework,Presentation Core, WindowsBase, MILorMilcore,Working withWPFWindows: UsingXAMLin WPF4.0Applications: Contentsof XAMLandWPFApplications:XAMLElements NamespaceandXAML,XAMLPropertySyntax,MarkupExtensions.
Module-5
WebAppDevelopmentandDataAccessusingADO.NET Introduction,WebBasics,MultitierApplicationArchitecture,Your First Web Application: Building Web-Time Application, Examining Web-Time.aspx'sCode-BehindFile,UnderstandingMasterpages, StandardWebControls:DesigningaForm, Validation Controls, GridViewControl, DropDownList, Session Tracking, ASP.NET AJAX:ExploringAJAX,NeedforAJAX,AJAXand otherTechnologies,AJAXServer Controls,ScriptManagercontrol, UpdatePanel, UpdateProgressControl,Creating SimpleApplicationusingAJAXServerControls
Question Paper Pattern: • The Question paper will have TEN questions • Each full question will be for 20 marks • There will be 02 full questions (with maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer FIVE full questions, selecting one full question from each module.
Textbooks
1. .NET4.0Programming(6-in-1),BlackBook,KogentLearningSolutionsInc.,Wiley-DreamTechPress.(Chapters:1,10,11,12,13,14and19). 2. PaulDeitelandHarveyDeitel:C#2010forProgrammers,4th Edition,PearsonEducation. (Chapters:14,15,19and27.3)
References
1.AndrewTrolsen:ProC#5.0andthe.NET4.5Framework,6th Edition,Wiley-Appress. 2.BartDeSmet:C#4.0Unleashed,PearsonEducation-SAMSSeries. 3.HerbertSchildt:CompleteReferenceC#4.0,TataMcGrawHill,2010.

Industry Internship **Choice Based Credit System**	
Semester: IV	CIE Marks: 100
Course Code: 20MCA43	SEE Marks:---
Contact Hours (L:T:P/S): 0:0:0	Exam Hours:-

Course outcomes:

CO1: Analyse the real-time industry/research work environment with emphasis on organizational structure/job process/different departments and functions / tools /technology.

CO2: Develop applications using modern tools and technologies.

CO3: Demonstrate self-learning capabilities with an effective report and detailed presentation.

General Rules

1) All the students have to undergo mandatory internship of 4 weeks during the vacation of 3rd semester to take up individual project in companies/respective Colleges at higher than the mini project standards already taken up during previous semesters.
2) Internship shall be considered as a head of passing and shall be considered for the award of degree.
3) Those, who do not take-up/complete the internship shall be declared as fail in internship course and have to complete the same during the subsequent semester.
4) After satisfying the internship requirements the degree will be awarded.
5) However, student can carry out 4thsemester project without completing the internship.
6) The student can present the progress about the internship to the committee at the department level.
7) CIE marks shall be evaluated with a weightage of Internship presentation for 50 marks and reports for 50 marks . The marks can be awarded to the student based on the criteria/rubrics formulated by the department.
8) The student has to submit a report about the outcome of the internship at the end of the semester along with the project report.
9) The internship report submitted by the studenthas to be evaluated by the guide concerned / a committee constituted by the head of the department.
10) The report shall be preserved at the department for future reference.

Project Work

Choice Based Credit System

Semester: IV	CIE Marks:40
Course Code:20MCA44	SEE Marks:60
Contact Hours (L:T:P/S): 0:0:0/2	Exam Hours:03

Course outcomes:

Course outcomes: At the end of this course, the students will be able to

CO1: Identify a suitable problem making use of the technical and engineering knowledgegained from previous courses with the awareness of impact of technology on the societyand their ethical responsibilities.

CO2: Work as an individual and team to segregate work and execute/implement

projects using appropriate tools.
CO3: Develop skills to disseminate technical and general information by means of oral aswell as written presentation and professional skills.
CO4: To conduct testing of application using appropriate techniques and tools.
CO5: To enhance interpersonal skills and group cohesion among the peers during the project work

General Rules

- The candidate should carry out the project individually in any industry or R&D institution or educational institution under a guide/co-guide.
- The candidate has to present the work carried out before the examiners during the University examination.
- The work out carried out should be free from plagiarism as per the guideline provided by the university.
- The literature study may be clearly written which may be summary of existing project and highlight of what are the functionalities that are proposed to this project.
- Student shall indicate the different research papers, documents refereed as a part of the literature study. It is recommended to do prior art search as part of literature survey before submitting the synopsis for the projects.
- This is an individual project for a duration of minimum of 4 months or duration of the semester.
- Regular project work weekly diary should be maintained by the students, signed by the external guide and internal guide in order to verify the regularity of the student.
- Project work may be application/testing or research-oriented and accordingly the project report contents may vary.
- The presentation should be given at various levels such as Synopsis, SRS, Design and Project implementation/ completion levels.
- Student has to publish a paper in conference or journal of either National or International level
- Paper publication in an indexed journal/conference is compulsory as part of the project work.
- Publications follow the Thesis. 10% weightage is given in SEE.
- There shall be three project presentations each to be considered for 5 marks (5X3= 15 marks) and a final presentation for 15 marks. Presentation may be given using Power point presentation/demonstrations of the work. Synopsis submitted in a proper format is to be evaluated for 10 marks.
- The students are informed to strictly follow the report format as prescribed by the University. However as per the title/domain of the project with a suitable justification guide/department can make the minor changes.
- If the project report is not as per the format, internal guide / external examiner will have every right to reject the project.
- The Students are encouraged and appreciated to show their project demo along

with their power pointduring their viva-voce exams as an added advantage.

- In case of the paper publication could not be completed before the submission of the report, or acceptance received from the organiser of the conference / journal authorities should be included while uploading/submitting the report to the university.

Rubrics / Scheme of Evaluation:

Course Code	Title	Internal (CIE)					External (SEE)			Total Marks
		Review-1	Review-2	Review-3	Final Review	Synopsis	Dissertation evaluation	Paper Publication	Viva-Voce	
20MCA44	Project Work	5	05	05	15	10	24	6	30	100

Each Faculty member shall be allocated to supervise individual internship/project work as an internal guide and review the internship/ project work carried out on weekly basis for a minimum of one hour duration. The review carried out shall be recorded week-wise in a dairy maintained for it.

VISVESVARAYA TECHNOLOGICAL UNIVERSITY

JNANA SANGAMA, BELAGAVI

Internship Report on

<INTERNSHIP TOPIC>

Submitted in partial fulfillment of the requirements of the 4th Semester in

MASTER OF COMPUTER APPLICATIONS

BY

<<STUDENT NAME>>

<<USN>>

Under the Guidance of

<<Guide1Name1>>

<<Designation>>

<<Guide**2** Name**2**>>

<<Designation>>

<<Affiliated College Logo>>

<< College Name and Address>>

2021-22 Even Semester

<< College name and Address.>

<<College Logo>>

INTERNSHIP CERTIFICATE

This is to certify that <<**Student Name**>> bearing <<**USN**>> has satisfactorily completed the Internship – 20MCA43entitled **<<Topic>>** in the academic year **2021-22**as prescribed by VTU for IV Semester of Master of Computer Applications.

Signature of the internal/external Guide **Signature of the HOD**

ACKNOWLEDGEMENT

<College name Address>>

<<College Logo>>

VISION

MISSION

PROGRAMME EDUCATIONAL OBJECTIVES

PEO 1

Develop innovative IT applications to meet industrial and societal needs

PEO 2

Adapt themselves to changing IT requirements through life-long learning

PEO 3

Exhibit leadership skills and advance in their chosen career

PROGRAM OUTCOMES

PO1: Apply knowledge of computing fundamentals, computing specialization, mathematics and domain knowledge to provide IT solutions

PO2: Identify, analyse and solve IT problems using fundamental principles of mathematics and computing sciences

PO3: Design, Develop and evaluate software solutions to meet societal and environmental concerns

PO4: Conduct investigations of complex problems using research based knowledge and methods to provide valid conclusions.

PO5: Select and apply appropriate techniques and modern tools for complex computing activities

PO6: Practice and follow professional ethics and cyber regulations

PO7: Involve in life-long learning for continual development as an IT professional.

PO8: Apply and demonstrate computing and management principles to manage projects in multidisciplinary environments by involving in different roles

PO9: Comprehend& write effective reports and make quality presentations.

PO10: Understand and assess the impact of IT solutions on socio-environmental issues

PO11: Work collaboratively as a member or leader in multidisciplinary teams.

PO12: Identify potential business opportunities and innovate to create value to the society and seize that opportunity

Internship (20MCA43)

Course Outcomes

1. Analyse the real-time industry/research work environment with emphasis on organizational structure/job process/different departments and functions / tools /technology.
2. Develop applications using modern tools and technologies.
3. Demonstrate self-learning capabilities with an effective report and detailed presentation.

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3		3					2		
CO2			3	3	3						2	
CO3						3	3		3			

Rubrics for Internship Presentation Assessment

	Excellent (10)	V. Good (8)	Good (6)	Satisfactory (4)	Poor (2)	Final Score
Knowledge on Industry experience /Research work	Demonstrates in depth knowledge about Industry / Research processes; answered all questions with elaboration	Adequate knowledge on most of the industry/ Research processes. Answered all questions but failed to elaborate	Knowledge to a limited extent on major processes. Able to answer most of the questions though not elaborate	Superficial knowledge of topic; only able to answer basic questions	Does not have any knowledge; Unable to answer questions	
Organization of the presentation	Presented in logical sequence; introduction and background given in proper context; key points and conclusions are clear and well presented with citations and references	Most information presented in logical sequence; clear introduction; adequate background; some irrelevant information. Some References are overlooked	Organized in a presentable manner though lacks details of some of the topics. Or very less references and citations.	Problems with sequencing, lacks clear transitions; incomplete or overly detailed introduction, emphasis given to less important information	Little or no organization, difficult to follow; missing or ineffective introduction; confusing background; key points unclear	
Usage of Modern tools and technologies	Effectively utilized appropriate tools and technologies for implementation.	Involved sufficiently in developing applications by	Developed applications, though not very effectively. Fair	Sufficient for understanding but not clearly elaborated about usage of tools	Too brief or insufficient for understanding or too detailed	

		utilizing modern tools and technologies	enough.	and technologies		
Presentation Skills	Clear articulation about tools/technology, steady delivery rate, good posture and eye contact, confident and appropriately dressed	Clear articulation about tools/technology but not very polished. Able to recover from minor mistakes. Appropriately dressed	Good articulation about tools/technology and not very polished. Not able to realize minor mistakes. Presentable attire	Refers to slides to make points, occasional eye contact, incorrect pronunciations, and Voice fluctuation.	No clarity in sentence, Inaudible or too loud, no eye contact, delivery rate is too slow or too fast, not in formal attire	
Visuals	Visually pleasing and easy to read; good use of white space, colour, backgrounds; images and Graphics support.	Adequate layout, but with some fonts, colours, backgrounds difficult to read	Good visuals but can be improved largely.	Difficult to read, cluttered appearance; images improperly sized; some distracting graphics or animations	Confusing layout, text extremely difficult to read; many graphics, sounds, animations distract from the presentation	
Total Score						

Rubrics for Internship Report Assessment

	Excellent (10)	V. Good (8)	Good(6)	Satisfactory (4)	Poor (2)	Final Score
Purpose and Objective of Internship	The purpose and objective of the Internship report is made clear, and the report addresses the objective(s) in a focused and logical manner.	The purpose and objective of the Internship report is made clear, and the report addresses the objective(s).	Documented well but with slight ambiguity in analyzing the problems	Purpose and objectives are stated ambiguously	The report does not clearly address the objective(s) of Internship.	
Documenting the essence of Tools/Technology used, Grammar & Spelling	Complete information is provided about tools/technology, Very few spelling errors, correct punctuation, grammatically correct, complete sentences.	Information is provided about tools/technology, Occasional lapses in spelling, punctuation, grammar, but not enough to seriously distract the reader.	Average technical details on tools/technology usage, Grammatical mistakes not corrected.	Less technical details, sentences are not framed properly and with a few spelling mistakes	No details about tools/technology, Numerous spelling errors, non-existent or incorrect punctuation, and/or severe errors in grammar that interfere with understanding.	
Code Development / self learning	Design and Code is self-developed wherever applicable.	Design and Code is self-developed wherever applicable. Code snippets are partially cited	Design and Code is not partially self-developed wherever applicable	Major part of the implementation is copied.	No details about design and development	
Report Format	All required elements of the report are present	All required elements of the report are present	All required elements are	All required elements are	Key elements of the report are not	

	and completed efficiently.	and completed to a satisfactory standard.	present but some of them are not given completely	provided but in a haphazard way	provided. Overall presentation of the document is not to a professional standard.	
Plagiarism Check	Uniqueness 90% and above	Uniqueness 85% to 89%	Uniqueness 80% to 85%	Uniqueness between 75% to 79%	Uniqueness less than 75%	
	Total Score					

Rubrics for Internship Presentation and Question/ Answer

(Knowledge on Industry experience /Research work) Assessment (out of 25+ 25marks)

Rubrics for Internship Report Assessment (out of 50 marks) =

Total Marks (Out of 100 marks) =

Signature of Project Guide

Table of Contents

Page No.

Department of Master of Computer Applications

Rubrics for Technical/Research Seminar Presentation Assessment

Name of the Student: **USN:**

Seminar Guide:

Particulars	Excellent (4)	Good (3)	Fair (2)	Poor (1)	Final Score
Knowledge of the topic at analyse level	Demonstrates in depth knowledge; answered all questions with elaboration	Adequate knowledge on most of the topics. Answered all questions but failed to elaborate	Superficial knowledge of topic; only able to answer basic questions	Does not have any knowledge; Unable to answer questions	
Organization of the presentation	Presented in logicalsequence; introductionand background giveproper context; key pointsand conclusions are clearand well presented	Most information presented in logical sequence; clear introduction; adequate background; some irrelevant information	Problems withsequencing, lacks clear transitions; incomplete or overly detailed introduction, Emphasis given to less important information	Little or no organization, difficult to follow; missing or ineffective troduction; confusing background; key points unclear	
Level of Understanding	Sufficient for understanding and presented very effectively	Sufficient for understanding and presented well	Sufficient for understanding but not clearly presented	Too brief or insufficient for understanding or too detailed	

Presentation Skills	Clear articulation, steady delivery rate, good posture and eye contact, confident and appropriately dressed	Clear Articulation but not very polished. Able to recover from minor mistakes. Appropriately dressed	Refers to slides to make points, occasional eye contact, incorrect pronunciations, and Voice fluctuation.	Inaudible or too loud, no eye contact, delivery rate is too slow or too fast, not in formal attire	
Visuals	Visually pleasing and easy to read; good use of white space, colour, backgrounds; images and Graphics support.	Adequate layout, but with some fonts, colours, backgrounds difficult toread	Difficult to read, cluttered appearance; images improperly sized; some distracting graphics or animations	Confusing layout, text extremely difficult to read;many graphics, sounds, animations distract from the presentation	
				Total Score	

Rubrics for Seminar Report Assessment

	Excellent (2)	**Good (1)**	**Poor(0)**	**Final Score**
Objective, relevance, impact and conclusion	The purpose and objective, relevance and impact of the topic is made clear, and the report addresses them in a focused and logical manner.	The purpose and objective, relevance and impact of the topic is made clear, and the report addresses them.	The report does not clearly address any of them.	

Grammar & Spelling	Very few spelling errors, correct punctuation, grammatically correct, complete sentences.	Occasional lapses in spelling, punctuation, grammar, but not enough to seriously distract the reader.	Numerous spelling errors, non-existent or incorrect punctuation, and/or severe errors in grammar that interfere with understanding.	
References	Sources are acknowledged with full reference details.	Sources are acknowledged with bare reference details.	Sources are not acknowledged.	
Report Format	All required elements of the report are present and completed efficiently.	All required elements of the report are present and completed to a satisfactory standard.	Key elements of the report are not provided. Overall presentation of the document is not to a professional standard.	
Plagiarism Check	Plagiarism below 10%	Plagiarism between 10% and 25%	Plagiarism more than 25%	
Total Score				

The seminar rubrics can be mapped to the following POs:

POs / Rubrics	PO1/PO2	PO5/PO6	PO7	PO9	PO10
Knowledge of the topic	3		3		2
Organization of the presentation& Report	2	3	3	3	
Level of Understanding			3		1
Presentation Skills			3	3	
Visuals		3	3	3	

PO1: Apply knowledge of computing fundamentals to provide IT solutions.

PO2: Analyse IT problems using fundamental principles of mathematics and computing sciences

PO5: modern tool usage [for references handling, plagiarism check, spelling check etc]

PO6: Understand professional ethics, cyber regulations, and responsibilities.

PO7: Engage and learn independently for continual development as an IT professional.

PO9: Comprehend, write effective reports and make quality presentations.

PO10: Understand the impact of IT solutions on socio-environmental issues

Course outcomes: At the end of the Seminar Course, students will be able to

CO1: Analyse relevant topic in computing sciences and make valid conclusions on industry/society/environment using fundamental/ research based knowledge

[mapped to PO1, PO2 and PO10]

CO2: Demonstrate self-learning by making effective presentation and report writing

[Mapped to PO7 and PO9]

CO3: Understand ethics, cyber regulations / responsibilities and demonstrate the same by using relevant / modern tool [mapped to PO5 and PO6]

Rubrics for Seminar Presentation Assessment (out of 50 marks) =

Rubrics for Seminar Report Assessment(out of 50 marks) =

Total Marks (Out of 100 marks) =

Note : Marks obtained out of 100 may be considered as attainment of CO1, CO2 and CO3 taken together.

Signature of Seminar Guide / Coordinator

1. **Name:**
   Signature:

2. Name:
Signature:

Signature of HOD

Note: Department offering MCA programme can define its own programme outcomes/course outcomes/rubrics. Sample of such items given here may be referred.

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI.

Scheme of Teaching and Examinations and Syllabus

MASTER OF BUSINESS ADMINISTRATION

(Effective from Academic year 2020 - 21)

SCHEME OF TEACHING AND EXAMINATION

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI
Scheme of Teaching and Examinations – 2020 - 21
MASTER OF BUSINESS ADMINISTRATION
Choice Based Credit System (CBCS) and Outcome Based Education(OBE)

I SEMESTER

Sl. No	Course	Course Code	Course Title	Teaching Hours /Week		Examination				Credits
				Theory	Practical component	Duration in hours	CIE Marks	SEE Marks	Total Marks	
1	PCC	20MBA11	Management & Organizational Behavior	03	02	03	40	60	100	4
2	PCC	20MBA12	Managerial Economics	03	02	03	40	60	100	4
3	PCC	20MBA13	Accounting for Managers	03	02	03	40	60	100	4
4	PCC	20MBA14	Business Statistics	03	02	03	40	60	100	4
5	PCC	20MBA15	Marketing Management	03	02	03	40	60	100	4
6	PCC	20MBA16	Managerial Communication	03	02	03	40	60	100	4
			TOTAL	**18**	**12**	**18**	**240**	**360**	**600**	**24**

Note:
PCC: Professional Core Course
Practical /Field Work / Assignment are part of contact hours for the faculty and must be considered in the workload.
Four credit courses are designed for 50 hours Teaching – Learning process.

Note:

1. Each course has a theory component of 3hrs (3credits) and a practical component of 2hrs (1credit). The time-table allotment for each course should be 5hrs (3+2). For the practical component it is mandatory to maintain a record.
2. 20% of marks should be allocated for application oriented questions in the **Semester End Examination (SEE)** question paper based on practical component.
3. Each course content has indicative case studies which can be dealt in the class by the course instructor. In addition to this the course instructor may use an extra case from Harvard/Case Centre. The student cannot assume the same cases will be part of the SEE question paper.
4. One industrial visit per semester is mandatory. The department shall insist on report submission by each student and shall maintain this as a documentary proof. The format of the report shall be prescribed by the department.
5. Students and course instructor/s to involve either individually or in groups to interact together to enhance the learning and application skills.
6. **Practical component:**
   Students should interact with industry (small, medium and large) to understand their problems or foresee what can be undertaken for study in the form of research/ testing / projects and for creative and innovative methods for guidance and to solve the identified problem.
7. **The students shall**
   (a) Gain confidence in modeling of management systems.
   (b) Work on different software/s (tools) to simulate, analyse and authenticate the output to interpret and conclude.
   (c) Involve in case studies and field visits/ field work.
   (d) Accustom with the use of standards to narrow the gap between academia and industry.

   All activities should enhance student's abilities to employment and/or self-employment opportunity, management skills, statistical analysis, fiscal expertise etc.

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI
Scheme of Teaching and Examinations – 2020 - 21
MASTER OF BUSINESS ADMINISTRATION
Choice Based Credit System (CBCS) and Outcome Based Education(OBE)

II SEMESTER

Sl. No	Course	Course Code	Course Title	Teaching Hours /Week		Examination				Credits
				Theory	Practical Component	Duration in hours	CIE Marks	SEE Marks	Total Marks	
1	PCC	20MBA21	Human Resource Management	03	02	03	40	60	100	4
2	PCC	20MBA22	Financial Management	03	02	03	40	60	100	4
3	PCC	20MBA23	Research Methodology	03	02	03	40	60	100	4
4	PCC	20MBA24	Operations Research	03	02	03	40	60	100	4
5	PCC	20MBA25	Strategic Management	03	02	03	40	60	100	4
6	PCC	20MBA26	Entrepreneurship & Legal Aspects	03	02	03	40	60	100	4
TOTAL				**18**	**12**	**18**	**240**	**360**	**600**	**24**

Note:
PCC: Professional Core Course
Practical /Field Work / Assignment are part of contact hours for the faculty and must be considered in the workload.
Four credit courses are designed for 50 hours Teaching – Learning process.

Note:

1. Each course has a theory component of 3hrs (3credits) and a practical component of 2hrs (1credit). The time-table allotment for each course should be 5hrs (3+2). For the practical component it is mandatory to maintain a practical record.
2. 20% of marks should be allocated for application oriented questions in the SEE Question Paper, based on practical component.
3. Each course content has indicative case studies which can be dealt in the class by the course instructor. In addition to this the course instructor may use an extra case from Harvard/Case Centre. The student cannot assume the same cases will be part of the question paper.
4. One industrial visit per semester is mandatory. The department shall insist on report submission by each student and shall maintain this as a documentary proof. The format of the report shall be prescribed by the department.
5. Internship (four weeks) to be carried out by students after second semester during vacation and the report submitted by the students be assessed internally during the third semester.

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI
Scheme of Teaching and Examinations – 2020 - 21
MASTER OF BUSINESS ADMINISTRATION
Choice Based Credit System (CBCS) and Outcome Based Education(OBE)

III SEMESTER(Core Courses and Specialisation Courses)

Sl. No	Course	Course Code			Teaching Hours /Week		Examination				Credits
		Marketing	Finance	Human Resource	Theory	Practical Component	Duration in hours	CIE Marks	SEE Marks	Total Marks	
1	PCC	20MBA301*	20MBA301*	20MBA301*	03	02	03	40	60	100	4
2	PCC	20MBA302*	20MBA302*	20MBA302*	03	02	03	40	60	100	4
3	PEC	20MBAMM303	20MBAFM303	20MBAHR303	03	02	03	40	60	100	4
4	PEC	20MBAMM304	20MBAFM304	20MBAHR304	03	02	03	40	60	100	4
5	PEC	20MBAMM305	20MBAFM305	20MBAHR305	03	02	03	40	60	100	4
6	PEC	20MBAMM306	20MBAFM306	20MBAHR306	03	02	03	40	60	100	4
7	PCC	20MBA IN 307	20MBA IN 307	20MBA IN 307	-	08	-	40	60	100	4
TOTAL					**18**	**20**	**18**	**280**	**420**	**700**	**28**

Note:
PCC: Professional Core Course, PEC: Professional Elective Course.
Practical /Field Work / Assignment are part of contact hours for the faculty and must be considered in the workload.
Four credit courses are designed for 50 hours Teaching – Learning process.
*** Interdisciplinary Core Courses may be taught by engineering faculty/subject expert.**

Note:

1. Each course has a theory component of 3hrs (3credits) and a Practical component of 2hrs (1credit). The time-table allotment for each course should be 5hrs (3+2). For the practical component it is mandatory to maintain a practical record.
2. 20% of marks should be allocated for application oriented questions in the SEE Question Paper, based on practical component.
3. One industrial visit per Semester is mandatory. The Department shall insist on report submission by each student and shall maintain this as a documentary proof. The format of the report shall be prescribed by the department.
4. Each course content has indicative case studies which can be dealt in the class by the course instructor. In addition to this the course instructor may use an extra case from Harvard/Case Centre. The student cannot assume the same cases will be part of the question paper.
5. Project (six weeks) to be carried out by students after third semester and the report submitted by the students during the fourth semester.

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI
Scheme of Teaching and Examinations – 2020 - 21
MASTER OF BUSINESS ADMINISTRATION
Choice Based Credit System (CBCS) and Outcome Based Education(OBE)

III SEMESTER (Core Courses and Dual Specialisation)

Sl. No	Course	Course Code			Teaching Hours /Week		Examination				Credits
		Marketing & Finance	Finance& Human Resource	Human Resource & Marketing	Theory	Practical Component	Duration in hours	CIE Marks	SEE Marks	Total Marks	
1	PCC	20MBA301*	20MBA301*	20MBA301*	03	02	03	40	60	100	4
2	PCC	20MBA302*	20MBA302*	20MBA302*	03	02	03	40	60	100	4
3	PEC	20MBAMM303	20MBAFM303	20MBAHR303	03	02	03	40	60	100	4
4	PEC	20MBAMM304	20MBAFM304	20MBAHR304	03	02	03	40	60	100	4
5	PEC	20MBAFM303	20MBAHR303	20MBAMM303	03	02	03	40	60	100	4
6	PEC	20MBAFM304	20MBAHR304	20MBAMM304	03	02	03	40	60	100	4
7	PCC	20MBA IN 307	20MBA IN 307	20MBA IN 307	--	08	--	40	60	100	4
TOTAL					**18**	**20**	**18**	**280**	**420**	**700**	**28**

Note:
PCC: Professional Core Course, PEC: Professional Elective Course.
Practical /Field Work / Assignment are part of contact hours for the faculty and must be considered in the workload.
Four credit courses are designed for 50 hours Teaching – Learning process.
*** Interdisciplinary Core Courses may be taught by engineering faculty/subject expert.**

Note:

1. Each course has a theory component of 3hrs (3credits) and a practical component of 2hrs (1credit). The time-table allotment for each course should be 5hrs (3+2). For the practical component it is mandatory to maintain a practical record.
2. 20% of marks should be allocated for application oriented questions in the SEE Question Paper, based on practical component.
3. One industrial visit per semester is mandatory. The Department shall insist on report submission by each student and shall maintain this as a documentary proof. The format of the report shall be prescribed by the department.
4. Each course content has indicative case studies which can be dealt in the class by the course instructor. In addition to this the course instructor may use an extra case from Harvard/Case Centre. The student cannot assume the same cases be part of the question paper.
6. Project (six weeks) to be carried out by students after third semester and the report submitted by the students during the fourth semester.

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI
Scheme of Teaching and Examinations – 2020 - 21
MASTER OF BUSINESS ADMINISTRATION
Choice Based Credit System (CBCS) and Outcome Based Education(OBE)

III SEMESTER
Core Courses

Subject Code	Title of the Subject		Subject Code	Title of the Subject		Subject Code	Title of the Subject
20MBA301	Emerging Exponential Technologies		20MBA301	Emerging Exponential Technologies		20MBA301	Emerging Exponential Technologies
20MBA302	Technology & Operational Strategy		20MBA302	Technology & Operational Strategy		20MBA302	Technology & Operational Strategy

Specialisation Courses

Marketing Professional Elective Courses			**Finance Professional Elective Courses**			**Human Professional Elective Courses**	
Subject Code	**Title of the Subject**		**Subject Code**	**Title of the Subject**		**Subject Code**	**Title of the Subject**
20MBAMM303	Services Marketing		20MBAFM 303	Investment Management		20MBAHR303	Recruitment & Selection
20MBAMM304	Marketing Research & Analytics		20MBAFM304	Direct Taxation		20MBAHR304	Human Resource Analytics
20MBAMM305	Consumer Behaviour		20MBAFM305	Banking and Financial Services		20MBAHR305	Industrial Relations and Labour Laws
20MBAMM306	Retail Management		20MBAFM306	Advanced Financial Management		20MBAHR306	Compensation & Reward System
20MBAIN307	Internship		20MBAIN307	Internship		20MBAIN307	Internship

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IV SEMESTER (Specialisation Courses)

Sl. No	Course	Specialisation Courses			Teaching Hours /Week		Examination				Credits
		Marketing	Finance	Human Resource	Theory	Practical Component	Duration in hours	CIE Marks	SEE Marks	Total Marks	
1	PEC	20MBAMM401	20MBAFM401	20MBAHR401	03	-	03	40	60	100	3
2	PEC	20MBAMM402	20MBAFM402	20MBAHR402	03	-	03	40	60	100	3
3	PEC	20MBAMM403	20MBAFM403	20MBAHR403	03	-	03	40	60	100	3
4	PEC	20MBAMM404	20MBAFM404	20MBAHR404	03	-	03	40	60	100	3
5	PEC	20MBAMM405	20MBAFM405	20MBAHR405	03	-	03	40	60	100	3
6	PEC	20MBAMM406	20MBAFM406	20MBAHR406	03	-	03	40	60	100	3
7	PCC	20MBAPR407	20MBAPR407	20MBAPR407	-	12	-	40	60	100	6
TOTAL					**18**	**12**	**18**	**280**	**420**	**700**	**24**

Note:
PEC: Professional Elective Course.
Practical /Field Work / Assignment are part of contact hours for the faculty and must be considered in the workload.
Three credit courses are designed for 40 hours Teaching – Learning process.

Note:
1. Each Course has a theory component of 3hrs (3credits). The Time-Table allotment for each course should be 3hrs.
2. 20% of marks should be allocated for application oriented questions in the SEE Question Paper, based on practical component.

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IV SEMESTER(Dual Specialisation)

Sl. No	Course	Subject Code			Teaching Hours /Week		Examination				Credits
		Marketing & Finance	Finance& Human Resource	Human Resource & Marketing	Theory	Practical Component	Duration in hours	CIE Marks	SEE Marks	Total Marks	
1	PEC	20MBAMM401	20MBAFM401	20MBAHR401	03	-	03	40	60	100	3
2	PEC	20MBAMM402	20MBAFM402	20MBAHR402	03	-	03	40	60	100	3
3	PEC	20MBAMM403	20MBAFM403	20MBAHR403	03	-	03	40	60	100	3
4	PEC	20MBAFM401	20MBAHR401	20MBAMM401	03	-	03	40	60	100	3
5	PEC	20MBAFM402	20MBAHR402	20MBAMM402	03	-	03	40	60	100	3
6	PEC	20MBAFM403	20MBAHR403	20MBAMM403	03	-	03	40	60	100	3
7	PCC	20MBAPR407	20MBAPR407	20MBAPR407	-	12	-	40	60	100	6
TOTAL					**18**	**12**	**18**	**280**	**420**	**700**	**24**

Note:
PEC: Professional Elective Course.
Practical /Field Work / Assignment are part of contact hours for the faculty and must be considered in the workload.
Three credit courses are designed for 40 hours Teaching – Learning process.

Note:
1. Each Course has a theory component of 3hrs (3credits). The Time-Table allotment for each course should be 3hrs.
2. 20% of marks should be allocated for application oriented questions in the SEE Question Paper, based on practical component.

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IV SEMESTER (Specialisation Courses)

Marketing Specialization			Financial Specialization			Human Resource Specialization	
Subject Code	**Title of the Subject**		**Subject Code**	**Title of the Subject**		**Subject Code**	**Title of the Subject**
20MBAMM401	B2B Marketing Management		20MBAFM401	Risk Management and Insurance		20MBAHR401	Organizational Leadership
20MBAMM402	Logistics and Supply Chain Management		20MBAFM402	Financial Derivatives		20MBAHR402	Personal Growth & Interpersonal Effectiveness
20MBAMM403	Digital Marketing Management		20MBAFM403	Indirect Taxation		20MBAHR403	International Human Resource Management
20MBAMM404	Strategic Brand Management		20MBAFM404	Mergers, Acquisitions & Corporate Restructuring		20MBAHR404	Organization Change and Development
20MBAMM405	Agri Business Marketing		20MBAFM405	Corporate Valuation		20MBAHR405	Human Recourse Audit
20MBAMM406	International Marketing Management		20MBAFM406	International Financial Management		20MBAHR406	Management Consulting for Business Excellence
20MBAPR407	Project Report		20MBAPR407	Project Report		20MBAPR407	Project Report

Programme Outcomes (POs)

1. Students are given sufficient theoretical knowledge and are enabled to apply them to solve practical problems in business and other organizations/institutions of importance
2. Students are provided effective communication skills with a high degree of lateral and critical thinking that enhances learn ability, developed for being continuously employable.
3. Students are instilled with leadership qualities, ethically sound, enabled with decision making skills that reflect a high degree of social consciousness
4. Students are trained for sustained research orientation to comprehend a growingly complex, economic, legal and ethical environment
5. Students are equipped with self sustaining entrepreneurship qualities that encourages calculated risk taking.

MANAGEMENT & ORGANIZATIONAL BEHAVIOUR			
Course Code	20MBA11	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Course Objectives

1. The student will be able to recite the theories and models of Management and Organisational Behavior.
2. The student will be able to apply and solve the workplace problems.
3. The student will be able to classify in differentiating between the best methods to solve the problem.
4. The student will be able to compare the appropriate framework for solving the problems at the workplace
5. The student will be able to design model in dealing with the problems in the organisation.

Module-1 Introduction to Management **9 hours**

Management -Introduction, Meaning, Nature, Objectives, Importance, Difference between Administration and Management, Levels of Management, Types of Managers, Managerial Skills, Managerial Competencies, Scope of Management, Functions of Management, Evolution of Management Thought, Fayol's fourteen principles of Management, Recent Trends in Management.

Module -2 Functions of Management **10 hours**

Planning- Definition, Features, Nature, Importance, Types, Steps in Planning, Planning Tools and Techniques, Essentials of a Good Plan. **Organisation-**Definitions, Importance, Principles, Types of Organisation Structures, Span of Control, Centralisation and Decentralisation of Authority. **Directing-**Definitions, Importance, Elements of Directing, Principles of Directing, Characteristics of Directing; **Controlling-**Definitions, Need of Controlling, Characteristics of Control, Steps in the Controlling Process, Resistance to Control, Design of Effective Control System, Types of Control, Control Techniques. **Decision-making-** Concepts, Types, Models, Difficulties in Decision-making, Decision-making for Organisational Effectiveness, Decision-making Styles.

Module -3 Organisational Behaviour **10 hours**

Organisational Behaviour: Introduction, Definitions, Nature, Goals, Importance, Approaches to Organisational Behaviour, Models. **Attitude-** Meaning, Definition, Types, Components, Attitudes and Behaviour, Changing Attitudes in the Workplace; **Perception-**Perception, Perceptual Process, Factors Influencing Perception, Perception and Decision-making; **Personality-**Definitions, Factors Influencing Personality, Big Five Personality Traits, Myers–Briggs Type Indicator (MBTI), Personality Tools and Tests; **Motivation-**Definitions, Process of Motivation (Cycle of Motivation), Nature, Importance, Types, Theories.

Module -4 Managing Human at Work **7 hours**

Group Dynamics- Meaning of Group, Group Characteristics, Classification of Groups, Models of Group Development, Meaning of Group Dynamics, Group Behaviour, Impact of Group on Individual's Behaviour, Impact of External Factors on Group Behaviour. **Teamwork-** Nature of Teams, Team Characteristics, Teams Versus Groups, Teamwork, Processes of Teamwork, Types of Teams, Reasons for Team Failure, Creating Effective Teams.

Module-5 Organizational Power, Politics and Culture **7 hours**

Power and Politics- Nature of Power and Politics, Early Voices, Questioning Power and Authority, Sources of Power for Individuals, Managing Organisational Politics. **Culture-** Definitions of Organisational Culture, Strong Versus Weak Culture, Characteristics, Types, Levels, Dimensions, Creating Organisational Culture, Changing Organisational Culture.

Module - 6 Change and Stress Management **7 hours**

Change- Nature, Characteristics, Process, Forces Responsible for Change in Organizations, Resistance to Change, Managing Resistance to Change. **Stress Management-**Definitions, Understanding Stress, Relation between Stress and Performance, Level, Signs and Symptoms of Stress, Types of Stress, Causes of Stress, Managing Stress.

Course Outcomes:

1. Gain practical experience in the field of Management and Organization Behaviour
2. Acquire the conceptual knowledge of Management, various functions of Management and theories in Organizational Behaviour.
3. Apply managerial and behaviour knowledge in real world situations.
4. Develop a greater understanding about Management and Behavioural aspects to analyse the concepts related to individual behavior, attitude, perception and personality.
5. Understand and demonstrate their exposure on recent trends in management.

Practical Component:

- Visit an Organisation and meet HR / Manager and note the Roles played in a Day.
- Conduct an event and try understanding the dynamics that goes on group.
- Develop few questions, interact with people in the organisation and try observing personality and reaction.
- Meet any Leader / HOD / Dean and observe the Management of depts. under the leader.

Note: Faculty can either identify the organizations/ leaders/job profile or students can be allowed to choose the same.

CO-PO Mapping

CO	PO				
	PO1	PO2	PO3	PO4	PO5
CO1	X	X	X		X
CO2	X			X	
CO3	X				X
CO4	X	X	X		X
CO5	X	X	X	X	X

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have 8 full questions carrying equal marks.
- Each full question is for 20 marks.
- Each full question will have sub question covering all the topics under a Module.
- The students will have to answer five full questions; selecting four full question from question number one to seven and question number eight is compulsory.
- 100 percent theory in the SEE

Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Essentials of Management	Koontz	McGraw Hill	8e, 2014
2	Principles and Practices of Management and Organisational Behaviour	Chandrani Singh and Aditi Khatri	Sage Publication	2016
3	Organizational behaviour	Stephen P Robbins, Timothy	Pearson	14e, 2012
Reference Books				
1	Organizational Behaviour	Fred Luthans,	McGraw Hill International	12/e, 2011
2	Principles of Management	Ramesh B. Rudani	Tata McGraw-Hill	2013
3	Masters of Management Thought	Mahanand Charati& M M Munshi	Swapna Book House	2015

MANAGERIAL ECONOMICS			
Course Code	20MBA12	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Course Objectives:

1. To introduce the fundamentals, tools and theories of managerial economics.
2. To provide an understanding of the application of Economics in Business
3. To learn the basic Micro and Macroeconomic concepts.
4. To have an understanding of Demand, Production, Cost, Profit and Market competitions with reference to a firm and industry.

Module -1 Introduction **7 hours**

Managerial Economics: Meaning, Nature, Scope, & Significance, Uses of Managerial Economics, Role and Responsibilities of Managerial Economist. Theory of the Firm: Firm and Industry, Objectives of the firm, alternate objectives of firm. Managerial theories: Baumol's Model, Marris's Hypothesis, Williamson's Model.

Module -2 Demand Analysis **9 hours**

Law of Demand, Exceptions to the Law of Demand, Elasticity of Demand –Classification of Price, Income & Cross elasticity, Advertising and promotional elasticity of demand. Uses of elasticity of demand for Managerial decision making, Measurement of elasticity of demand. Law of supply, Elasticity of supply, Demand forecasting: Meaning & Significance, Methods of demand forecasting. (No problems).

Module -3 Cost Analysis & Production analysis **9 hours**

Concepts of Production, production function with one variable input - Law of Variable Proportions. Production function with 2 variable inputs and Laws of returns to scale, Indifference Curves, ISO-Quants & ISO-Cost line, Least cost combination factor, Economies of scale, Diseconomies of scale. Technological progress and production function. Types of cost, Cost curves, Cost – Output Relationship in the short run and in the long run, LAC curve **Break Even Analysis** – Meaning, Assumptions, Determination of BEA, Limitations, Uses of BEA in Managerial decisions (with simple Problems).

Module -4 Market structure and Pricing Practices **9 hours**

Perfect Competition, Features, Determination of price under perfect competition, Monopoly: Features, Pricing under monopoly, Price Discrimination. Monopolistic Competition: Features, Pricing Under monopolistic competition, Product differentiation. Oligopoly: Features, Kinked demand Curve, Cartels, Price leadership.

Descriptive Pricing Approaches: Full cost pricing, Product line pricing, Pricing Strategies: Price Skimming, Penetration Pricing, Loss leader pricing, Peak Load pricing.

Module -5 Indian Business environment **9 hours**

Nature, Scope, Structure of Indian Business Environment – Internal and External Environment. Political and Legal Environment, Economic Environment, Socio – Cultural Environment, Global Environment

Basic Macro Economic Concepts: Open and Closed Economies, Primary, secondary and Tertiary sectors and their contribution to the economy. SWOT Analysis for the Indian economy. Measuring the Economy: Measuring GDP and GDP Growth rate, Components of GDP.

Module-6 Indian Industrial Policy **7 hours**

Industrial Policies and Structure: A critical look at Industrial Policies of India, New Industrial Policy 1991; - Private Sector- Growth, Problems and Prospects, SMEs –Significance in Indian economy-problems and prospects. **Fiscal policy and Monetary Policy. Foreign Trade:** Trends in India's Foreign Trade, Impact of WTO on India's Foreign Trade.

Course outcomes:

At the end of the course the student will be able to:

1. The student will understand the application of Economic Principles in Management decision making.
2. The student will learn the micro economic concepts and apply them for effective functioning of a Firm and Industry.
3. The Student will be able to understand, assess and forecast Demand.
4. The student will apply the concepts of production and cost for optimization of production.
5. The student will design Competitive strategies like pricing, product differentiation etc. and marketing according to the market structure.
6. The student will be able to understand macroeconomic concepts.

Practical Component:

- Assessment of Demand Elasticity – Price, Income, Cross, Advertising.
- Demand Forecasting:
- Application of qualitative and quantitative methods of demand forecasting to various sectors (Automobile, Service, Pharmaceutical, Information Technology, FMCG, Hospitality etc.) in India.
- Preparing a Project proposal for a Business Venture.(Compulsory)

CO-PO MAPPING

CO	PO				
	PO1	PO2	PO3	PO4	PO5
CO1	X		X		
CO2	X	X		X	
CO3	X				X
CO4	X				X
CO5	X			X	
CO6	X			X	

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have 8 full questions carrying equal marks.
- Each full question is for 20 marks.
- Each full question will have sub question covering all the topics under a Module.
- The students will have to answer five full questions; selecting four full question from question number one to seven and question number eight is compulsory.
- 80 percent theory and 20 percent problems in the SEE.

Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Managerial Economics	Geethika, Ghosh & Choudhury	McGraw Hill	2/e, 2011
2	Managerial Economics	Dominick Salvotore,	Oxford Publishers	2e, 2016

Reference Books

1	Managerial Economics	R. Panneerselvam, P. Sivasankaran, P. Senthilkumar	Cengage	2015
2	Managerial Economics	Samuelson & Marks	Wiley	5/e, 2015
3	Managerial Economics	D.M Mithani	HPH	2016
4	Managerial Economics	H.L Ahuja Samuelson & Marks	S.Chanda	2014

ACCOUNTING FOR MANAGERS			
Course Code	20MBA13	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Course Objectives

1. To explain fundamental accounting concepts, the elements of financial statements, and basic accounting vocabulary.
2. To explain and use the accounting equation in basic financial analysis and explain how the equation is related to the financial statements.
3. To prepare basic entries for business transactions and present the data in an accurate and meaningful manner.
4. Prepare basic financial statements and explain the articulation between the basic statements.
5. To analyze a company's financial statements and come to a reasoned conclusion about the financial situation of the company.

Module-1 Introduction to Accounting **7 hours**

Financial Accounting: Need and Types of Accounting, Single Entry System, Double Entry System, Concepts and Conventions of Accounting, Relation of Accounting with other disciplines, Journal, Ledgers, Trial balance.

Module -2 Financial Statements **10 hours**

Preparation of final accounts of companies in vertical form as per Companies Act of 2013 (Basic problems of Final Accounts), Window dressing. Case Study problem on Final Accounts of Company-Appropriation accounts.

Module -3 Analysis of Financial Statements **10 hours**

Limitations of Financial Statements; Meaning and Purpose of Financial Statement Analysis, Trend Analysis, Comparative Analysis, Financial Ratio Analysis, Preparation of Financial Statements using Financial Ratios, Case Study on Financial Ratio Analysis. Preparation of Cash flow Statement (indirect method). **Lab compulsory for Financial Statement Analysis using excel.**

Module -4 Management Accounting **9 hours**

Scope, Purpose of Management Accounting

Cost Volume Profit Analysis: Meaning-Methods of determination-Applications. Managerial Decision-Making-Make /Buy etc: Short-run Decision Analysis-Decision situations: Sales-volume related, Sell or further process, Make or Buy, Operate or shut-down.

Module -5 Functional and Flexible Budgeting **7 hours**

Functional budgets, Flexible Budgets: Meaning-Measure of Volume-Cost Behaviour with change in volume-Fixed, variable & mixed costs.Variance Analysis: Cost Variances – Revenue Variances-Variance Reporting-Disposition of variances.

Module-6 Emerging Issues in Accounting and Computerised Accounting **7 hours**

Emerging Issues in Accounting: Human Resource Accounting, Forensic Accounting, Sustainability Reporting, Applicability of Ind AS – Indian Accounting Standards.

Computerised Accounting Systems-Structuring Database for Accounting- Accounting system Using Database Management systems- Illustration of Accounting Database.

Course outcomes:

At the end of the course the student will be able to:

1. Demonstrate theoretical knowledge and its application in real time accounting.
2. Capable of preparing financial statement of companies.
3. Independently undertake financial statement analysis and take decisions.
4. Comprehend emerging trends in accounting and computerization of Accounting systems.

Practical Components:

- To collect Annual reports of the companies and analyzing the financial statements using different techniques and presenting the same in the class.
- To analyze the companies' cash flow statements and presenting the same in the class.
- To get exposed to use of accounting software's (preferably Tally. ERP 9).
- To identify the sustainability report of a company and study the contents.

CO-PO MAPPING

CO	PO				
	PO1	PO2	PO3	PO4	PO5
CO1	X		X		X
CO2	X	X	X		
CO3	X	X	X		
CO4	X	X		X	X

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have 8 full questions carrying equal marks.
- Each full question is for 20 marks.
- Each full question will have sub question covering all the topics under a Module.
- The students will have to answer five full questions; selecting four full question from question number one to seven and question number eight is compulsory.
- 40 percent theory and 60 percent problems in the SEE.

Textbooks

Sl. No.	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Accounting for Management-Text & Cases	S.K.Bhattacharya & John Dearden	Vikas Publishing House Pvt. Ltd.	3e, 2018
2	Financial Accounting	S.N.Maheshwari, Suneel K. Maheshwari, Sharad K. Maheshwari	Vikas Publishing House Pvt. Ltd.	6e, 2018
3	Computerized Accounting	Neeraj Goyal, Rohit Sachdeva	Kalyani Publishers	1e, 2018
Reference Books				
1	Accounting for Managers	J.Made Gowda	Himalaya Publishing House	1e, 2007
2	Financial Accounting for Management	N. Ramachandran, Ram Kumar Kakani	McGraw Education (India) Private Limited	4e., 2016
3	Management Accounting : Text, Problems and Cases	M Y Khan, P K Jain	Tata McGraw-Hill Education	7e, 2007
4	Accounting and Finance for Non-finance Managers	Jai Kumar Batra	Sage Publications	1e, 2018

BUSINESS STATISTICS			
Course Code	20MBA14	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Course Objectives:

1. To make the students learn about the applications of statistical tools and Techniques in decision making.
2. To emphasize the need for statistics and decision models in solving business problems.
3. To enhance the knowledge on descriptive and inferential statistics.
4. To develop analytical skills in students in order to comprehend and practice data analysis at different levels.
5. To familiarize the students with analytical package MS Excel.

Module -1 Introduction to Statistics **9 hours**

Introduction to Statistics: Meaning and Definition, functions, scope and limitations, Collection and presentation of data, frequency distribution, measures of central tendency - Mean, Median, Mode, Geometric mean, Harmonic mean. **Measures of dispersion:** Range – Quartile Deviation – Mean Deviation -Standard Deviation – Variance- Coefficient of Variance - Comparison of various measures of Dispersion.

Module -2 Correlation and Regression **7 hours**

Scatter Diagram, Karl Pearson correlation, Spearman's Rank correlation (one way table only), simple and multiple regressions (problems on simple regression only).

Module -3 Probability Distribution **9 hours**

Probability Distribution: Concept and definition - Rules of probability –Random variables – Concept of probability distribution – Theoretical probability distributions: Binomial, Poisson, Normal and Exponential – Baye's theorem (No derivation) (Problems only on Binomial, Poisson and Normal).

Module -4 Time Series Analysis **8 hours**

Time Series Analysis –Objectives, Variations In Time Series - Methods Of Estimating Trend: Freehand Method - Moving Average Method - Semi-Average Method - Least Square Method. Methods of Estimating Seasonal Index: Method Of Simple Averages - Ratio To Trend Method - Ratio To Moving Average Method.

Module -5 Hypotheses **7 hours**

Types, characteristics, source, formulation of hypotheses, errors in hypotheses. Parametric and Non-Parametric Tests- t-test, z-test, f-test, u-test, K-W Test (problems on all tests). Normality and reliability of hypothesis. Statistical analysis- Bivariate and Multivariate Analysis- ANOVA-one-way, two-way classification (theory only).

Module-6 Computer lab for Statistics **10 hours**

MS Excel: Functions, Formulas, Types of errors in excel, Data analysis using MS-Excel- Mean, Median, Mode, Geometric Mean, Harmonic mean, Standard Deviation, Correlation

Course Outcomes:

At the end of the course the student will be able to:

1. Facilitate objective solutions in business decision making under subjective conditions.
2. Demonstrate different statistical techniques in business/real-life situations.
3. Understand the importance of probability in decision making.
4. Understand the need and application of analytics.
5. Understand and apply various data analysis functions for business problems.

Practical Component:

- Students are expected to have a basic excel classes.
- Students need to be encouraged to do a small primary research inside the classroom in groups and to analyze the data using statistical tools like Mean, SD, Correlation(Ex: Motivation, Stress etc)
- Students can also be encouraged to go out for a live survey in Malls, Showrooms and in other Colleges to collect data's and to analyze it. Ex: Buying behavior, Brand aspects etc)

Lab compulsory-minimum 10 hours.

CO-PO MAPPING

CO	PO				
	PO1	PO2	PO3	PO4	PO5
CO1	X			X	X
CO2	X	X	X		X
CO3	X		X		X
CO4	X		X		
CO5	X	X	X	X	X

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have 8 full questions carrying equal marks.
- Each full question is for 20 marks.
- Each full question will have sub question covering all the topics under a Module.
- The students will have to answer five full questions; selecting four full question from question number one to seven and question number eight is compulsory.
- 40 percent theory and 60 percent problems in the SEE.

Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Fundamentals of Statistics	S C Gupta	Himalaya Publications	2012
2	Research Methodology	Ranjit Kumar	Sage Publications	2018
3	Parametric and Non Parametric Statistics	Vimala Veeraraghavan and Suhas	Sage Publication	2017
Reference Books				
1	Statistical Methods	Dr. S P Gupta	Sultan Chand Publications	2014
2	Research Methodology	C R Kothari	Viswa Prakasam Publication	2015
3.	Business Research Methods	S.N.Murthy and U.Bhojanna.	Excel Books	3e, 2016

MARKETING MANAGEMENT			
Course Code	20MBA15	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Course Objectives

1. Make students have an understanding of the fundamental concepts of marketing & the environment in which marketing system operates.
2. To analyze the motives influencing buying behaviour & Describe major bases for segment marketing, target marketing, and market positioning.
3. Identify a Conceptual framework, covering basic elements of the marketing mix.
4. To understand fundamental premise underlying market driven strategies.
5. Giving them hands on practical approach to subject study.

Module-1 Introduction to Marketing **9 hours**

Marketing V/s Selling, Customer value, Components of customer value and components of customer cost. Marketing Ethics- green marketing and green economy. Marketing Myopia.Marketing Environment - Components of Environment to be analysed- Micro/ Macro Environment, Technological environment, Socio-cultural environment, Economic Environment, Legal Environment, Consumer/demographic environment, Government policies, Political environment. Techniques used in Environment Analysis. Contemporary Indian Marketing Environment. Cause and Social Marketing alternate concepts like 3V concepts of Nirmalaya Kumar Social Responsibility of marketing- new marketing realities, new responsibilities, new-age marketing, societal marketing concept, Corporate Social Responsibility. Emerging areas- Neuro Marketing , Sensory Marketing- concepts only. **Assignment:** Contemporary Indian Marketing Environment

Module -2 Analysing Consumer Behaviour **9 hours**

Connecting with consumers and consumer in sighting, Factors influencing Consumer Behaviour, Consumer characteristics influencing buying behaviour- personal factors and cultural factors. Consumer Buying Decision Process, Buying Roles, Buying Motives. The black box model of consumer behaviour. Psychological Processes underlying consumer behaviour. **Market Segmentation:** Concept of Market Segmentation, Benefits, Requisites of Effective Segmentation, Bases for Segmenting Consumer Markets, Market Segmentation Strategies. Segmentation method – Geographic segmentation and Demographic segmentation, psychographic segmentation, behavioural segmentation, volume segmentation, deep segmentation. Indian Consumer- Features about consumer India, Classifying Indian consumer by Income B2B marketing Vs Consumer Marketing. **Assignment- Live projects on Consumer Behaviour.**

Module -3 Product, Brand Equity, Services Marketing **9 hours**

Product Management- fundamentals, primary objective of product management, product hierarchy, product line, product mix, product mix strategies, Appraisal of product lines, products and brands. Managing PLC of product/brand, New Product Development, packing as a marketing tool, Role of labelling in packing. Main tasks in product management. Components of Product personality. Brand- selecting brand name, selecting logo, brand extension- effects. Introducing new product, innovations, new product development, stages in new product development, pricing strategy for new product. Branding - Concept of Branding, Types, Brand Equity, Branding strategies.Services Marketing & its Characteristics- tasks involved in service marketing, differentiating, positioning and brand building in services, premiumisation in service marketing.Market Segmentation, Targeting & Positioning (STP): Targeting - Bases for identifying target Customer target Marketing strategies, Positioning - Meaning, Product Differentiation Strategies, Tasks involved in Positioning. Monitoring brands performance and positioning.

Module -4 Pricing , Marketing Channels **7 hours**

Pricing decisions: Significance of pricing, factor influencing pricing (Internal factor and External factor), objectives, Pricing Strategies-Value based, Cost based, Market based, Competitor based, Pricing Procedure.
Marketing Channels: Roles and purpose of Marketing Channels, Factors Affecting Channel Choice, Channel Design, Channel Management Decision, Channel Conflict, Designing a physical Distribution System, Network Marketing. Contemporary Channels and Retailing in India.**Product Distribution Logistics:** Product distribution Concept. Distinction between distribution logistics and Supply Chain Management..

Module -5 Direct Marketing & Digital Marketing: **9 hours**

Concept and scope of direct marketing, concept and components of digital marketing. Digital marketing communications, digital marketing in India. **Promotions**- Marketing communications- Integrated Marketing

Communications (IMC)-communication objectives, steps in developing effective communication, Stages in designing message. Advertising: Advertising Objectives, Advertising Budget, Advertising Copy, AIDA model, Traditional Vs Modern Media- Online and Mobile Advertising, Social Media for Advertising. Customer Relationship Management- components. Significance of Marketing Research- importance of data.

Module - 6 Sales Promotion, Marketing Planning and Rural Marketing 7 hours

Sales Promotion: Tools and Techniques of sales promotion, Push-pull strategies of promotion. Personal selling: Steps/process involved in Personal Selling. Publicity/Public Relation-word of mouth, sponsorships. Database marketing: Basic concepts of e-commerce, e-marketing, m-Commerce, m-marketing, e-networking, CRM, MkIS.
Marketing Planning: Meaning, Steps involved in Marketing planning. Marketing Audit- Meaning, components of Marketing Audit. Market Share analysis, Marketing cost analysis, Marketing Strategic Planning Process.
Concept of Rural Marketing: Flumist (HBR) and Saffola Journey- Case Studies
Classroom Exercise: Brand Communication (create and enact a commercial)

Course outcomes:

At the end of the course the student will be able to:

1. Develop an ability to assess the impact of the environment on marketing function.
2. To formulate marketing strategies that incorporate psychological and sociological factors which influence buying .
3. Understand concept of Branding, development of product and significance of market segmentation , targeting and positioning.
4. Identifying marketing channels and the concept of product distribution.
5. Identifying techniques of sales promotion , significance of marketing research.
6. Synthesize ideas into a viable marketing plan for various modes of marketing

Practical Components:

- Understanding Contemporary Indian Marketing Environment.
- Understanding and demonstrating their exposure on consumer behaviour
- Effectively using their skill in creating and enacting a commercial on brand communication.

CO-PO MAPPING

CO	PO				
	PO1	PO2	PO3	PO4	PO5
CO1	X		X		
CO2	X	X	X		X
CO3	X	X	X		
CO4	X	X			X
CO5	X			X	
CO6	X			X	X

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have 8 full questions carrying equal marks.
- Each full question is for 20 marks.
- Each full question will have sub question covering all the topics under a Module.
- The students will have to answer five full questions; selecting four full question from question number one to seven and question number eight is compulsory.
- 100 percent theory in the SEE.

Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Marketing Management- Indian Context, Global Perspective.	Ramaswamy & Namakumari	SAGE	6th Edition

2	Marketing Management: A South Asian Perspective.	Kotler, Keller, Koshy & Jha	Pearson Education	Latest edition
3	New Product Management	Merle Crawford and Anthony Di Benedetto	McGraw-Hill	Latest Editon
4	Advertisement Brands & Consumer Behaviour	Ramesh Kumar	Sage Publications	2020
Reference Books				
1	Marketing in India: Text and Cases	Neelamegham S	Vikas	Latest edition
2	Marketing	Lamb, Hair, Mc Danniel	Cengage Learning	Latest edition
3	Fundamentals of Marketing Management,	Etzel M J BJ Walker & William J Stanton	Tata Macgraw Hill	Latest edition

MANAGERIAL COMMUNICATION			
Course Code	20MBA16	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Course Objectives:

1. To enable the students to become aware of their communication skills and sensitize them to their potential to become successful managers.
2. To enable learners with the mechanics of writing and also help them to draft business letters in English precisely and effectively.
3. To introduce the students to some of the practices in managerial communication those are in vogue.
4. To prepare students to develop the art of business communication with emphasis on analysing business situations.
5. To train Students towards drafting business proposals.

Module -1 Introduction **7 hours**

Introduction: Meaning & Definition, Role, Classification – Purpose of communication – Communication Process – Characteristics of successful communication. Communicating within Organizations – Levels of communication, Communication flow, Communication barriers, Media choices, Legal Consequences and Ethics, Communication in a cross-cultural setting.

Module -2 Oral Communication **7 hours**

Oral Communication: Meaning – Principles of successful oral communication, Conversation control –Reflection and Empathy: two sides of effective oral communication.

Oral Presentation: Role of business presentations, Planning and Organizing Presentation, Planning Team and Online Presentations, Developing Visual Support for Business presentation, Practicing and Delivering Presentation - Refining your delivery.

Business Pitch:10 steps in Pitching, Elevator Pitching

Class room Exercise: Business pitch with video recording using PowerPoint and feedback.

Module -3 Written Communication **9 hours**

Written Communication: Purpose of writing – Clarity in writing –Principles of effective writing – Approaching the writing process systematically: The 3X3 writing process for business communication Pre writing – Writing – Revising. Audience analysis, Writing Positive, Neutral, Persuasive and Bad-news Messages

Types of Written Communication in Business: Business Letters, Employee Reviews, Recommendation Letters, Thank You Letters, Memos, proposals and Reports, Planning Documents, Press Releases, Proactive Media Writing and E-mail.

Module -4 Business Reports **9 hours**

Business Reports: Purpose, Kinds and Objectives of reports – Organization & Preparing reports, short and long reports Writing, writing executive summary.

Business Case Analysis: What is a case? Characteristics of Case and its Analysis, Process of Case Analysis, Requirements of Case analysis, The structure of written cases analysis.

Meeting Documentation: Notice, Agenda, and Resolution & Minutes

Assignment: Executive summary to be submitted.

Module -5 Employment communication **9 hours**

Employment communication: Putting your best self forward, Preparing your resume, Writing covering letters and Inquiry Emails, Preparing for a Job Interview, Conducting Yourself during the Interview, Following up throughout the process, Practicing business etiquette.

Business Meetings: Format, planning, facilitating, participating and following-up.

Lab component: Video conferencing across stakeholders.

Module-6 Interpersonal Communication **9 hours**

Interpersonal Communication: Nonverbal communication and Listening.

Conflict Management and Negotiation skills: Meaning and characteristics of Conflict, Conflict management through communication, Managing the process of communication in Conflict, Verbal skills for communicating in conflict. Communication for effective negotiation – Meaning, nature and need for negotiation, Factors affecting negotiation, stages in negotiation process, Negotiation strategies.

Technological Advancement and Business Communication: Intranet, Internet, Teleconference, Video conference, Blogs, Webinars, Chat rooms, Voice and Text messaging.

Social Media: Introduction, Characteristics, Classification, Nature and scope of Six types of Social Media, Choosing the most suitable social media. Using Social Media to build business relationships.

Lab component: Creating a Blog

Note: Suggested for practical component: Effective Communication Development.

Subject faculty to design suitable practical components for the topics in syllabus.

Course Outcomes:

At the end of the course the student will be able to:

1. The students will be aware of their communication skills and know their potential to become successful managers.
2. The students will get enabled with the mechanics of writing and can compose the business letters in English precisely and effectively.
3. Students will get exposure in drafting business proposals to meet the challenges of competitive environment.
4. The students will be introduced to the managerial communication practices in business those are in vogue.
5. Students will get trained in the art of Interpersonal communication and technological advancement and social media usage in communications, with emphasis on analysing business situations.

Practical component:

- Make students enact and analyze the non-verbal cues.
- Conduct a mock meeting of students in the class identifying an issue of their concern. The students should prepare notice, agenda and minutes of the meeting.
- Organize a mock press conference addressing to the launch of new product by an organization.
- Students should be given an assignment to draft a proposal to undertake research project.
- Video conferencing across stakeholders
- Create a Blog
- Business pitch with video recording using PowerPoint and feedback

CO-PO MAPPING

CO	PO				
	PO1	PO2	PO3	PO4	PO5
CO1	X	X		X	
CO2	X	X	X		
CO3	X	X	X		X
CO4	X	X			
CO5	X	X	X		X

Question paper pattern:
The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have 8 full questions carrying equal marks.
- Each full question is for 20 marks.
- Each full question will have sub question covering all the topics under a Module.
- The students will have to answer five full questions; selecting four full question from question number one to seven and question number eight is compulsory.
- 100 percent theory in the SEE

Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Communicating in Business	Ober Newman	Cengage	8th Edition, 2018
2	BCOM A South-Asian Perspective	Lehman, Dufrene,Sinha	Cengage Learning	2nd Edition, 2012
3	Business Communication	P D Chaturvedi Mukesh Chaturvedi	Pearson	3rd Edition, 2013
4	Business and Professional Communication	Kelly m. Quintanilla Shawn T. Wahl	SAGE South Asia Edition	2017

Reference Books

1	Communicating in Business	Williams,Krizan Logan,Merrier	Cengage Learning	8th Edition, 2017
2	Business Communication: Process	Mary Ellen Guffey	Cengage Learning	3rd Edition, 2002
3	Business Communication	Lesikar,Flatley,Rentz ,Pande	TMH	11th Edition, 2011
4	Communicating in Business	Williams, Krizan, Logan & Merrier	Cengage Learning	8e, 2014

II SEMESTER

HUMAN RESOURCE MANAGEMENT			
Course Code	20MBA21	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Course Objectives

1. The student will be able to recite the theories and various functions of Human Resources Management
2. The student will be able to describe and explain in her/his own words, the relevance and importance of Human Resources Management at workplace
3. The student will be able to apply and solve the workplace problems through Human Resources Management intervention
4. The student will be able to classify and categorise in differentiating between the best method to solve the problem
5. The student will be able to compare and contrast different approaches of HRM for solving the complex issues and problems at the workplace
6. The student will be able to design and develop an original framework and model in dealing with the problems in the organization.

Module-1 Introduction **7 hours**

Human Resource Management and Personnel Management, The Importance of Human Resource Management, Models of Human Resource Management, Evolution of Human Resource Management, HRM in India, The Factors Influencing Human Resource Management , Human Resource Management and Line Managers, The HR Competencies, Human Resource Management and Firm Performance.

Module -2 Human Resource Planning **9 hours**

Importance of HR Planning, Manpower Planning to HR Planning, Factors Affecting HR Planning, Benefits of HR Planning, HRP Process, Tools for Demand Forecasting, Attributes of an Effective HR Planning, Barriers to HR Planning, The Challenges for HR, Process of Job Analysis and Job Evaluation.

Recruitment and Selection: Importance of Recruitment, Recruitment Policies, Factors Influencing Recruitment, Recruitment Process, Sources, Evaluation of Recruitment Process, Recruitment Strategy ; Selection, Future Trends in Recruitment; Selection Process; Selection Tests; Factors Influencing Selections, Challenges in Selection, Application Tracking System using MS-Excel

Learning, Training, and Development: Training, Learning and Development, Learning Theories, The Future of Training, Learning, and Development: Crystal Gazing into the Future, World of Learning. Process of training and Techniques of Training

Module -3 Performance Management and Appraisal **9 hours**

Objectives of Performance Management, Performance Management and Performance Appraisal, Common Problems with Performance Appraisals, Performance Management Process, Types of Performance Rating Systems, Future of Performance Management.

Compensation and Benefits

Introduction, Definitions, Total Compensation, Total Rewards System, Forms of Pay, Theories of Compensation, External Factors, Internal Factors, Establishing Pay Rates, Employee Benefits.

Industrial Relations

Decent Workplace: International Labor Organisation, Industrial Relations, The Objectives of Industrial Relations, Approaches of Industrial Relations Systems, The Actors in Industrial Relations, Indian Context, Industrial Relations and Human Resource Management.

Employment Relations - The Definition, Traditional Employment Relations, Actors in the Fray: Role-taking, The New Frameworks for Employment Relations, The Future of Employee Relations.

Module -4 Human Resource Management in Small and Medium Enterprises **9 hours**

Definition of SMEs, Human Resource Management and Performance in SMEs, The Difference in Adoption of Human Resource Management: SMEs and Large Firms, Indian Experience, Impact of Weak Adoption of Human Resource Management in SMEs, Factors Influencing the Adoption of Human Resource Management Practices in SMEs, Future of Human Resource. Management in SMEs.

Human Resource Management in the Service Sector

Introduction, The Emergence of the Services Sector, Implications for Human Resource, Management Function, Differences Between Services Sector and the Manufacturing Sector, Difference in Human Resource Management

Practices in Services and Manufacturing Sectors, Human Resource Management and Service Quality Correlation, Some Specific Industries in Services Sector, Trade Unions in Services Sector, Models of Union Strategies.
Case Study on "Training Program at ABC Cement". .

Module -5 Human Resource Management Innovations **9 hours**

Introduction, Human Resource Management and Innovations, Factors Affecting the Innovation Process in Organisations, Characteristics of Human Resource Management Innovations, Conditions Necessary for Successful HRMI Implementation, Current Trends in Human Resource Management Innovations, Innovative Human Resource Management Practices in India, How Human Resource Management Practices Contribute to Organisational Innovation, How to Make Human Resource Management Innovations Sustainable.

Module - 6 HR Leadership and Organisation Transformation **7 hours**

Future of Human Resource Management: The next generation HR professionalism, Critical HR Issues of Today and Tomorrow, Changing Mental Models: HR's Most Important Task, HR roles critical for business survival, HR profession in today's changeful workplace, HR and Technology.

Course Outcomes:

At the end of the course the student will be able to:

1. Gain practical experience in the field of Human Resource Concepts, functions and theories.
2. Acquire the conceptual insight of Human Resource and various functions of HR.
3. Apply personnel, managerial and welfare aspects of HR.
4. Develop a greater understanding about HR practices, analyse the trends in the field of HR.

Practical Component:

- An visit to Organisation and interact with HR Manager and list out the roles played by HR manager.
- Meet Recruitment Manager and ask- 10 questions one asks during Interview.
- Meet Training and Development Manager and list out various training given to employees; basis of training program; Need analysis.
- Visit any Service Organisation and observe HR functions; List them.

CO-PO MAPPING

CO	PO				
	PO1	PO2	PO3	PO4	PO5
CO1	X	X	X		X
CO2	X	X		X	
CO3	X	X	X		
CO4	X			X	

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have 8 full questions carrying equal marks.
- Each full question is for 20 marks.
- Each full question will have sub question covering all the topics under a Module.
- The students will have to answer five full questions; selecting four full question from question number one to seven and question number eight is compulsory.
- 100 percent theory in the SEE

Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Human Resource Management: Theory and Practices,	R. C. Sharma, Nipun Sharma	Sage Publication India Pvt. Ltd.,	2019
2	Human Resource Management: Concepts	Amitabha Sengupta	Sage Publication India Pvt. Ltd.	2019

3	Leadership: Theory and Practices	Peter G. Northouse	Sage Publication	2016
4	Human Resources Management	T.P RenukaMurthy	HPH.	2015
Reference Books				
1	The HR Scorecard: Linking People, Strategy, and Performance	Brian Becker, Dave Ulrich, and Mark A. Huselid	Harvard Business School Press	2001
2	The HR Answer Book: An Indispensable Guide for Managers and Human Resources Professionals	Shawn Smith and Rebecca Mazin	AMACOM	2011
3	Performance Management and Appraisal Systems HR Tools for Global Competitiveness	T. V. Rao		First Edition, 2004
4	Human Resource Management	Appasaba L.V and Kadakol A M	College Book House	2016
5	Human Resource Management	V.S.P Rao		2014

FINANCIAL MANAGEMENT			
Course Code	20MBA22	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Course Objectives:

1. To familiarize the students with basic concepts of financial management and financial system.
2. To understand concept of time value of money and its implication.
3. To evaluate the investment proposals.
4. To understand the management of working capital in an organization.
5. To analyze capital structure and dividend decision.

Module-1 Introduction **9 hours**

Meaning and objectives of Financial Management, changing role of finance managers. Interface of Financial Management with other functional areas. Indian Financial System: Financial markets, Financial Instruments, Financial institutions and financial services. Emerging issues in Financial Management: Risk Management, Behavioural Finance, Financial Engineering, Derivatives (Theory).

Module-2 Time value of money **9 hours**

Meaning of Time value of money –Future value of single cash flow & annuity, present value of single cash flow, annuity & perpetuity. Simple interest & Compound interest, Capital recovery & loan amortization. (Theory & Problem). Case Study on Loan amortization. Computer lab for calculation of future value, present value and loan amortisation in MS excel.

Module-3 **9 hours**

Sources of Financing: Shares, Debentures, Term loans, Lease financing, Hybrid financing, Venture Capital, Angel investing and private equity, Warrants and convertibles (Theory Only). **Cost of Capital:** Basic concepts. Cost of debenture capital, cost of preferential capital, cost of term loans, cost of equity capital (Dividend discounting and CAPM model) - Cost of retained earnings - Determination of Weighted average cost of capital (WACC) and Marginal cost of capital. (Theory & Problem). Case Study on WACC.

Module-4 Investment Decisions **9 hours**

Capital budgeting process, Investment evaluation techniques – [Net present value, Internal rate of return, Modified internal rate of return, Profitability index, Payback period, discounted payback period, accounting rate of return Problem). Risk analysis in capital budgeting-Case Study on replacement of capital project. (Numerical problems). Computer lab for calculation of NPV, IRR, PI, Payback period, ARR in MS excel.

Module-5 Working Capital Management **7 hours**

Factors influencing working capital requirements - Current asset policy and current asset finance policy- **Determination of operating cycle and cash cycle on Excel**- Estimation of working capital requirements of a firm. (Does not include Cash, Inventory & Receivables Management). Case study on Working Capital Determination and the impact of negative working capital Amazon-negative working capital and profitability. Computer lab for calculation of working capital cycle and operating cycle in MS excel.

Module-6 Capital structure and dividend decisions **7 hours**

Capital structure and dividend decisions – Planning the capital structure-Governance of Equity and Debt, Fall in interest rates and perils of Debt funding. Leverages, EBIT and EPS analysis. ROI & ROE analysis. Capital structure policy. Dividend policy – Factors affecting the dividend policy - Dividend Policies- Stable Dividend, Stable Payout (No dividend theories to be covered). Case Study on EBIT-EPS analysis & Leverages.

Course outcomes:

At the end of the course the student will be able to:

1. Understand the basic financial concepts
2. Apply time value of money
3. Evaluate the investment decisions
4. Estimate working capital requirements
5. Analyze the capital structure and dividend decisions

Practical Components:

- Identifying the small or medium sized companies and understanding the Investment evaluation techniques used by them.
- Using the annual reports of selected companies, students can study the working capital management employed by them. Students can also compare the working capital management of companies in the same sector.
- Students can choose the companies that have gone for stock split and Bonus issue in the last few years and study the impact of the same on the stock price.
- Students can study any five companies capital structure
- Students can do Company analysis for select companies using profitability and liquidity ratios.

CO-PO MAPPING

CO	PO				
	PO1	PO2	PO3	PO4	PO5
CO1	X				
CO2	X	X			
CO3	X		X		
CO4	X		X	X	
CO5	X		X		

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have 8 full questions carrying equal marks.
- Each full question is for 20 marks.
- Each full question will have sub question covering all the topics under a Module.
- The students will have to answer five full questions; selecting four full question from question number one to seven and question number eight is compulsory.
- 40 percent theory and 60 percent problems in the SEE.

Textbooks

Sl. No.	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Financial Management	Khan M. Y.& Jain P. K,	TMH	7/e,
2	Financial Management	Prasanna Chandra	TMH	9/e,
3	Financial Management	Prahlad Rathod ,Babitha Thimmaiah and Harish Babu	HPH	1/e, 2015
4	Financial Management: A Strategic Perspective	Nikhil Chandra Shil & Bhagaban Das	Sage Publications	1/e, 2016

Reference Books

1	Financial Management	I M Pandey	Vikas Publishing	11/e, 2012
2	Principles of Corporate Finance	Brealey, Myers, Allen & Mohanty	McGraw Hill Education	11/e, 2014
3	Cases in Financial Management	I.M.Pandey & Ramesh Bhat	McGraw Hill Education	3/e, 2015
4	Corporate Finance	Vishwanath S. R.	Sage Publications	3/e, 2019

RESEARCH METHODOLOGY			
Course Code	20MBA23	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Course Objectives:

1. To understand the basic components of research design.
2. To Gain an insight into the applications of research methods.
3. To equip students with various research analytical tools used in business research.
4. To equip students with necessary critical thinking skills using excel.

Module-1 Business Research **9 hours**

Business Research: Meaning, types, process of research- management problem, defining the research problem, formulating the research Hypothesis, developing the research proposals, research design formulation, sampling design, planning and collecting the data for research, data analysis and interpretation. Research Application in business decisions, Features of good research study.

Module -2 Business Research Design **9 hours**

Meaning, types and significance of research design. Exploratory and Conclusive Research Design.

Exploratory Research: Meaning, purpose, methods- Literature search, experience survey, focus groups and comprehensive case methods. Conclusive Research Design - Descriptive Research - Meaning, Types – Cross sectional studies and longitudinal studies.

Experimental Research Design – Meaning and classification of experimental designs- formal and informal, Pre experimental design, Quasi-experimental design, True experimental design, statistical experimental design.

Module -3 Sampling **7 hours**

Sampling: Concepts- Types of Sampling - Probability Sampling – simple random sampling, systematic sampling, stratified random sampling, cluster sampling -Non Probability Sampling –convenience sampling-judgemental sampling, snowball sampling- quota sampling - Errors in sampling.

Module -4 Data Collection **9 hours**

Meaning of Primary and Secondary data, Primary data collection methods - observations, survey, interview and Questionnaire, Qualitative Techniques of data collection, Questionnaire design – Meaning - process of designing questionnaire. Secondary data -Sources – advantages and disadvantages.

Measurement and Scaling Techniques: Basic measurement scales-Nominal scale, Ordinal scale, Interval scale, Ratio scale. Attitude measurement scale - Likert's Scale, Semantic Differential Scale, Thurstone scale, Multi-Dimensional Scaling. Case Study as per the chapter needs.

Module -5 **7 hours**

Data Analysis and Report Writing: Editing, Coding, Classification, Tabulation, Validation Analysis and Interpretation- Report writing and presentation of results: Importance of report writing, types of research report, report structure, guidelines for effective documentation.

Module – 6 **9 hours**

Advanced Excel and real time application: V Look Up, H Look up, Sort and filter, concatenate, Conditional Formatting., Pivot Table, If statement, Nested If, Charts. Statistical tests and how to interpret statistical outputs.

Course outcomes:

At the end of the course the student will be able to:

1. Understand various research approaches, techniques and strategies in the appropriate in business.
2. Apply a range of quantitative / qualitative research techniques to business and day to day managemen problems.
3. Demonstrate knowledge and understanding of data analysis, interpretation and report writing.
4. Develop necessary critical thinking skills in order to evaluate different research approaches in Business using excel in particular

Practical components:

- To identify research problem and collect relevant literatures for data analysis.
- To write the research design by using Exploratory and Descriptive Research methods.
- To conduct Market survey and to investigate consumer perception towards any FMCG and to conduct the data analysis using excel and need to submit a small report.

• To demonstrate Report writing and Presentation methods.

CO-PO MAPPING

CO	PO				
	PO1	PO2	PO3	PO4	PO5
CO1	X			X	
CO2	X			X	
CO3	X	X	X		X
CO4	X		X	X	X

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have 8 full questions carrying equal marks.
- Each full question is for 20 marks.
- Each full question will have sub question covering all the topics under a Module.
- The students will have to answer five full questions; selecting four full question from question number one to seven and question number eight is compulsory.
- 100 percent theory in the SEE.

Textbook/ Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Research Methodology	C R Kothari	Viswa Prakasam Publication	2014
2	Business Research Methods	S. N. Murthy & U. Bhojanna	Excel Books	3e, 2016
3	Research Methods	M MMunshi & K Gayathri Reddy	HPH	2015
Reference Books				
1	Research Methodology	Ranjit Kumar	Sage Publications	
2	Excel for dummies	Harvey .G	John Wiley & Sons	2016
3	Research Methodology	Deepak Chawla and Neena Sondhi	Vikas Publications	2014

OPERATIONS RESEARCH			
Course Code	20MBA24	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Course objectives:

- Understand the mathematical tools that are needed to solve optimisation problems
- Solve linear programming problems using appropriate techniques to take informed Decision
- To understand and practice allocation problems, Assignments problems, Transportation problems and Network Analysis (PERT & CPM).

Module -1 Introduction **7 hours**

Definition, scope of Operations Research, characteristics, advantages and limitations. Quantitative approach to decision making models (Theory Only)

Module -2 Linear programming **9 hours**

Structure of linear program model, Assumption, Advantages, Limitations, General mathematical model, Guidelines for formulation of linear programming model, Formulation of problems, graphical method.

Module -3 Transportation problem **7 hours**

General structure of transportation problem, methods of finding initial basic feasible solution (NWCM, LCM & VAM), Degeneracy, Optimality Test using Stepping Stone and MODI Methods (theory only). Assignment problems - Introduction, General structure. Problems on minimization & maximization.

Module -4 Decision theory **9 hours**

Decision under uncertainty- Maxmin & Minmax, Decision under Risk- Expected Value, Simple decision tree problems. (Only theory). Job Sequencing- N Jobs-two machines and N Jobs-three machines, 2 jobs-M machines cases. (Only theory).

Module -5 Theory of games **9 hours**

Formulation of game models, Two person Zero sum games & their solution, 2 x N and M x 2 games, pure strategy games with saddle point, Mixed strategies (Graphical and algebraic methods), Limitations of game theory.

Simulation: process of simulation, types of simulation, steps in simulation process, Monte Carlo simulation, Simple problems on Simulation applications in Inventory, Queuing, finance problems, Advantages & Disadvantages.

Module-6 Project management **9 hours**

Structure of projects, phases of project management-planning, scheduling, controlling phase, work breakdown structure, project control charts, network planning, PERT & CPM, Network components & precedence relationships, critical path analysis, probability in PERT analysis, Theory of crashing (Theory Only), Theory of Constraints (Theory only).

Course outcomes:

1. Get an insight into the fundamentals of Operations Research and its definition, characteristics and phases
2. Use appropriate quantitative techniques to get feasible and optimal solutions
3. Understand the usage of game theory , Queuing Theory and Simulation for Solving Business Problems
4. Understand and apply the network diagram for project completion

Practical component:

- Learn and use TORA Software for analysis of all the ORTechniques and Real life Problems.
- Student should demonstrate the application of the techniques covered in this course.

CO – PO MAPPING.

CO	PO				
	PO1	PO2	PO3	PO4	PO5
CO1	X				
CO2	X		X	X	X
CO3	X		X		X
CO4	X		X		X

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have 8 full questions carrying equal marks.
- Each full question is for 20 marks.
- Each full question will have sub question covering all the topics under a Module.
- The students will have to answer five full questions; selecting four full question from question number one to seven and question number eight is compulsory.
- 40 percent theory and 60 percent problems in the SEE.

Textbook/ Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Operation Research: An Introduction	H.A. Taha	Pearson Publication	2012
2	Operation Research	J K Sharma	McMillan Publications	2014
Reference Books				
1	Quantitative Techniques in management	N D Vohra	McGraw Hill	2015
2	Operation Research	J K Sharma	McMillan Publications	2016

STRATEGIC MANAGEMENT			
Course Code	20MBA25	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Course objectives:

1. To provide insights into the core concepts of strategic management.
2. To evaluate various business strategies in dynamic market environments.
3. To gain insights into various strategic management models.

Module-1 Introduction **7 hours**

Meaning and Nature of Strategic Management, its Importance and Relevance and. Characteristics of Strategic Management, The Strategic Management Process. Relationship Between a Company's Strategy and its Business Model. **Case Study related to the Module.**

Module -2 External Analysis **9 hours**

Strategically Relevant Components of a Company's External Environment – Industry Analysis - Factors Driving Industry Change and its Impact - Porter's Dominant Economic Feature - Competitive Environment Analysis - Porter's Five Forces Model – Key Success Factors Concept and Implementation. **Case Study on external analysis.**
Students Assignment: Industry External Analysis.

Module -3 Internal Analysis **9 hours**

Describe Strategic Vision, Mission, Goals, Long Term Objectives, Short-Term Objectives and Discuss Their Value to the Strategic Management Process, Resources, Capabilities, Competencies, Resource Based View of the firm (RBV), Balanced Score Card, SWOC Analysis, Value Chain Analysis, Benchmarking. **Case Study on internal analysis.**
Students Assignment: Industry Internal Analysis.

Module -4 Strategy Formulation **9 hours**

Business Strategies –Porter's Generic Strategies: Low Cost, Differentiation, Best Cost, Focused Low Cost and Focused Differentiation, Corporate Strategies – Growth Strategies (Internal Growth, External Growth, Integration, Diversification, Mergers, Strategic Alliances), Ansoff's Matrix, Stability Strategies (No-Change, Profit and Proceed With Caution), Retrenchment Strategies (Turnaround, Divestment and Liquation), International Business Level Strategies. **Case Study on Strategic Formulation. Students Assignment: Strategies of listed companies**.

Module -5 Strategy Implementation **9 hours**

Strategy Implementation -Organisational Structure, Strategic Leadership and Organisational Culture
Strategy and Innovation - Introduction to Innovation: Process, Product and Platform; Creative Destruction and Disruptive Technologies; Designing Organisations for Innovation; Innovation Environments: Institutional Innovation and Environments, The Co-creation of Value, Open Innovation and Open Strategy, National Innovation Systems, Learning Networks and Clusters, Social Innovation. **Case Study on Strategy Implementation**.

Module - 6 Strategic Control **7 hours**

Strategic Control: Focus of Strategic Control, Establishing Strategic Controls (Premise Control, Strategic Surveillance, Special Alert Control, Implementation Control), Exerting Strategic Control (through Competitive Benchmarking, Performance and Formal and Informal Organisations). Case Study on Strategic Control.

Course outcomes:

At the end of the course the student will be able to:

1. Students should get clear idea about the concept of Strategic Management, its relevance, Characteristics, process nature and purpose.
2. Student to acquire an understanding of how firms successfully institutionalize a strategy and create an organizational structure for domestic and overseas operations and gain competitive advantage.
3. To give the students an insight on strategy at different levels of an organization to gain competitive advantage.
4. To help students understand the strategic drive in multinational firms and their decisions in different markets.
5. To enable the students to gain knowledge of strategy implementation and the control measures for effective decision-making.

Practical Component:

- Analyzing the Mission and Vision statements of selected Indian companies.
- Applying Michael Porter's model to an industry (Retail, Telecom, Infrastructure, FMCG, Insurance, Banking etc(Industry Note to be submitted)
- Internal Analysis & Strategies of a listed company in the form of the report to be submitted.
- Pick a company that has performed very badly compared to its competitors. Collect information on why the

company failed. What were the issues in strategy and execution that were responsible for the company's failure in the market; analyze the internal and external factors.

- Map out GE 9-cell matrix and BCG matrix for some companies and compare them.
- Conduct SWOT analysis of companies around your campus.

CO-PO MAPPING

CO	PO				
	PO1	PO2	PO3	PO4	PO5
CO1	X				
CO2	X	X	X		
CO3	X		X		
CO4	X		X	X	X
CO5	X		X	X	X

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have 8 full questions carrying equal marks.
- Each full question is for 20 marks.
- Each full question will have sub question covering all the topics under a Module.
- The students will have to answer five full questions; selecting four full question from question number one to seven and question number eight is compulsory.
- 100 percent theory in the SEE.

Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Crafting and Executing Strategy: The Quest for Competitive Advantage – Concepts and Cases	Arthur A. Thompson Jr. Margaret A. Peteraf John E. Gamble A. J. Strickland III Arun K. Jain	McGraw Hill Education	19/e 2017
2	Strategic Management: A South-Asian Perspective	Michael A. Hitt R. Duane Ireland Robert E. Hoskisson S. Manikutty	Cengage Learning	9/e 2016

Reference Books

1	Strategy: Theory & Practice	Stewart Clegg Chris Carter Marting Kornberger Jochen Schweitzer	Sage Publications	3/e ,2020
2	Strategy Management: Theory & Practice	John Parnell	Biztantra	2004
3	Strategic Management: Planning for Domestic and Global Competition	John A. Pearce Richard B. Robinson	McGraw Hill Education	14/e 2015

ENTREPRENEURSHIP AND LEGAL ASPECTS			
Course Code	20MBA26	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Course Objectives:

1. To develop and strengthen entrepreneurial quality and motivation in students.
2. To impart basic entrepreneurial skills and understandings to run a business efficiently and effectively.
3. To provide insights to students on entrepreneurship opportunities, sources of funding and institutions supporting entrepreneurs.
4. To make students understand the ways of starting a company of their own.

Module -1 Introduction to Entrepreneur & Entrepreneurship **7 hours**

Meaning of entrepreneur - Evolution of the concept - Functions of an Entrepreneur - Types of Entrepreneur - Intrapreneur- an emerging class - Concept of Entrepreneurship -Entrepreneurial Culture - Stages in entrepreneurial process.

Creativity and Innovation: The role of creativity – The innovation Process – Sources of New Ideas – Methods of Generating Ideas – Creative Problem Solving – Entrepreneurial Process.

Module -2 Developing Business Model **9 hours**

Importance of Business Model – Starting a small scale industry -Components of an Effective Business Model, Osterwalder Business Model Canvas.

Business Planning Process: Meaning of business plan - Business plan process - Advantages of business planning - Final Project Report with Feasibility Study - preparing a model project report for starting a new venture.

Lab Component and assignment: Designing a Business Model Canvas

Module -3 Marketing function and forms of organisation **9 hours**

Industry Analysis – Competitor Analysis – Marketing Research for the New Venture – Defining the Purpose or Objectives – Gathering Data from Secondary Sources – Gathering Information from Primary Sources – Analyzing and Interpreting the Results – The Marketing Process

Forms of business organization: Sole Proprietorship – Partnership – Limited liability partnership - Joint Stock Companies and Cooperatives.

Module -4 Entrepreneurial finance **7 hours**

Entrepreneurial finance- Estimating the financial needs of a new venture, internal sources of finance, external sources of finance, components of financial plan

Institutions supporting Entrepreneurs: Small industry financing developing countries - A brief overview of financial institutions in India - Central level and state level institutions - SIDBI - NABARD - IDBI - SIDCO - Indian Institute of Entrepreneurship - DIC - Single Window - Latest Industrial Policy of Government of India.

Module -5 Rules And Legislation **9 hours**

Applicability of Legislation; Industries Development (Regulations) Act, 1951; Factories Act, 1948; Industrial Employment (Standing Orders) Act, 1946, Suspension, Stoppage of work, Termination of employment; Karnataka Shops and Establishment Act, 1961; Environment (Protection) Act, 1986; The sale of Goods Act, 1930; Industrial Dispute Act 1947.

Module-6 Company Incorporation **9 hours**

Process of Company Incorporation; process of registration; Importance of Marketing; Funding, Four stages of Start Up.

Intellectual property protection and Ethics: Patents – Copyright - Trademark- Geographical indications – Ethical and social responsibility and challenges.

Course outcomes:

At the end of the course the student will be able to:

1. Display keen interest and orientation towards entrepreneurship, entrepreneurial opportunity Modules' in order to setup a business and to think creatively.
2. To know about the various business models and B-Plans across Business sectors.
3. Able to understand the importance of marketing and different forms of businesses.
4. Become aware about various sources of funding and institutions supporting entrepreneurs.
5. Awareness about legal aspects and ways to protect the ideas.
6. To understand the ways of starting a company and to know how to protect their ideas.

Practical Component:

- Make a business plan for your intended business - talk to bankers to find out what they look for in a business plan - modify accordingly and present it in the class.
- Analyze the performance of listed family firms. How is their performance compared to the performance of other firms? Does a family firm successfully manage to create wealth for non-family investors?
- Design a Business Model Canvas
- Interview a local entrepreneur to find out his/her major motivations to start a business - which of the skills and characteristics do you find in the entrepreneur?
  -Examine how he/she started a business, funding opted, protection of ideas etc.
- Study a local for-profit business and try to list out the positive social impacts of the business.
- Visit a trade show and try to compare the marketing activities of various stalls in that show - make a list of good practices you come across in the show.

CO-PO MAPPING

CO	PO				
	Po1	**PO2**	**PO3**	**PO4**	**PO5**
CO1	**X**				**x**
CO2	**x**	**X**			**X**
CO3	**x**		**x**	**X**	
CO4	**x**		**X**		
CO5	**x**		**X**		X
CO6	**x**		**X**		**x**

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have 8 full questions carrying equal marks.
- Each full question is for 20 marks.
- Each full question will have sub question covering all the topics under a Module.
- The students will have to answer five full questions; selecting four full question from question number one to seven and question number eight is compulsory.
- 100 percent theory in the SEE.

Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Vasant Desai	The Dynamics of Entrepreneurial Development and Management	Himalaya Publishing House	2010
2	Donald F. Kuratko and Richard M. Hodgetts	Entrepreneurship	South-Western	2012
Reference Books				
1	Gupta S.L., Arun Mittal	Entrepreneurship Development	International Book House	2012
2	Sudha G. S	Management and Entrepreneurship Development	Indus Valley Publication	2009

III SEMESTER
CORE COURSES

EMERGING EXPONENTIAL TECHNOLOGIES			
Course Code	20MBA301	CIE Marks	40
Teaching Hours/Week	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Objective of the Course:

1. To understand the emerging technologies applicable in field of Management.
2. To study data science as a tool for decision making in Management
3. To understand the concept of AI, IOT and AR.
4. To study other emerging technologies in Management.

Module -1 Introduction to Emerging Technologies **9 hours**

Evolution of technologies; Introduction to Industrial revolution; Historical background of the Industrial Revolution; Introduction to Fourth industrial revolution (IR 4.0); Role of data for Emerging technologies; Enabling devices and networks for emerging technologies (programmable devices); Human to Machine Interaction; Future trends in emerging technologies.

Module -2 Data Science **7 hours**

Overview for Data Science; Definition of data and information; Data types and representation; Data Value Chain; Data Acquisition; Data Analysis; Data Curating; Data Storage; Data Usage; Basic concepts of Big Data.

Module -3 Artificial Intelligence(AI) **9 hours**

Concept of AI, meaning of AI, History of AI, Levels of AI, Types of AI, Applications of AI in Agriculture, Health, Business (Emerging market), Education, AI tools and platforms (eg: scratch/object tracking).

Module -4 Internet of Things (IoT) **9 hours**

Overview of IOT; meaning of IOT; History of IOT; Advantages of IOT; Challenges of IOT; IOT working process; Architecture of IOT; Devices and network; Applications of IOT at Smart home; Smart grid; Smart city; Wearable devices; Smart farming; IOT tools and platforms; Sample application with hands on activity.

Module-5 Augmented Reality (AR) and Virtual Reality (VR) **9 hours**

Introduction to AR, Virtual reality (VR), Augmented Reality (AR) vs mixed reality (MR), Architecture of AR systems. Application of AR systems (education, medical, assistance, entertainment) workshop oriented hands demo.

Module-6 Ethics, Professionalism and Other Emerging Technologies **7 hours**

Technology and ethics, Digital privacy, Accountability and trust, Treats and challenges.

Other Technologies: Block chain technology, Cloud and quantum computing, Autonomic computing, Computer vision, Cyber security, Additive manufacturing (3D Printing)

Course Outcomes:

By the end of this course the student will able to:

1. Identify different emerging technologies
2. Select appropriate technology and tools for a given task
3. Identify necessary inputs for application of emerging technologies
4. Understand the latest developments in the area of technology to support business

Practical Component:

- Big data analysis using an analytical tool
- Study the Application of AI in any one field and prepare a Report
- Study the Ethical practices of a Company
- 3D model Printing by Group or team
- Exposing the students to usage of IoT

CO-PO mapping

CO	PO				
	PO1	PO2	PO3	PO4	PO5
CO1	×				
CO2	×	×		×	
CO3	×	×		×	
CO4	×				

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have 8 full questions carrying equal marks.
- Each full question is for 20 marks.
- Each full question will have sub question covering all the topics under a Module.
- The students will have to answer five full questions; selecting four full question from question number one to seven and question number eight is compulsory.
- 100 percent theory in the SEE.

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Designing for Emerging Technologies: UX for Genomics, Robotics, and the Internet of Things	Follett, J.	O'Reilly Media	2014
2	Emerging Technologies for Emerging Markets	Vong, J., & Song, I.	Springer Singapore	2014
3	Disruption: Emerging Technologies and the Future of Work	Del Rosal, V.	Emtechub.	2015
4	Emerging Internet-Based Technologies	Sadiku, M. N. O	CRC Press	2019
Reference Books				
1	Digital Economy. Emerging Technologies and Business Innovation,	Mohamed Anis Bach Tobji, Rim Jallouli, Yamen Koubaa, Anton Nijholt		2018
2	Virtual & Augmented Reality for Dummies	Paul Mealy,		2018
3	Augmented Reality and Virtual Reality: Empowering Human, Place and Business,	Timothy Jung, M. Claudia tom Dieck		**2019**

Technology & Operational Strategy			
Course Code	20MBA302	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Course Objectives

1. To acquaint the student with the basic management principles with respect to production and operations management.
2. To Familiar the student with different types of Production Systems.
3. To explain the students regarding various techniques used in Operations Management.

Module-1 Introduction to Production and Operation Management (POM) 7 hours

Introduction Operations Management: Meaning, Definition, Scope and Functions. Difference Between Production and Operations Management. Management Guru's and their Contribution. The Roles and Functions of Operations Manager. Industry 4.0; Productions and Operations Management in Indian Context.

Module -2 Process Management Mapping 9 hours

Process Mapping, Process Flow charts, Ishikawa Diagrams, Fishbone Diagram and Cause and Effect Relationship, 5M, 8P, and 4S Systems, Theory Z Approach.

Module -3 Lean Manufacturing 9 hours

Concept of Lean Manufacturing; meaning of lean manufacturing; History of Lean Operations, Types of Waste, "5S" Technique of Eliminating the Waste, Lean Operations in the service sector, Role of Leadership, Lean Operations and Just In Time(JIT).

Module -4 Production System 9 hours

Production System: Meaning, Types- Batch and Continuous Production, TPS: Introduction, Overview of Toyota Production Systems – Focused Areas, Techniques: 5S, JIT, JIDOKA, KANBAN, KAIZEN, POKAYOKE, Toyota Production Systems.

Module -5 Total Quality Management(TQM) 9 Hours

Evolution of quality; Concept, Meaning and Features of TQM, Eight building blocks of TQM; TQM tools. Benchmarking: Concepts, Meaning, Benefits, Elements, Reasons for benchmarking, Process of benchmarking, FMEA; Quality Function Deployment (QFD) – House of Quality, QFD Process, Benefits, Taguchi Quality Loss Function, Quality Circles. Total Productive Maintenance (TPM) – Concept and need.

Module-6 Quality Systems 7 Hours

ISO: ISO role; Functions of ISO, Quality System Family Series ISO 9000; ISO 14000; ISO21000.
Six Sigma: Features of Six Sigma, Goals of Six Sigma, DMAIC, Six Sigma implementation.
Supply Chain and Operations: Supply Chain "KEIRETSU", Core Competency, Relationship of Operations and Supply Chain; Relationship of Purchasing and Supply Chain; Sources, Service Quality and Supply Chain.

Course Outcomes:

At the end of the course the student will be able to:

1. Acquire the knowledge about the concepts of production and operation management
2. Demonstrate the basic concepts of process mapping
3. Evaluate the importance of Lean Manufacturing
4. Develop strategies of Total quality management
5. Understand the roles of ISO standards and production system

Practical Component:

- Students should understand process management
- Students to visit an organization and study the quality management system
- Students has to understand production system
- Study the role of leader in operation management and prepare a Report
- Students need to understand the practicality of the ISO standards

CO-PO MAPPING

CO	PO				
	PO1	PO2	PO3	PO4	PO5
CO1	X				
CO2	X			X	
CO3	X			X	
CO4	X		X	X	X
CO5	X		X		X

Question paper pattern:

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- 100 percent theory in the SEE.

Textbooks				
Sl No	**Title of the book**	**Name of the Author/s**	**Publisher Name**	**Edition and year**
1	Production and Operations Management	S. N. Chari.	Mc Graw Hill.	6/e
2	Operations Management Theory and Practical	B. Mahadevan	Pearson.	3/e
3	Operations Management	Jay Heizer Barry Render, Chuck Munson, Amit Sachan	Pearson.	12/e
4	Production and Operations Management	R. Panneerselvam.	PHI	3/e
Reference Books				
1	The Goal: Process of Improvement	Eliyahu M. Goldratt	North River Press	3/e
2	The Toyota Way	Jeffery Liker.		

MARKETING SPECIALISATION COURSES

SERVICES MARKETING			
Course Code	20MBAMM303	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Course Objectives

1. To acquaint the students with the characteristics of services and their marketing implications.
2. To discuss and conceptualize the service quality, productivity in services, role of personnel in service marketing and to manage changes in the environment.
3. To familiarize the students with the GAPS model and strategizing towards closing the GAPS for effective services marketing.

Module-1 Introduction to services **9 hours**

Reasons for the growth of services sector and its contribution; difference in goods and service marketing; characteristics of services; concept of service marketing triangle; service marketing mix; GAP models of service quality.

Consumer behaviour in services: Search, Experience and Credence property, consumer expectation of services, two levels of expectation, Zone of tolerance, Factors influencing customer expectation of services.

Customer perception of services-Factors influencing customer perception of service, Service encounters, Customer satisfaction, Strategies for influencing customer perception.

Module -2 Market Research for Customer Expectation **9 hours**

Key reasons for gap using marketing research to understand customer expectation, Types of service research, Building customer relationship through retention strategies –Relationship marketing, Evaluation Of customer relationships, Benefits of customer relationship, levels of retention strategies, Market segmentation-Basis & targeting in services.

Module -3 Customer defined service standards **9 hours**

"Hard" & "Soft" standards, challenges of matching supply & demand in capacity, four common types of constraints facing services, optimum v/s maximum use of capacity, strategies for matching capacity & demand.

Yield management-balancing capacity utilization, pricing. Waiting line strategies- four basic Waiting line strategies.

Leadership &Measurement system for market driven service performance-key reasons for GAP-2 service leadership- Creation of service vision and implementation, Service quality as profit strategy, Role of service quality In offensive and defensive marketing.

Module -4 Employee role in service designing and Delivery **7 hours**

Boundary spanning roles, Emotional labour, Source of conflict, Quality- productivity trade off, Strategies for closing GAP 3.

Customer's role in service delivery-Importance of customer & customer's role in service delivery, Strategies for enhancing-Customer participation, Delivery through intermediaries-Key intermediaries for service delivery, Intermediary control strategies.

Module -5 Role of services marketing communication **9 hours**

Role of services marketing communication- Key reasons for GAP 4 involving communication, four categories of strategies to match service promises with delivery.

Pricing of services- Role of price and value in provider GAP 4, Role of non-monitory cost, Price as an indicator of service quality –Approaches to pricing services, pricing strategies, SERVQUAL Model.

Mini Project – On measuring SERVQUAL

Module - 6 Physical Evidence in Services **7 hours**

Physical evidence in services: Importance of Physical Evidence, Elements of Physical Evidence, Physical Evidence Strategies, Guidelines for Physical Evidence.

Service scapes: Types of service scapes-Objective and Goals of services capes Role of services capes, Approaches for understanding service scapes effects, Frame work for understanding services capes & its effect on behaviour-Guidance for physical evidence strategies.

Course outcomes:

At the end of the course the student will be able to:

1. Develop an understanding about the various concepts and importance of Services Marketing.
2. Enhance knowledge about emerging issues and trends in the service sector.
3. Learn to implement service strategies to meet new challenges.

Practical Component:

- Ask students to choose a service industry of their choice at the beginning of the semester
- Ask them to do an in-depth study of the industry and give a presentation at the end of the every Module relating the concepts to the particular industry(GAPS).
- Students can prepare service blueprints for any service of their choice.
- Identify any existing services, locate loopholes in the design and suggest modifications.
- Visit a service industry and analyze the role of customers in service delivery.

CO-PO MAPPING

CO	PO				
	PO1	PO2	PO3	PO4	PO5
CO1	X				
CO2	X			X	
CO3	X		X		X

Question paper pattern:

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- Each full question is for 20 marks.
- Each full question will have sub question covering all the topics under a Module.
- The students will have to answer five full questions; selecting four full question from question number one to seven and question number eight is compulsory.
- 100 percent theory in the SEE.

Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and
1	Services Marketing	Valarie A Zeithmal & Mary Jo	McGraw Hill	6/e 2018
2	Services Marketing	Christopher Lovelock	Pearson Education	2014
3	Services Marketing	Rajendra Nargundkar	McGraw Hill	2015
4	Marketing Research	Kumar	Sage Publications	4/e, 2018

Reference Books

1	Services Marketing	Parasuraman	Sage Publications	2018
2	Services Marketing	Hoffman & Bateson	Cengage Learning	2017
3	Services Marketing: Operation, Management and Strategy	Strategy-Kenneth E Clow& David L. Kurtz	Biztantra	2016

MARKETING RESEARCH & ANALYTICS			
Course Code	20MBAMM304	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Course Objectives

1. To provide an understanding of the basics of marketing research process.
2. To orient on the theoretical and practical aspects of marketing research.
3. Encourage the students to take up analytical thinking through research.
4. To highlight importance marketing research for enhancing marketing strategies.

Module-1 Marketing Research Dynamics **9 hours**

Meaning of Marketing research; when marketing research is unnecessary; Nature and Scope of Marketing Research; Marketing Research in the 21st Century (Indian Scenario); limitations of Marketing Research; threats to marketing research; Introduction to marketing intelligence: concept of marketing intelligence (MI), components, need for MI, Domains of MI. Ethics in marketing research. Design of consumer experiments using Conjoint Analysis. Case Study on Marketing Research Dynamics.

Module -2 Marketing Research Projects **7 hours**

Design and implementation of Marketing Research Projects, defining research questions, identifying respondents, sampling accuracy and sufficiency. Issues around studying human subjects.

Lab on socially acceptable responses- managing

Module -3 Decision Support System **9 hours**

Marketing Decision Support System-meaning, Use of Decision Support Systems in Marketing Research, Data base & Data warehousing. The three Vs: Volume, Velocity & Varity, The Fourth V: Value. Elements of data base, types of data base, using marketing data base for marketing intelligence, ways to gather consumer data.

Module -4 Applications of Marketing Research **9 hours**

Applications of Marketing Research: Introduction, Consumer Market Research, Business-to-Business Market Research, Product Research, Pricing Research, Motivational Research, Distribution Research, Advertising Research, Media research, Sales Analysis and Forecasting.

Live project & Assignment: Agriculture Marketing or B2B marketing

Module -5 Predictive analysis **9 hours**

Meaning of predictive analysis, how good are models at predictive behavior, benefits of predictive models and applications of predictive analysis, reaping the benefits, avoiding the pitfalls, importance of predictive model, process of predictive analytics. Predictive Analytics, Data Mining and Big Data_ Myths, Misconceptions and Methods by Steven Finlay.

Module - 6 Product Research **7 hours**

Product Research- Analysis of Diffusion of products, Adoption decisions, Product – services tradeoffs, evaluating prototypes, Luxury and Lifestyle products.

Live project: New Product adoption

Course outcomes:

The student should be able to:

1. Comprehend the objectives of Market research & its application in solving marketing problems.
2. Appreciate the use of different data collection methods, sampling design techniques, measurement methods to analyze the data.
3. Generalize and interpret the data with the help of various measurement techniques.
4. To understand the emergence of new trends in research.

Practical Component:

- Choose 5 successful products or services and identify the insight behind them through a field survey.
- Do a comprehensive essay on the difference between consumers vs. trade vs. Competition insights & how best to exploit them.
- Take 5 recent digital innovations like twitter or face book and identify the insights.
- Running case with real data Dell, Comprehensive critical thinking case Baskin-Robbins.
- Data Analysis case with real data IBM.

CO-PO MAPPING

CO	PO				
	PO1	PO2	PO3	PO4	PO5
CO1	X		X		
CO2	X	X		X	
CO3	X		X		X
CO4	X			X	X

Question paper pattern:

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- Each full question is for 20 marks.
- Each full question will have sub question covering all the topics under a Module.
- The students will have to answer five full questions; selecting four full question from question number one to seven and question number eight is compulsory.
- 100 percent theory in the SEE.

Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Marketing Research- An Applied Orientation	Naresh K Malhotra & SatyaBhushan Dash	Pearson	7th Edition
2	Marketing Analytics Using Excel	.Ajithab Dash	Sage publications	2019
3	Essentials of Marketing Research	William G Zikmund et. al	Cengage Learning	7/e
4	Marketing Research	V Kumar	Sage Publications	1/e, 2015

Reference Books

1	Market Research: Text and cases	Rajendra Nargundkar	Mc Graw Hill	3rd Edition
2	The Effective Use of Market Research: How to drive and focus better business decisions	Robin J Birn	Viva	4th Edition
3	Marketing Research: Methodological Foundations	Gilbert A Churchill & Dawan Lacobucci		8th Edition

CONSUMER BEHAVIOUR			
Course Code	20MBAMM305	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Course Objectives

1. To understand the concept of consumer behaviour, decision making by consumers, behavioural variables and its influences on consumer behaviour.
2. To comprehend the social and cultural dimensions of consumer behaviour.
3. To provide an insight of the psychological and behavioural concepts of consumers.

Module-1 Introduction **7 hours**

Meaning of Consumer Behaviour; Difference between Consumer & Customer; Nature & characteristics of Indian Consumers; Consumerism: meaning; Consumer Movement in India; Rights & Responsibilities of consumers in India; Benefits of consumerism. Research on Consumer Behaviour; Consumer Behaviour and Society.

Module -2 Models of Consumer Behaviour **9 hours**

Input-Process-Output Model, Nicosia Model, Howard Sheth Model, Engel-Kollat-Blackwell Models of Consumer Behaviour, Internal Influences, External Influences.

Consumer Decision Making: Consumer Buying Decision Process, Levels of Consumer Decision Making – Four views of consumer decision making. On-line Decision Making: Meaning & Process/Stages.

Situational Influences- Nature of Situational Influence, Situational Characteristics and consumption behaviour.

Class Exercise: Conducting consumer experiments.

Module -3 Individual Influences on Consumer Behaviour and CRM Part –I **9 hours**

a) Motivation: Basics of Motivation, Needs, Goals, Positive & Negative Motivation, Rational Vs Emotional motives, Motivation Process, Arousal of motives, Selection of goals. Motivation Theories and Marketing Strategy - Maslow's Hierarchy of Needs, McGuire's Psychological Motives.

b) Personality: Basics of Personality, Theories of Personality and Marketing Strategy (Freudian Theory, Neo-Freudian Theory, Trait Theory), Applications of Personality concepts in Marketing, Personality and understanding consumer diversity, Brand Personality, Self and Self-Image.

c) Perception: Basics of Perception & Marketing implications, Elements of Perception, Dynamics of Perception, Influence of perception on CB, Consumer Imagery, Perceived price, Perceived quality, price/quality relationship, Perceived Risk, Types of risk, How to consumers' handle risk.

Module -4 Individual Influences on Consumer Behaviour and CRM Part –II **9 hours**

d)Learning: Elements of Consumer Learning, Marketing Applications of Behavioural Learning Theories, Classical Conditioning – Pavlovian Model, Neo-Pavlovian Model, Instrumental Conditioning.

e) Attitude: Basics of attitude, the nature of attitude, Models of Attitude and Marketing Implication, (Tri-component Model of attitude, Multi attribute attitude models. Elaboration Likelihood Model).

Persuasive Communication: Communications strategy, Target Audience, Media Strategy, Message strategies, Message structure and presentation

Module -5 External Influences on Consumer Behaviour **9 hours**

Social Class: Social Class Basics, What is Social Class? (Social class & Social status, the dynamics of status consumption, Features of Social Class, Five Social-Class Categories in India.

Culture: Basics, Meaning, Characteristics, Factors affecting culture, Role of customs, values and beliefs in Consumer Behaviour. Subculture: Meaning, Subculture division and consumption pattern in India, Types of subcultures. Cross Culture - Cross-cultural consumer analysis - Cross-cultural marketing strategy: Cross-cultural marketing problems in India, Strategies to overcome cross-cultural problems.

Groups: Meaning and Nature of Groups, Types Family: The changing structure of family, Family decision making and consumption related roles, Dynamics of husband-wife decision making, The family life cycle & marketing strategy, Traditional family life cycle & marketing implications, Reference Groups: Understanding the power & benefits of reference groups, Factors that affect reference group influence, Types of reference group, Reference Group Appeals.

Module - 6 Consumer Influence and Diffusion of Innovations **7 hours**

Opinion Leadership: Dynamics of opinion leadership process, Measurement of opinion leadership, Market Mavens, Opinion Leadership & Marketing Strategy, Creation of Opinion Leaders.

Diffusion of Innovations: Diffusion Process, Adoption Process: Stages, categories of adopters, Post Purchase Processes.

Customer Relationship Management- Meaning & Significance of CRM, Types of CRM Strategies for building relationship marketing, e-CRM, Meaning, Importance of e-CRM, Difference Between CRM & e-CRM
Case Study: Pillsbury Cookie Challenge.

Course outcomes:

At the end of the course the student will be able to:

1. Explain the background and concepts vital for understanding Consumer Behaviour.
2. Identify the role of variables that determines Consumer Behaviour in Social & cultural domain.
3. Identifying the psychological and behavioural practices adopted by organizations to enhance the Consumer Behaviour.

Practical Components:

- Students can go to malls and unorganized retail outlets and observe the behaviour of consumers of different demographic segments while buying different category of goods. The students need to present the findings / observations followed with a group discussion.
- Students have to prepare a questionnaire and conduct the survey on consumer buying behaviour and present the findings in the class.
- Find three advertisements that appeal to the need for power, affiliation and achievement. Discuss their effectiveness. Rewrite these for persons in different levels of Maslow's Hierarchy?
- Meet your friends and conduct a survey to find what are the important factors in their purchase of mobiles, shoes, bags etc.
- Conduct a study on advertisements regarding a specific product and find out how consumer deal with the information overload.

CO-PO MAPPING

CO	PO				
	PO1	PO2	PO3	PO4	PO5
CO1	X				
CO2	X		X	X	
CO3	X				X

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have 8 full questions carrying equal marks.
- Each full question is for 20 marks.
- Each full question will have sub question covering all the topics under a Module.
- The students will have to answer five full questions; selecting four full question from question number one to seven and question number eight is compulsory.
- 100 percent theory in the SEE.

Texbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Consumer Behaviour	Leon Schiffman, Leslie	Pearson	Latest Edition
2	Consumer Behaviour: A Managerial Perspective	Dr.Dheeraj Sharma, Jagdish N Sheth, Banwari Mittal	Cengage Learning	Latest Edition
3	Consumer Behaviour	Sethna	Sage Publications	4/e, 2018
4	Advertisement Brands & Consumer Behaviour-Case Book	Ramesh Kumar	Sage Publications	2017

Reference Books				
1	Consumer Behaviour in Indian Perspective	Suja Nair	Himalaya Publications	2015
2	Consumer Behaviour: Building Marketing Strategy	Dell, Hawking & others	Tata McGraw Hill	Latest Edition
3	Consumer Behaviour	Satish K Batra & S H H Kazmi	Excel Books	Latest Edition

RETAIL MANAGEMENT			
Course Code	20MBAMM306	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Course Objectives

1.To provide an understanding of the concepts, techniques and approaches in Sales Management
2. To emphasize on the Sales Manager's problems and dilemmas.
3.To develop skills for generating, evaluating and selecting sales strategies.
4.To develop an understanding of the contemporary retail management, issues, strategies and trends.
5.To highlight the importance of retailing and its role in the success of modern business.
6.To acclimatize with the insights of retailing, key activities and relationships.

Module-1 Sales Management **7 hours**

Meaning, Personal Selling, the sales management process Emerging Trends in Sales Management, Qualities and Responsibilities of a sales manager. Selling skills & selling strategies: selling and buying styles, selling situations, selling skills, selling process.

Module -2 Management of Sales Territory & Sales Quota **7 hours**

Sales territory, meaning, size, designing, sales quota, procedure for sales quota. Types of sales quota, Methods of setting quota. Recruitment and selection of sales force, Training of salesforce.

Module -3 Retail Management **10 hours**

Introduction and Perspectives on Retailing World of Retailing, Retail management, introduction, meaning, characteristics, emergence of organizations of retailing - Types of Retailers (Retail Formats) - Multichannel Retailing -Customer Buying Behaviour, role of retailing, trends in retailing, FDI in Retail - Problems of Indian Retailing - Current Scenario. **Assignment: History and current trends including Indian retail FDI Policy.**

Module-4 Setting up Retail organization **10 hours**

Size and space allocation, location strategy, factors Affecting the location of Retail, Retail location Research and Techniques, Objectives of Good store Design. Retail Market Strategy - Financial Strategy Human Resource Management, Information Systems and supply chain management & Logistics.

Store Layout and Space planning: Types of Layouts, role of Visual Merchandiser, Visual Merchandising Techniques, Controlling Costs and Reducing Inventories Loss, Exteriors, Interiors.

Store Management: Responsibilities of Store Manager, Store Security, Parking Space Problem at Retail Centers, Store Record and Accounting System, Coding System, Material Handling in Stores, Management of modern retails stores.

Assignment: ***Merchandise Planning and Category Management, Mall Management-key aspects***

Module -5 Retail Pricing **9 hours**

Retail Pricing: Factors influencing retail pricing, Retail pricing strategies, Retail promotion strategies

Relationship Marketing in Retailing: Management & Evaluation of Relationships in Retailing, Retail **Research in Retailing:** Importance of Research in Retailing, Trends in Retail Research, Areas of Retail Research. Customer Audits, Brand Management in retailing Retail Audit and ethics in Retailing Undertaking an audit, responding to a retail Audit, problems in conducting a retail audit

Retail Analytics Case Study: Customer Analytics at Big Basket.

Module – 6 Internationalization of Retailing **7 hours**

Evolution of International Retailing, Motives of International Retailing, International Retail Environment – Socio-Cultural, Economic, Political, Legal, Technological and issues in international retailing.

Course Outcomes:

1.Career development in the field of sales
2.Management of sales
3.Find out the contemporary retail management, issues, and strategies.
4.Evaluate the recent trends in retailing and its impact in the success of modern business.
5.Relate store management and visual merchandising practices for effective retailing.

Practical Component:

- Interview a salesperson in a retail store and write a brief report about what they like and dislike about their jobs, their salary, travelling allowances, sales quotas, why they chose a sales career, and what does it take to

succeed in this profession.

- Go to a kirana store and a supermarket and compare the following: a) store arrangement b) No of brands carried c) pricing policies – are discounts given? d) Service – personal or impersonal? Etc.
- Go to at least three kirana stores in your neighbourhood (around 2 kms) and discuss with them the importance of location, pricing, credit policy, etc. What percentages of goods are sold 'loose' in each locality and compare this with the approximate income range of the customers? What are the retailer's losses when a customer defaults in payment? Does he make up for it by increasing his prices to other customers?
- Ask your friends if they would buy certain goods like groceries, vegetables, socks, mobile, pens etc from the roadside vendor as against a regular shop. Group the products into low risk and high risk ones. Does this buying behavior also depend on the personality of the individual doing the buying? Or the one doing the selling?
- Student can make a presentation on any product or the services of student choice, covering selling strategies and one day work exposure towards merchandising in any big retail outlets of respective places where institute is operating. Rural colleges can send the students to the city nearby to observe the merchandising planning in retail outlets and to make a small report.

CO-PO MAPPING

CO	PO				
	PO1	PO2	PO3	PO4	PO5
CO1	X		X	X	
CO2	X		X	X	
CO3	X				X

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have 8 full questions carrying equal marks.
- Each full question is for 20 marks.
- Each full question will have sub question covering all the topics under a Module.
- The students will have to answer five full questions; selecting four full question from question number one to seven and question number eight is compulsory.
- 100 perecent theory in the SEE.

Texbooks

1	Sales & Distribution Management	Tapan K. Panda & Sunil Sahadev,	6/e, Oxford University Press	2012
2	Managing of Sales Force	Spiro Stanton Rich	TMH	2003.
3	Sales Management	Charles M. Futrell		2012
4	Retail Management	Levy &Weitz	McGraw Hill	Latest Edition
5	Retail Management	Chetan Bajaj	Oxford University	
3	Retail Management-A Global Perspective: Text and Cases	Dr.Harjit Singh	S.Chand	Reprint 2018

Reference Books

	Sales & Distribution Management	Gupta S. L	Excel Books	2010
2	Retail Marketing Management	Dravid Gilbert,	Pearson Education	Latest Edition
3	Retail Management: A Strategic Approach	Barry Berman, Joel R. Evans	Pearson Education	Latest Edition

FINANCE SPECIALISATION COURSES

INVESTMENT MANAGEMENT			
Course Code	20MBAFM303	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Course Objectives

1. To understand the capital market and various instruments for investment.
2. Learn valuation of equity, debt and mutual funds.
3. To learn theories of portfolio management.
4. To learn diversification of securities for risk return trade off in capital market.
5. To lean portfolio construction for retail investors, high net worth individuals, mutual funds.

Module -1 Introduction to Investment **7 hours**

Investment Avenues, Attributes, Investor V/s speculator, Features of a good Investment, Investment Process. Financial Instruments: Money Market Instruments, Capital Market Instruments, Derivatives.

Securities Market: Primary Market, Secondary Market. Stock Market Indicators- Indices of Indian Stock Exchanges (only Theory).

Module -2 **7 hours**

Return and Risk Concepts: Concept of return, individual security returns, rate of return, Concept of Risk, Causes of Risk, Types of Risk- Systematic risk- Market Price Risk, Interest Rate Risk, Purchasing Power Risk, Unsystematic Risk- Business risk, Financial Risk, Insolvency Risk, Risk-Return Relationship, Concept of diversifiable risk and non-diversifiable risk. Calculation of Return and Risk of Individual Security (Theory & Problems).

Module -3 Valuation of Securities **9 hours**

Bond features, Types of Bonds, Determinants of interest rates, Bond Valuation, Bond Duration, Bond Management Strategies. Preference Shares- Concept, Features, Valuation. Equity Shares- Concept, Valuation, Dividend Valuation Models, P/E Ratio valuation model. (Theory & Problems).

Module -4 **7 hours**

Macro-Economic and Industry Analysis: Fundamental analysis-EIC Frame Work, Economy Analysis, Industry Analysis, Company Analysis- Financial Statement Analysis.

Market Efficiency: Efficient Market Hypothesis, Forms of Market Efficiency, Empirical test for different forms of market efficiency.

Technical Analysis – Concept, Theories- Dow Theory, Eliot Wave theory. Charts-Types, Trends and Trend Reversal Patterns. Mathematical Indicators –Moving Average Convergence-Divergence, Relative Strength Index (Theory only).

Module -5 Modern Portfolio Theory **11 hours**

Markowitz Model- Diversification, Portfolio Return, Portfolio Risk, Efficient Frontier. Sharpe's Single Index Model, Capital Asset Pricing Model: Assumptions, CAPM Equation, Capital Market Line, Security Market Line, CML V/s SML. Sharpe's Optimum Portfolio Construction. Arbitrage Pricing Theory: Equation, Assumption, CAPM V/s APT (Theory & Problems).

Module-6 Portfolio Management Strategies and Performance Evaluation **9 hours**

Portfolio Management Strategies: Active and Passive Portfolio Management strategy. Portfolio Revision: Portfolio Revision Strategies – Objectives, Performance plans. **Mutual Funds**: Concept of Mutual Funds, Participants in Mutual Funds, Advantages of Investment in Mutual Fund, Measure of Mutual Fund Performance. **Portfolio performance Evaluation:** Measures of portfolio performance (Theory & Problems).

Course outcomes:

At the end of the course the student will be able to:

1. The student will understand the capital market and various Instruments for Investment.
2. The learner will be able to assess the risk and return associated with investments and methods to value securities.
3. The student will be able to analyse the Economy, Industry and Company framework for Investment Management.
4. The student will learn the theories of Portfolio management and also the tools and techniques for efficient portfolio management.

CO-PO MAPPING

Practical Components:

• Each student will be given a virtual cash of Rs.10 Lakhs and they will be asked to invest in equity shares based on fundamental analysis throughout the semester. At the end the best investment will be awarded based on the final net worth. Virtual on line trading account can be opened for the student and every week 2 hours can be allotted to invest, monitor and evaluate.

• Students should study the stock market pages from business press and calculate the risk and return of selected companies.

• Students can do a macro economy using GDP growth.

• Students' are expected to do Industry analysis for specific sectors.

• Students can do Company analysis for select companies using profitability and liquidity ratios.

• Practice technical analysis using Japanese candle sticks.

CO	PO				
	PO1	PO2	PO3	PO4	PO5
CO1	X				
CO2	X			X	X
CO3	X				X
CO4	X			X	

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have 8 full questions carrying equal marks.
- Each full question is for 20 marks.
- Each full question will have sub question covering all the topics under a Module.
- The students will have to answer five full questions; selecting four full question from question number one to seven and question number eight is compulsory.

40 percent theory and 60 percent problems in the SEE.

Textbook/ Textbooks

Sl. No.	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Investment Analysis and Portfolio management	Prasanna Chandra	Tata McGraw Hill Education	3/e, 2010
2	Investments	ZviBodie, Kane, Marcus & Mohanty	Tata McGraw Hill Education	8/e, 2010
3	Security Analysis & Portfolio Management	J Kevin	Tata McGraw Hill Education	2014
Reference Books				
1	Analysis of Investments & Management	Reilly & Brown	Cengage Publications,	10e/2017
2	Security Analysis & Portfolio Management	Punithavathy Ehavathy Pandian	Vikas Publications	2/e, 201/8
3	Investment management (Security Analysis and & Portfolio Management)	Bhalla V.K.	Vikas Publications	19/e, 2018

DIRECT TAXATION			
Course Code	20MBAFM304	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Course Objectives

1. To provide the students with a comprehensive understanding of basic concepts of Income tax
2. To understand the computation of taxable Income under different heads.
3. To know the deductions available while computing Income.
4. To understand corporate taxation system in India

Module-1 Income Tax Act, 1961 **7 hours**

Income Tax Act, 1961, Basic Concepts and definitions, Capital and revenue – receipts, expenditures, Basis of charge and scope of total income , Residential Status and Incidence of Tax, Incomes which do not form part of Total Income (Sec.10), Tax Planning, Tax Evasion and Tax Management. (Problems on residential Status of Individual assessee).

Module -2 Income from Salaries **9 hours**

Meaning of Salary, Allowances, Valuation & Taxability of Perquisites, Death cum Retirement benefits, Deductions against Salary. Income from House Property (Theory Only). (Problems on salary Income).

Module -3 Income from Business or Professions **9 hours**

Income under the head Profit and Gains of Business or Professions and its computation- basic method of accounting- scheme of business deductions/ allowance- deemed profits- maintenance of books, Depreciation. (Problems on computation of income from business/ profession of Individual assessee and Depreciation).

Module -4 Income under capital gain **9 hours**

Income under capital gain, basis of charge, transfer of capital asset, inclusion & exclusion from capital asset, capital gain, computation of capital gain, deductions from capital gains. Income from Other Sources (Theory Only). (Problems on computation of Income from capital gain).

Module -5 Permissible Deductions **9 hours**

Permissible deductions under section 80C to 80U, computation of tax liability of Individuals. Setoff and carry forward of losses (Theory only). (Problems on Computation of taxable Income and tax liability of Individuals).

Module -6 Computation of taxable income of a company **7 hours**

Computation of taxable income of a company with special reference to MAT. (Problems on MAT).

Course outcomes:

At the end of the course the student will be able to:

1. Understand the basics of taxation and process of computing residential status.
2. Calculate taxable income under different heads.
3. Understand deductions and calculation of tax liability of Individuals.
4. Know the corporate tax system.

Practical Components:

- Calculation of Taxable income and tax liability using Excel.
- Encouraging the students to register as tax return preparers.
- Students can be exposed to filing of tax returns of Individual assesses.

CO-PO MAPPING

CO	PO				
	PO1	PO2	PO3	PO4	PO5
CO1	X				
CO2	X			X	
CO3	X				
CO4	X				

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have 8 full questions carrying equal marks.
- Each full question is for 20 marks.
- Each full question will have sub question covering all the topics under a Module.
- The students will have to answer five full questions; selecting four full question from question number one to seven and question number eight is compulsory.
- 40 percent theory and 600 percent problems in the SEE

Textbooks

Sl. No.	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Direct Taxes Law and practice	Vinod Singhania and Kapil Singhania	Taxman Publications	2019/2020 Edition
2	Students Guide to Income Tax Vinod Singhania and Kapil Singhania	Vinod Singhania and Kapil Singhania	Taxman Publications	2019/2020 Edition
Reference Books				
1	Students Handbook on Taxation	T N Manoharan	Snow White Publications Pvt. Ltd	Jan 2020 Edition
2	Income Tax Law & Practice	B.B.Lal & N. Vashisht	Pearson	33e/2019
3	Income Tax	H.C.Mehrotra & S.P.Goyal	Sahithya Bhavan Publications	60 e/2019

BANKING & FINANCIAL SERVICES			
Course Code	20MBAFM305	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Course Objectives:

1. To understand the structure and functions of central and Commercial banking in India.
2. To learn the functions of various financial services in India.

Module-1 Structure of Banking in India **7 hours**

Structure of Banking in India: Functions of RBI, Monetary system, Sources of funds, Quantitative and qualitative measures of credit control. Banking sector reforms, Bank performance analysis and Future of Banking.(Theory)

Module -2 Commercial Banking **9 hours**

Commercial Banking: Structure, Functions - Primary & secondary function, Role of commercial banks in socio-economic development, Services rendered. Banking Technology- Concept of Universal Banking-Home banking– ATMs-Internet Banking– Mobile Banking-Core Banking Solutions–Debit, Credit and Smart Cards– Electronic Payment systems-MICR- Cheque Truncation-ECS- EFT – NEFT-RTGS. (Theory)

Module -3 Merchant Banking **9 hours**

Merchant Banking: Categories, Services offered, Issue management – Pre and Post issue management, Issue pricing, preparation of prospectus, Issue Management, Underwriting, Private Placement, Book Building Vs. Fixed price issues.(Theory)

Module -4 NBFCs; Micro-finance; Leasing & Hire Purchase Banking **9 hours**

A. NBFCs: An Overview -Types of NBFCs in India-Regulatory framework.
B. Micro-finance: Models, Services, Challenges.
C. Leasing & Hire Purchase: Concept, Types, Evaluation. Problems in Evaluation of Leasing & Hire Purchase. (Theory& Problems)

Module -5 Credit Rating; Venture Capital; Depository System & Securitisation of Debt **9 hours**

A. Credit Rating: Meaning, Process, Methodology, Agencies And Symbols.
B. Venture Capital: Concept, Features, Process. Stages, Performance of Venture Capital Funded Companies In India.(Theory)
C. Depository System: Objectives, Activities, NSDL& CDSL. Process of Clearing and Settlement.
D. Securitization of Debt: Meaning, process, Types, Benefits. (Theory)

Module-6 Mutual Funds **7 hours**

Meaning, Structure, Functions, Participants, Types of Funds, Types of Schemes, Performance of Mutual Funds, Regulations for Mutual Funds.

Course outcomes:

At the end of the course the student will be able to:

1. The Student will be acquainted to various Banking and Non-Banking financial services in India.
2. The Student will understand the activities of Merchant Banking and credit rating.
3. The Student will be equipped to understand micro financing and other financial services in India.
4. The Student will understand how to evaluate and compare leasing & hire purchase.

Practical Components:

- Study and compare the performance of Public and private sector banks.
- Issue management: Study the recent public issues.
- Factoring and forfeiting business in India.
- Venture capital funding and start up challenges.
- Status of securitization in India

CO-PO MAPPING

CO	PO				
	PO1	PO2	PO3	PO4	PO5
CO1	X				
CO2	X			X	
CO3	X				X
CO4	X			X	

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have 8 full questions carrying equal marks.
- Each full question is for 20 marks.
- Each full question will have sub question covering all the topics under a Module.
- The students will have to answer five full questions; selecting four full question from question number one to seven and question number eight is compulsory.
- 80 percent theory and 20 percent problems in the SEE.

Textbook/ Textbooks

Sl. No.	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Financial services	Khan M Y	McGraw Hill	6/e
2	Banking and Financial Services	Mukund Sharma	Himalaya Publishing House	2015
3	Financial Services in India: Concept and Application	Rajesh Kothari	Sage Publications	1/e, 2010
Reference Books				
1	Financial Markets and Services	Gordon & Natarajan	Himalaya Publishing House	7/, 2011
2	Merchant Banking & Financial	Vij & Dhavan	McGraw Hill	1/e, 2011
3	Investment Banking	Pratap G Subramanyam	Tata McGraw Hill	2012
4	Behavioural Finance	Sujata Kapoor & Jaya Mamta Prosad	Sage Publications	1/ e, 2019

ADVANCED FINANCIAL MANAGEMENT			
Course Code	20MBAFM306	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Course Objectives

1. To understand the concept capital structure and capital structure theories.
2. To assess the dividend policy of the firm.
3. To be aware of the management of working capital and its financing.
4. To understand the techniques of managing different components of working capital.

Module -1 Capital Structure Decisions **9 hours**

Capital structure & market value of a firm. Theories of capital structure – NI approach, NOI approach, Modigliani Miller approach, Traditional approach. Planning the capital structure: EBIT and EPS analysis. ROI & ROE analysis. (Theory and Problems).

Module -2 Dividend Policy **9 hours**

Dividend policy – Theories of dividend policy: relevance and irrelevance dividend decision. Walter's & Gordon's model, Modigliani & Miller approach. Dividend policies – stable dividend, stable payout and growth. Bonus shares and stock split corporate dividend behavior. (Theory and Problems).

Module -3 Working Capital Management Policy **9 hours**

Working capital management – Determination of level of current assets. Sources for financing working capital. Bank finance for working capital. (No problems on estimation of working capital). Working capital financing: Short term financing of working capital, long term financing of working capital. Working capital leverage. (Theory).

Module -4 Inventory Management **7 hours**

Inventory Management: Determinations of inventory control levels: ordering, reordering, danger level. EOQ model. Pricing of raw material. Monitoring and control of inventories, ABC Analysis. (Theory and problems)

Module -5 Receivables Management **7 hours**

Receivables Management – Credit management through credit policy variables, marginal analysis, Credit evaluation: Numerical credit scoring and Discriminate analysis. Control of accounts receivables, Problems on credit granting decision. (Theory and Problems)

Module-6 Cash Management **9 hours**

Cash Management – Forecasting cash flows – Cash budgets, long-term cash forecasting, monitoring collections and receivables, optimal cash balances – Baumol model, Miller-Orr model, Strategies for managing surplus fund. (Theory and Problems)

Course outcomes:

At the end of the course the student will be able to:

1. Get an overview of capital structure theories.
2. Understand and assess the dividend policy of the firm.
3. Realize the importance of management of working capital in an organization.
4. Be aware of the techniques of cash, inventory and receivables management

Practical Component:

• Study the working capital financing provided by a Bank and submit the report on the same.
• Study the annual report of any two companies and prepare a cash budget for next year.
• Study dividend policy of companies and its impact on shareholders' wealth.
• Study implications of bonus issues/stock splits of companies.

CO-PO MAPPING

CO	PO				
	PO1	**PO2**	**PO3**	**PO4**	**PO5**
CO1	X				
CO2	X			X	
CO3	X				
CO4	X				X

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have 8 full questions carrying equal marks.
- Each full question is for 20 marks.
- Each full question will have sub question covering all the topics under a Module.
- The students will have to answer five full questions; selecting four full question from question number one to seven and question number eight is compulsory.
- 40 percent theory and 60 percent problems in the SEE.

Textbooks

Sl. No.	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Financial Management	M.Y.Khan & P.K.Jain	TMH	6/e, 2011
2	Financial Management	Prasanna Chandra	TMH	8/e, 2011
3	Corporate Finance-Text and Cases	Vishwanath S.R.	Sage Publishing	3/e, 2019

Reference Books

1	Financial Management & Policy	Vanhorne	Pearson	12/e,
2	Financial Planning: Theory and Practice	Sid Mittra, Shailendra Kumar Rai, Anandi P Sahu & Harry Starn, Jr.	Sage Publishing	1/e, 2015
3	Financial Management-A	Rajesh Kothari	Sage Publishing	2/e, 2017

HUMAN RESOURCE SPECIALISATION COURSES

RECRUITMENT AND SELECTION			
Course Code	20MBAHR303	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Course Objectives

1. The student will be able to recite the theories and various steps involved in Recruitment and Selection
2. The student will be able to describe and explain in her/his own words, the relevance and importance of Recruitment and Selection in the Organization
3. The student will be able to apply and solve the workplace problems through Recruitment and Selection intervention
4. The student will be able to classify and categorize in differentiating between the best method to be adopted by organization related to Recruitment and Selection
5. The student will be able to compare and contrast different approaches of Recruitment and Selection framework for solving the complex issues and problems
6. The student will be able to design and develop an original framework and framework in dealing with the problems in the organization.

Module-1 Workforce Planning and Recruitment Analytics **9 hours**

Concept of Work, Organisation's Work and Jobs; Millennials at the work place; Key Characteristics of Millennials; Types of Millennial; The Evolution of Work Structure; Organising the Work; Strategic Job Redesign and Its Benefits; Strategic Issues in Recruitment; What make Bad Recruitment; Overview of the Hiring Process; Recruitment Metrics; Factors Affecting Recruitment; Recruitment Strategy: An Internal Approach; Recruitment Strategy: An External Approach; Legal and Ethical Considerations; Organisational Best Practices.

Module -2 Job Analysis, Job Description and Job Design **9 hours**

Identify the Job to Examine; Determine Appropriate Information Sources and Collect Job-Related Data; Job Description; Competency and Competency Ice Berg Model; Why Competency Based Recruitment; Sources of Recruitment; Different steps of job search; Motivational Job Specification; Creation of Functional Specification; Creation of Behavioural Specification; Employer branding; Social Media; Job Design.

Module -3 Job Evaluation **7 hours**

The Job Evaluation Process; Obtain Job KSAOs, Qualifications, Working Conditions, and Essential Duties; Examine Compensable Factors Using the Rating/Weighting Evaluation Method; Determine Overall Job Value; Hay Group—Pioneer in Job Evaluation; Determining Compensation using Job Evaluation Data; Legal and Ethical Considerations for Job Evaluation; Online Salary Survey.

Module -4 Selection and Interview Strategy **9 hours**

Interview Strategy and Process; Millennials shaping the Recruitment landscape in the organizations; Strategies for recruiting and selecting Generation Y into the workforce Developing Effective. Interviewers; Interviewing Techniques; Legal and Ethical Considerations in the Interview Process; The overall BEI Process; Assessment Centre's; Simulations.

Module -5 Testing and Assessment **9 hours**

Testing in Occupational Selection; Test related to Assessment of Knowledge, Skills, and Abilities; Personality Assessment; The Birkman method and MBTI® comparison; FIRO-B; Honesty and Integrity Assessment; Various Non-Interviewing Methods; Graphology; Skills Assessment; Games and Group Activity for Leadership Assessment; Administration of Tests and Assessments; Key Interviewer Skills.

Module – 6 Making the Hire; Assessment of Candidate and Job Fit **7 hours**

Unique Recruitment strategies; Biodata and Application Forms; Implications of Using Social Media Content in Hiring Decisions; Background Checks; Reference Checks; Pre-employment Testing; Making a Job Offer; Transitioning from Job Candidate to Employee; Induction; Placement.

Course outcomes:

At the end of the course the student will be able to:

1. Gain the practical insight of various principles and practices of recruitment and selection.
2. Acquire knowledge of latest conceptual framework used in recruitment and selection process and procedure applied in various industries.

3. Illustrate the application of recruitment and selection tools and techniques in various sectors.
4. Develop a greater understanding about strategies for workforce planning and assessment, analyse the hiring management system followed in various industries.

Practical Component:

- Design and Job Advertisement and Calculate the Cost; Paper Print mode; Social Media formalities.
- Meet a Manager (which ever stream), interact and design and JD for that role.
- Meet HR Manager / Officer, and ask Best 10 Interview Questions they ask during Candidate interaction.
- Visit HR department, and take part on shortlisting/ Scrutiny the CV.

CO-PO MAPPING

CO	PO				
	PO1	PO2	PO3	PO4	PO5
CO1	X				
CO2	X			X	
CO3	X				X
CO4	X		X	X	

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have 8 full questions carrying equal marks.
- Each full question is for 20 marks.
- Each full question will have sub question covering all the topics under a Module.
- The students will have to answer five full questions; selecting four full question from question number one to seven and question number eight is compulsory.
- 100 percent theory in the SEE.

Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	How to Recruit, Incentives and Retain Millennials.	Rohtak	Sage Publications	2019
2	Recruitment and Selection- Strategies for Workforce Planning & Assessment	Carrie A. Picardi	Sage Publication	2019
3	Human Resource Management	R. C. Sharma	Sage Publication	2019

Reference Books

1	Human Resource Management:	Amitabha Sengupta	Sage Publication	2018
2	Leadership: Theory and Practices	Peter G. Northouse	Sage Publication India Pvt. Ltd	7/e, 2016
3	Performance Management and	T. V Rao	Response Books	2004

HUMAN RESOURCE ANALYTICS			
Course Code	20MBAHR304	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Course Objectives

1. The student will be able to describe and Identify the application of HR Analytics in the Organisation
2. The student will be able to describe and explain in her/his own words, the relevance and importance of HR Analytics in the Organisation
3. The student will be able to apply and solve the workplace problems through application of HR Analytics in the Organisation
4. The student will be able to classify and categorise different models of HR Analytics in the Organisation
5. The student will be able to compare and contrast different approaches of HR Analytics in the Organisation
6. The student will be able to design and develop an original framework and model in dealing with the problems in the organisation.

Module-1 Introduction **7 hours**

Evolution of Business Analytics, Motivation for Studying Business Analytics, Emergence of Business Analytics, Understanding Business Analytics, Managing a Business Analytics Project, Advantages of Business Analytics, Making the Best Use of Business Analytics, Challenges to Business Analysts, Analytics in Different Domains of Business, Levels of Analytics Maturity.

Module -2 Rise of Human Resource(HR)Analytics **7 hours**

Meaning of HR Analytics; Pitfalls of HR Analytics; What is not HR Analytics; Evolution of HR Analytics, Levels of Analysis, Conducting HR Analytics, Who Are Applying HR Analytics, Future of HR Analytics, The Scope of Big Data in HR Analytics, Scope of Text Analytics in HR Analytics.

Module -3 Applications of HR Metrics and Creating HR Dashboards **9 hours**

HR Metrics, Types of HR Metrics, Staffing Metrics, Training and Development Metrics, Application-oriented Exercises : Dashboards: Few Key Excel Add-ins/Functions to Help Create Dashboards, Name Range, The Developer Tab, Form Controls, Important Excel Formulas Useful for Creating Dashboards, VLOOKUP, INDEX, SUMIF, AVERAGEIF and COUNTIF, Application of Excel Functions in Creating HR Dashboards, Storyboarding: Connecting the Dots and Integrating the Findings.

Module -4 Correlation and Regression for HR Analytics **9 hours**

Correlation Analysis, Output of Correlation Analysis, The Case of Outlier, Software for Statistical Analysis 1- GNU PSPP, Plotting Scatter Plot in PSPP, Conducting Correlation in PSPP , Software for Statistical Analysis 2: R and R Commander, The Advantage of Free OSS over Closed Software, Simple Linear Regression Analysis, Co-variation of the Cause and Effect, Temporal Precedence, Plausible Alternative Explanations, Assumptions of Regression Analysis, Interpretation of the Output of Simple Linear Regression Analysis, Conducting Simple Linear Regression Analysis in PSPP, Conducting Simple Linear Regression Analysis in R Commander, Multiple Regression Analysis, Interaction Effects.

Module -5 HR Analytics Applications using ANOVA **9 hours**

One-Sample T-test, Null and Alternate Hypotheses, One-Sample T-Test, Assumptions of One-Sample T-test , Conducting One-Sample T-Test in PSPP, Conducting One-Sample T-Test in R Commander, Interpreting the Output of One-Sample T-Test, Paired Sample T-Test, Conducting Paired-Sample T-Test in PSPP, Conducting Paired-Samples T-Test in R Commander, Independent-Sample T-Test, Conducting Independent-Sample T-Test in PSPP, Conducting Independent-Sample T-Test in R Commander, Analysis of Variance, Conducting Independent One-Way ANOVA in PSPP, Conducting Independent One-Way ANOVA in R Commander, Steps to Analyse the Output of ANOVA, Advanced Concepts.

Module – 6 HR Analytics Applications using Regression **9 hours**

Logistic Regression with Single Nominal Predictor, Assumptions of Logistic Regression Analysis Conducting Logistic Regression Analysis in PSPP, Conducting Logistic Regression Analysis in R Commander, The Output of Logistic Regression Analysis, Multiple Predictors, Conducting Logistic Regression Using Rattle Package, Advanced Concepts , Pros and Cons of Logistic Regression as a Supervised Learning Algorithm; Factor Analysis and Cluster Analysis: Factor Analysis, Assumptions of Factor Analysis, Considerations Before Conducting Factor Analysis; Conducting Factor Analysis in PSPP, Conducting Factor Analysis in R Commander, Interpretation of the Output of Factor Analysis, Cluster Analysis, Assumptions of Cluster Analysis, Conducting Cluster Analysis in PSPP, Conducting Cluster Analysis in R Commander, Conducting Cluster Analysis in Rattle, Interpreting the Output of Cluster Analysis, Advanced Concepts.

Course Outcomes:

At the end of the course the student will be able to:

1. Gain practical insight of HR Processes, HR analytics and predictive modelling used in HR functions.
2. Acquire conceptual knowledge of HRA frameworks, models and approaches.
3. Illustrate the application of datafication of HR, predictive analytics tools and techniques.
4. Analyse the employee data set, considering the various concepts and functions of HR, facilitating the decision making in business context.

Practical Component:

- To visit an Organisation and interact with Analyst who deals with HR function; Know how the data is used and worked.
- Prepare a dashboard and analysis various functions and interrelations of data.
- Work on Excel through real time data of any company and generate the output.

CO-PO MAPPING

CO	PO				
	PO1	PO2	PO3	PO4	PO5
CO1	X				X
CO2	X			X	
CO3	X	X		X	
CO4	X			X	

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have 8 full questions carrying equal marks.
- Each full question is for 20 marks.
- Each full question will have sub question covering all the topics under a Module.
- The students will have to answer five full questions; selecting four full question from question number one to seven and question number eight is compulsory.
- 100 percent theory in the SEE.

Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year

1	Practical Applications of HR Analytics	Pratyush, Banerjee; Jatin Pandey; Manish Gupta	Sage Texts, India	2019
2	HR Analytics- Understanding Theories and Applications	Bhattacharya, Dipak Kumar	Sage Texts, India	2017
3	Winning on HR Analytics- Leveraging Data for Competitive Advantage	Ramesh, Soundarajan and Kuldeep Singh	Sage Publication India Pvt. Ltd.	2016
Reference Books				
1	Applying Advanced Analytics to HR Management Decisions: Methods for Selection, Developing Incentives and Improving Collaboration	Sesil James, C	Pearson, New Jersey	2017
2	Predictive Analytics- Mastering the HR Matrix	Martin Edwards and Kirsten Edwards	Kogan Page	2019
3	Fundamentals of HR Analytics: A Manual on Becoming HR Analytical	Fermin Diez, Mark Bussin, Venessa Lee	Emerald Publishing Limited	2019

INDUSTRIAL RELATIONS AND LABOUR LAWS			
Course Code	20MBAHR305	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Course Objectives

1. The student will be able to describe and Identify the application of Labour Laws regulating Industrial Relations in Organisation
2. The student will be able to describe and explain in her/his own words, the relevance and importance of Labour Laws and Industrial Relations in Organisation
3. The student will be able to apply and solve the workplace problems through Labour Laws
4. The student will be able to classify and categorise different Laws and Codes
5. The student will be able to create and reconstruct Industrial Relations System to be adopted in the Organisation
6. The student will be able to appraise and judge the practical applicability of Labour Laws regulating Industrial Relations in Organisation

Module-1 Fundamental Aspects of Industrial Relations **9 hours**

Introduction, Nature of Industrial Relations, Approaches to Industrial Relations, Trade Unions: The Participants of Industrial Relation Activities, State and Employer/Management. The Participants of Industrial Relation Activities; **Evolution of Labour Legislation in India -** History of Labour Legislation in India, Objectives of Labour Legislation, Types of Labour Legislations in India, Constitutional Provisions for the Protection of Labour Workforce in India, Rights of Woman Workers; The Present Labour Laws and Codes

Module -2 Factories Act, 1948 **7 hours**

Introduction, Objectives, Scope and Important Definitions, Approval, Licensing and Registration of Factories, Health and Safety of Workers, Provisions Related to Working Conditions, Hazardous Processes, Employee Welfare and Working Hours, Employment of Young Persons and Women, Annual Leaves with Wages, Penalties and Contingence of Offences

Module -3 Social Security Act **9 hours**

The Employees' Compensation Act, 1923

Introduction, Objectives, Scope and Important Definitions of the Act, Eligibility, Rules for Workmen's Compensation, Amount and Distribution of Compensation, Notice, Claims and Other Important Provisions, Enforcement of Act and Provisions for Penalty

The Employees' State Insurance Act, 1948

Introduction, Objectives, Scope and Important Definitions, Administration of the Act, Finance and Audit, Contribution, Benefits, Obligations of Employers under the Act, Adjudication of Disputes, Claims and Penalties, Exemptions

The Maternity Benefit Act, 1961

Introduction, Objectives, Scope and Important Definitions, Provisions Related to Maternity, Benefits, Enforcement of the Act, Penalties and Offences, Miscellaneous Provisions of the Act

The Employees' Provident Funds and Miscellaneous Provisions Act, 1952

Introduction, Objectives, Scope and Important Definitions, Administration of the Schemes under the Act, Administration of the Act, Calculation of Money Due from Employers, Their Recovery and Employees', Provident Funds Appellate Tribunal, Enforcement of the Act, Penalties and Offences, Miscellaneous Provisions of the Act

The Payment of Gratuity Act, 1972

Introduction, Objectives, Scope and Important Definitions, Payment and Forfeiture of Gratuity and Exemption, Compulsory Insurance and Protection of Gratuity, Determination and Recovery of Gratuity, Enforcement of the Act, Penalties and Offences.

Module -4 Wages Act **9 hours**

The Payment of Wages Act, 1936

Introduction, Objectives, Scope and Important Definitions, Provisions for Payment of Wages, Deductions from Wages, Enforcement of the Act, Penalties and Offences, Miscellaneous, Provisions of the Act

The Minimum Wages Act, 1948

Introduction, Objectives, Scope and Important Definitions, Fixation and Revision of Wages, Payment of

Minimum Wages, Enforcement of the Act, Penalties and Offences, Miscellaneous, Provisions of the Act

The Payment of Bonus Act, 1965

Introduction, Objectives, Scope and Important Definitions of the Act, Eligibility, Disqualification and Amount of Bonus, Calculation of Bonus, Special and Miscellaneous Provisions, Dispute, Penalties and Offences

Module -5 Regulating Employer-Employee Relations Act **9 hours**

The Industrial Disputes Act, 1947

Introduction, Objectives, Scope and Important Definitions, Procedure for Settlement of Industrial Disputes and Authorities under the Act, (Chapter II), Notice of Change in Conditions of Service (Chapter II-A), References of Disputes to Boards, Courts or Tribunals and Voluntary References

(Chapter III) Award and Settlements, Strikes and Lockouts (Chapter V), Layoff and Retrenchment (Chapters V-A and V-B), Transfer and Closing Down of Undertakings, Special Provisions Related to Layoff, Retrenchment and Closure (Chapter V-B), Unfair Labour Practices (Chapter V-C), Miscellaneous Provisions of the Act (Chapter VII)

The Industrial Employment (Standing Orders) Act, 1946

Introduction, Objectives, Scope and Important Definitions of the Act, Procedure for Certification of Standing Orders, Other Provisions Relating to Standing Orders, Miscellaneous Provisions of the Act, Penalties and Offences

The Trade Unions Act, 1926

Introduction, Objectives, Scope and Important Definitions, Registration and Cancellation of Registration of Trade Unions, Rights and Duties of Registered Trade Unions, Amalgamation and Dissolution of Trade Union, Penalties

Module – 6 Contract Labour (Regulation and Abolition) Act, 1970 **7 hours**

Contract Labour (Regulation and Abolition) Act, 1970

Introduction, Objectives, Scope and Important Definitions, Registration of Establishments Employing Contract Labour, The Advisory Boards, Prohibition of Employment of Contract Labour, Appointment of Licensing Officer and Licensing of Contractors, Welfare and Health of Contract Labour, Offences by Companies

The Employment Exchanges (Compulsory Notification of Vacancies) Act, 1959

Introduction, Objectives, Scope and Important Definitions, Notification of Vacancies, Penalties Miscellaneous Provisions, The Employment Exchanges (Compulsory Notification of Vacancies)
Amendment Bill, 2013

Course outcomes:

At the end of the course the student will be able to:

1. Gain practical experience related to labour legislations in India across various sectors.
2. Acquire conceptual knowledge of Industrial relations and labour laws followed within industries.
3. Develop the greater understanding of IR concepts and its application in solving various issues in IR.
4. Apply the IR and labour laws concepts in various industries in India.

Practical Component:

- Visit Any Organisation and discuss the applicability of Laws at the workplace
- Meet HR Manager and discuss the statutory and non-statutory measure
- Visit Labour Dept, Government, and Interact with Labour Commissioner

CO-PO MAPPING

CO	PO				
	PO1	PO2	PO3	PO4	PO5
CO1	X				
CO2	X			X	
CO3	X		X		X
CO4	X		X		

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have 8 full questions carrying equal marks.
- Each full question is for 20 marks.
- Each full question will have sub question covering all the topics under a Module.
- The students will have to answer five full questions; selecting four full question from question number one to seven and question number eight is compulsory.
- 100 percent theory in the SEE.

Texbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Industrial Relations and Labour Laws for Managers	Parul Gupta	Sage Publication India Pvt. Ltd	2019
2	The SAGE Handbook of Industrial Relations	Paul Blyton, Edmund Heery, Nicolas Bacon, Jack Fiorito	SAGE Publications	2008
3	Labour and Industrial Laws	P. K. PADHI	Prentice Hall India Pvt., Limited	2017

Reference Books

1	Bare Acts, Ministry of Labour	GOI	GOI	2019
2	The Idea of Labour Law	Guy Davidov, Brian Langille	The Oxford University Press	2011
3	Labour and Industrial Laws	PADHI, P. K	PHI Learning Pvt. Ltd	2019

COMPENSATION MANAGEMENT AND REWARD SYSTEM			
Course Code	20MBAHR306	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Course Objectives

1. The student will be able to describe and Identify the application of Compensation Management in the Organisation
2. The student will be able to describe and explain in her/his own words, the relevance and importance of Compensation Management in the Organisation
3. The student will be able to apply and solve the workplace problems through application of Compensation Management
4. The student will be able to classify and categories different models and approaches of Compensation Management adopted in the Organisation
5. The student will be able to formulate and prepare Compensation Management to be adopted in the Organisation
6. The student will be able to design and develop an original framework and model in dealing with compensation problems in the organisation.

Module-1 Compensation **7 hours**

Compensation, Meaning of compensation, Total Compensation/Reward and Its Components and Types, Importance of the Total Compensation Approach, Wages/Salaries, Some Other Terms, Theories of Wages, Does Compensation Motivate Behaviour?, Compensation Philosophy, Compensation Strategy, Compensation Policy, Base of Compensation Management, The Psychological Contract, Compensation and Legal Issues in Compensation Management, Factors Affecting Employee Compensation/Wage Rates/Wage Structure/Levels of Pay.

Module -2 Compensation Management **7 hours**

Meaning of Compensation Management, Methods of Wage Payment, Essentials of a Satisfactory Wage System, National Wage Policy in India, Wage Policy at the Organisational Level, Wage Problems in India, Components/Functions of Compensation Management/W&S Admin, Divergent Systems and Institutions for Wage Fixation in India.

Module -3 Wage Determination Practices in India **9 hours**

Divergent Systems for Wage Determination in Practice in Indian Organisations

Introduction, Management's Strategy, Reward Policy, Reward Management Processes, Reward Management Procedures, Pay Reviews, Planning and Implementing Pay Reviews, Procedures for Grading Jobs and Pay, Rates Fixation, Controlling Payroll Costs, Evaluation of Reward Processes, Some Other Trends, Boardroom Pay; Divergent Systems and Institutions for Wage Fixation in Practice in India, Management Strategy; Fringe Benefits, Fringe Benefits and Current Practices, Internal Audit of Compensation and Benefits; Different types of Direct and Indirect compensation include: Base Pay / Base pay; Commissions; Overtime Pay; Bonuses, Profit Sharing, Merit Pay; Stock Options; Travel/Meal/Housing Allowance; Benefits including: dental, insurance, medical, vacation, leaves, retirement, taxes; Merit pay; Incentive Pay; Deferred Pay ; Pay for time; Recreational facilities.

Module -4 Contingent Pay, Pay for Performance, Competence **9 hours**

Competency-Based Pay, Skill-Based Pay, Team-Based Rewards, Gainsharing, Profit-Sharing Profit-Related Pay and Beyond Other Cash Payments and Allowances Overtime Payments Attendance Bonuses, Shift Pay, Clothing Allowances, Honoraria, Payments for Qualifications, Pay for Person, Pay for Excellence, Managerial Compensation and Rewards, Sales Force Incentive Programmes, Competency based Pay- Framework, Model and Challenges; Pay for Performance : Steps involved in the design for pay for performance - Intent ; Eligibility; Participation; Performance and Goal Criteria-Measurements ; Funding; Pay Outs and Timing; Benefits Impact & Administration; Evaluation.

Module -5 Administration & Controlling Salary Costs and Salary Review **9 hours**

Salary Survey data, Salary Costs, Salary Planning, Salary Budget, Salary Control, Salary Reviews, Guidelines for Salary Review Process, Responding to Negative Salary Review, Five Key Steps: Manager's Guide to Annual Salary Review, Fixing of Salary, Method of Paying Salary, Flexibility, Process of Wage and Salary Fixation.

Module - 6 Operating, Non-financial Benefits(Intrinsic and Relational Rewards) **9 hours**

on, Role of Non-financial Benefits/Rewards on Employee Motivation, Types of Non-financial Benefits/Rewards, Planning the Non-financial Benefits/Rewards, A Few Most Effective Non-financial Benefits/Rewards to Motivate Employees, Heineken's Refreshing Approach to Reward, Non-financial Metrics Intellectual Capital Assessment and Market Implications of Human Capital, Recognition, Praise, Learning and Development, Achievement, Value Addition in Personality Others.

Course outcomes:

At the end of the course the student will be able to:

1. Gain insights of various conceptual aspects of Compensation and Benefits to achieve organizational goals.
2. Determine the performance based compensation system for business excellence and solve various cases.
3. Designing the compensation strategies for attraction, motivation and retaining high quality workforce.
4. Understand the Legal & Administrative Issues in global compensation to prepare compensation plan, CTC, wage survey and calculate various bonus.

Practical Component:

- To understand the theoretical and practical aspects in the area of compensation and benefits.
- Exposure to MS-Excel or HRIS packages recommended.
- Acquire knowledge of compensation and reward system policies, processes and procedure.
- Apply the concepts of compensation administration and intrinsic and extrinsic reward system in national and global perspective.
- Analyse the divergent system and wage determination practices followed in various sectors.

CO-PO MAPPING

CO	PO				
	PO1	PO2	PO3	PO4	PO5
CO1	X				X
CO2	X	X	X		
CO3	X	X			
CO4	X			X	X

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have 8 full questions carrying equal marks.
- Each full question is for 20 marks.
- Each full question will have sub question covering all the topics under a Module.
- The students will have to answer five full questions; selecting four full question from question number one to seven and question number eight is compulsory.
- 100 percent theory in the SEE.

Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Compensation Management	R. C. Sharma, Sulabh Sharma	Sage Publication India Pvt. Ltd	2019
2	Compensation and Benefit Design	Biswas, Bashker, D	Pearson	2013
3	Managing Employees Performance and Rewards	Shields	Cambridge Press	2007

Reference Books				
1	Human Resource Information Systems: Basics, Applications, and Future Directions	Michael J. Kavanagh, Mohan Thite, Richard D. Johnson	Sage Publication India Pvt. Ltd	3/e, 2015
2	Competency-Based Human Resource Management	Anindya Basu Roy, Sumati Raym	Sage Publication India Pvt. Ltd	2019
3	Compensation and Reward Management	Singh, B D	Excel Books	2007

GUIDELINES FOR INTERNSHIP 20MBA IN 307
(BETWEEN 2ND AND 3RD SEMESTER MBA)

INTERNSHIP			
Course Code	20MBA IN 307	CIE Marks	40
Teaching Hours/Week (L:T:P)	0:0:8	SEE Marks	60
Credits	04	Exam Hours	00

OBJECTIVE
To expose the students to understand the working culture of the organization and apply theoretical concepts in real life situation at the work place for various functions of the organization.

STRUCTURE
The Internship shall consist of study of an organization for 4 credits for 4 weeks.

GENERAL GUIDELINES

- The Internship shall be for a period of 4 weeks immediately after the completion of 2nd Semester Examinations but before the commencement of the 3rd semester classes
- The Course code of the Internship shall be 20MBA IN 307 and shall be compulsory for all the students.
- No two students of an institute shall work on the same organization.
- The student shall seek the guidance of the internal guide on a continuous basis, and the guide shall give a certificate to the effect that the candidate has worked satisfactorily under his/her guidance. Student need to identify an external guide (Working in the organization) and seek guidance from him/her.

Submission of Report: Students shall submit one hard copy of the report to the college with hard bound color of royal blue and a soft copy in PDF file (Un-editable Format)

Evaluation:
Internal evaluation will be done by the internal guide.
Viva-Voce / Presentation: A viva-voce examination shall be conducted at the respective institution where a student is expected to give a presentation of his/ her work. The viva –voce examination will be conducted by the respective HOD or Senior Professor or Internal Guide of the department and an external evaluator drawn from industry. In case of non availability of industry professional, a senior professor or a faculty with more than 10 years of experience may be invited to conduct the viva-voce examination. Internship carries 100 marks consisting of 40 marks for Internship report (evaluated by internal guide) and 60 marks for viva-voce examination.

Contents of the Internship Report

- Cover page
- Certificate from the Organization (scanned copy)
- Certificate from the guide, HOD and Head of the Institution (scanned copy) indicating bonafide performance of Internship by the student.
- Declaration by the student (scanned copy)
- Acknowledgement
- Table of contents
- List of tables and graphs

Executive summary
Chapter 1: Introduction about the Organisation & Industry.
Chapter 2: Organization Profile

i. Back ground,
ii. Nature of business,
iii. Vision mission, quality policy
iv. Workflow model
v. Product/service profile
vi. Ownership pattern
vii. Achievements/awards if any
viii. Future growth and prospects

Chapter 3: Mckensy's 7S framework and Porter's Five Force Model with special reference to Organization under study.
Chapter 4: SWOT Analysis
Chapter 5: Analysis of financial statements

Chapter 6: Learning experience.
Bibliography
Annexure relevant to the Internship such as figures, graphs, photographs, Financial statements etc.,
Format of the Internship: Report shall be prepared using the word processor viz., MS Word, Times New Roman font sized 12, on a page layout of A4 size with 1" margin all sides (1.5" on left side due to binding) and 1.5line spacing. The Internship report shall not exceed 60 pages.

Rubrics for Internship 20MBAIN 307 Marks

SL. No		Particulars	Marks
1	CIE	Assessment by the Guide- Interaction with the student	20
2	CIE	Report Evaluation by the Guide	20
3	SEE	Viva-Voce Examination to be conducted by the Guide and an External examiner from the Industry/Institute	60
		Total	100

Mark sheet for Viva voce Examination (SEE)
Visvesvaraya Technological University
Name of the Institution
Name of the Department

Course Code and Course Title: 20MBA IN 307 Internship

SL. No	**Aspects**	**Marks**
1	Introduction	**5**
2	Understanding the Industry	**5**
3	Understanding the Corporate Functions/Company profile	**10**
4	Mckensy's 7S framework and Porter's Five Force Model	**10**
5	SWOT/SWOC analysis justification	**10**
6	Financial statement analysis	**10**
7	Learning experience	**10**
	Total	**60**

Marks Sheet for Viva Voce examination

SL No	**USN**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Total**
1									
2									
3									
4									
5									
	Total								

Signature of Internal Examiner
Name and Designation with affiliation

Signature of External Examiner
Name and Designation with affiliation

IV SEMESTER
MARKETING SPECIALISATION COURSES

B2B MARKETING MANAGEMENT			
Course Code	20MBAMM401	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	60
Credits	03	Exam Hours	03

Course Objectives

1. Make students have an understanding of B2B Marketing and its characteristics
2. To analyze the purchasing decisions of online customers
3. Analysing traditional marketing approach vis-a vis modern marketing approach using the B2B strategy
4. To enhance knowledge of emerging trends in integrated marketing communications.
5. Managing innovation in the B2B context and understand concept of Relationship portfolio and Key Account Management.

Module-1 B2B Marketing **7 hours**

B2B-Introduction, significance and concept of B2B Marketing. Business Markets, characteristics. Classification of Business Products and Markets.

Module -2 Purchasing Behaviour **7 hours**

Factors affecting purchasing decisions, purchasing orientation, Segmenting purchase categories. Purchase Process- variations. Buying situations and marketer actions. Online buying.
Traditional marketing approach- uncertainties of buyer and supplier/ marketer. Supplier uncertainties. Relationship variables. Impact of IT. Inter-firm Relationships and Networks. **Case Study**

Module -3 B2B strategy and Market Segmentation **7 hours**

Process, approach. Responsible strategy-CSR and sustainability, Customer value and strategy.
Researching B2B markets. Standard industrial classification.
B2B Market Segmentation- Significance of segmentation. Basis of segmentation. Challenges of segmentation in B2B markets. B2B positioning**. Case Study.**

Module -4 Market Communication **7 hours**

Brand expression, Communication mix and customer acquisition process. Relationship Communication, sales responsibilities. The relationship communication process, call preparation, selling to low-priority and high-priority customers. Value selling and consequences- order fulfilment-relationship building**. Case Study.**

Module -5 Relationship Portfolio & Key Account Management **7 hours**

Principles of Portfolio management, identifying key accounts, Classification criteria. Relationship life-cycle, declassification, managing loyalty. **Case Study**.
Assignment: Implementing KAM

Module – 6 B2B product Offerings and Price Setting **5 hours**

Elements of B2B offering, strategic tools for managing product offerings, managing innovation in the B2B context.
Price setting in B2B markets- 3 C's of pricing-cost, customer and competition-Pricing- strategy, price positioning, role of sales force in pricing, bid pricing, internet auctions, ethical aspects of B2B pricing.
Case Study

Course outcomes:

At the end of the course the student will be able to:

1. Understand significance of B2B marketing .
2. Ability to create an integrated marketing communications plan which includes promotional strategies.
3. Effectively use marketing communication for customer acquisition
4. Define and apply knowledge of various aspects of managerial decision making related to marketing communications strategy and tactics.

Practical Component:

- Interview a salesperson and write a brief report about what they like and dislike about their jobs, their salary, travelling allowances, sales quotas, why chose sales career, and what does it take to succeed in this profession.
- Ask your friends if they would buy certain goods like groceries, vegetables, socks, mobile, pens etc from the roadside vendor as against a regular shop. Group the products into low risk and high risk ones. Does this buying behaviour also depend on the personality of the individual doing the buying? Or the one doing the selling?
- Students can make a presentation on any product or the services of student choice, covering selling strategies

and one day work exposure towards merchandising in any big retail outlets of respective places where the institute if operating.

- Rural colleges can send the students to the city nearby to observe the merchandising planning in retail outlets and to make a small report.
- Roles and functions of sales manager and sales people are different in every organization Sales people view the roles of sales managers in their own way and vice versa. You are the sales manager of a company. You make an analysis of what you feel should be roles of a sales manager and a salesperson for maximizing sales of the organization.
- Your company is active in internet trading. A current issue in internet trading is : how to make internet selling safe. Different methods have been suggested for safety or security of internet trading. You have to analyze different methods and recommend a method for your company.

CO-PO MAPPING

CO	PO				
	PO1	PO2	PO3	PO4	PO5
CO1	X				
CO2	X	X	X		
CO3	X	X	X		X
CO4	X		X	X	X

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have 8 full questions carrying equal marks.
- Each full question is for 20 marks.
- Each full question will have sub question covering all the topics under a Module.
- The students will have to answer five full questions; selecting four full question from question number one to seven and question number eight is compulsory.
- 100 percent theory in the SEE

Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Business to Business Marketing	Ross Brennan, Louise Canning & Raymond McDowell	Sage Publications	3e -2014
2	B2B Marketing Strategy: Differentiate, Develop and Deliver Lasting Customer Engagement	Heidi Taylor	Kogan Page	1/e, 2017

Reference Books

1	Innovative B2B Marketing: New Models, Processes and Theory	Simon Hall	Kogan Page	1/e, 2017
2	Product and Brand Management	Michael Baker and Stuart Hart	Pearson	4/e, 2014

LOGISTICS AND SUPPLY CHAIN MANAGEMENT			
Course Code	20MBAMM402	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	60
Credits	03	Exam Hours	03

Course Objectives

1. To understand the basic concepts, processes and key elements of a supply chain.
2. To understand the elements and scope of logistics in supply chain management
3. To provide insights for establishing efficient, effective, and sustainable supply chains.
4. To comprehend the role of warehouse management
5. To gain knowledge about Inventory Management
6. To provide insights into International Logistics
7. To explain the role of technology in supply chain planning, visibility, and execution.

Module-1 Supply Chain **7 hours**

Concept, significance and key challenges. Scope of SCM- historical perspective, essential features, decision phases – process view, supply chain framework, key issues in SCM and benefits.

Definition and scope of Logistics. Elements of Logistics, types, incremental value delivery through Logistics management. Innovations in Supply Chain. Estimating customer demand, forecasting in Supply Chain.

Case Study.

Module -2 Warehouse Management System **7 hours**

Warehousing – scope, primary functions. Efficient Warehouse Management. Types of Warehouse. Warehouse Layout Design, criteria. Warehouse Management System,

Distribution Management, Designing the distribution network, role of distribution, factors influencing distribution, design options, distribution networks in practice, network design in the supply chain, factors affecting the network design decisions. HUB & SPOKE vs Distributed Warehouses. **Case Study**

Module -3 Inventory Management **7 hours**

Concept, various costs associated with inventory, EOQ, buffer stock, lead time reduction, reorder point / re-order level fixation, ABC analysis, SDE/VED Analysis. Goals, need, impact of inventory management on business performance. Types of Inventory, Alternative approach for classification of inventories, components of inventory decisions, inventory cost management, business response to stock out, replenishment of inventory, material requirements planning.

Dealing with demand uncertainty in Supply Chain- managing uncertainty in Supply Chain, (Bullwhip Effect) ,Impact of uncertainties. **Case Study**

Module -4 Transportation **5 hours**

Role, functions, mode of transportation and criteria of decision. Transportation Infrastructure. Factors impacting road transport cost, hazards in transportation, State of Ocean Transport, global alliances.

Packaging Issues in Transportation, role of containerisation. **Case Study**

Module -5 Logistics Management **7 hours**

Logistics of part of SCM, logistics costs, logistics, sub-systems, inbound and out bound logistics bullwhip effects in logistics, distribution and warehousing management. Demand Management and Customer Service: Demand Management, CPFRP, customer service, expected cost of stock outs.

Recent Issues in SCM: Role of computer/ IT in supply chain management, CRM Vs SCM, Benchmarking concept, features and implementation, outsourcing – basic concepts, value addition in SCM.

Case Study

Module - 6 International Logistics **7 hours**

Logistics and Environment, Methods and tools facilitating International Logistics, challenges, Integrated Supply Chain and Logistics Value Chain, Supply Chain Security Initiatives in the USA, Logistics Industry in India.

Sourcing Decisions in Global SCM- Logistics, trends, Key issues in Global sourcing, Factors influencing Outsourcing. Performance Management in Supply Chain introduction. **Case Study**

Course outcomes:

The student should be able to:

1. Demonstrate knowledge of the functions of logistics and supply chain management.
2. To relate concepts and activities of the supply chain to actual organizations.
3. Highlight the role of technology in logistics and supply chain management.
4. Evaluate cases for effective supply chain management and its implementation.

Practical Components:

- Students are expected to choose any four Indian Organizations and study their supply chain in terms of drivers of the Supply chain and submit a report.
- Students should visit different logistics companies and understand the services provided by them and submit a report.
- Students should identify any product/service and study the type of distribution system used and understand the reason for using that particular type and present it in the class.
- Students should identify the various types of IT applications employed by Indian Organizations in their Supply chain

CO-PO MAPPING

CO	PO				
	PO1	PO2	PO3	PO4	PO5
CO1	X				
CO2	X		X	X	
CO3	X				X
CO4	X			X	

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have 8 full questions carrying equal marks.
- Each full question is for 20 marks.
- Each full question will have sub question covering all the topics under a Module.
- The students will have to answer five full questions; selecting four full question from question number one to seven and question number eight is compulsory.
- 100 percent theory in SEE

Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	A Logistic approach to Supply Chain Management	Coyle, Bardi, Longley	Cengage Learning	Latest edition
2	Integrated Supply Chain and Logistics Management	Rajat K. Baisya	Sage	2020
3	Supply Chain Management- Text and Cases	Janat Shah	Pearson	Latest edition
4	Supply Chain Management- Strategy, Planning and Operation	Sunil Chopra, Peter Meindl, D.V.Kalra	Pearson	Latest edition
5	Marketing Channels	Anne Coughlan, Anderson, Stern and El-Ansary		

Reference Books

1	The Box	Marc Levinson		
2	Essentials of Supply Chain Management	Michaael H Hugos		
3	Logistics and Supply Chain	Martin Christopher	FT Publishing	5th Editon
4	Supply chain Logistics Management	Donald J Bowersox,	Mc Graw Hill	4th Edition

DIGITAL MARKETING MANAGEMENT			
Course Code	20MBAMM403	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	60
Credits	03	Exam Hours	03

Course Objectives

1. To understand the important concepts related to e-marketing
2. To learn the use of different electronic media for designing marketing activities.
3. To acquaint the students with the latest techniques of e-marketing.

Module-1 Introduction to Digital Marketing **7 hours**

Concept of Digital Marketing, Origin, traditional versus Digital Marketing. Digital Marketing Strategy- The P-O-E-M Framework, Segmenting and customising Messages, Digital Landscape. Digital advertising Market in India. Skills required in Digital Marketing, Digital Marketing Plan

Module -2 Display Advertising **7 hours**

Concept of Display Advertising, types of display ads, buying models, display plan
Targeting- contextual targeting placement targeting, remarketing, interest categories, geographc and language tagging, demographics, mobile, other targeting methods. Programmatic digital advertising, You Tube Advertising.

Module -3 Search Engine Advertising **7 hours**

Understanding Ad Placement, Understanding Ad Ranks, Creating First Ad Campaign, Performance Reports.
Social Media Marketing: Building a successful Strategy
Live Project: Create a digital marketing plan

Module -4 Social Media Marketing **7 hours**

Face Book Marketing: Facebook for business & facebook insights
LinkedIn Marketing: LinkedIn Strategy, LinkedIn Analytics
Twitter Marketing: Building Content Strategy, twitter usage , Twitter Analytics
Instagram & Snanpchat: Objectives of Instagram, Hashtags. What is Snanpchat. Digital Public Relations

Module -5 Mobile Marketing **7 hours**

Mobile Usage, Mobile Advertising- Mobile Advertising Models, advantages of Mobile advertising, Mobile Marketing Toolkit, Mobile Marketing features- Location based services, Social marketing on mobile, QR Codes, Augmented Reality, Gamification.**Tracking mobile campaigns-** Mobile Analytics.
Live Project: Create a mobile advertising project..

Module – 6 Search Engine Optimization **5 hours**

Search Engine Optimization: How search engines work, concept of search engine optimisation (SEO), On Page Optimisation, Off Page Optimisation, Social media Reach, Maintenance- SEO tactics, Google Search Engine, Web Analytics- Key Metrics- concepts only

Course outcomes:

At the end of the course the student will be able to:

1. Recognize appropriate e-marketing objectives.
2. Appreciate the e-commerce framework and technology.
3. Illustrate the use of search engine marketing, online advertising and marketing strategies.
4. Develop social media strategy's to solve business problems.

Practical Components:

- Students will learn to create a digital marketing plan.
- Students will learn to create a mobile advertising project.

CO-PO MAPPING

CO	PO				
	PO1	PO2	PO3	PO4	PO5
CO1	X				
CO2	X	X			
CO3	X		X	X	
CO4	X		X		X

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have 8 full questions carrying equal marks.
- Each full question is for 20 marks.
- Each full question will have sub question covering all the topics under a Module.
- The students will have to answer five full questions; selecting four full question from question number one to seven and question number eight is compulsory.
- 100 percent theory in the SEE.

Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Digital Marketing	Seema Gupta	McGraw Hill Education	2017
2	Markeing 4.0: Moving from Traditinal to Digital	Philip Kotler, Hermawan Kartajaya, Iwan Setiawan	Wiley	2017
3	Fundamentals of Digital Marketing	Puneet Bhatia	Pearson	2/e, 2014
4	Social Media Marketing	Tracy L Tuten, Michael R Solomon	Sage Publications	3/e, 2020

Reference Books

1	Digital Marketing	Swaminathan T N, Karthik Kumar	Cengage Learning India Pvt. Ltd	2019
2	Digital Marketing	Hanlon	Sage Publications	2/e, 2017
3	Digital Marketing	Ian Dodson	Wiley	2016

STRATEGIC BRAND MANAGEMENT			
Course Code	20MBAMM404	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	60
Credits	03	Exam Hours	03

Course Objectives

1. To appreciate the relationship between corporate strategy and Brand Management.
2. To explore the various issues related to Brand Management, brand association, brand identity, brand architecture, leveraging brand assets, brand portfolio management.
3. To develop familiarity and competence with the strategies and tactics involved in building, leveraging and defending strong brands in different sectors.

Module-1 Brand Management **7 hours**

Concept, Meaning of Brand, Evolution of Brands, Functions of Brand to consumer, Role of Brand-Advantages of Brand, Product Vs Brand. **Branding-** Meaning, Creation of Brands through goods, services, people, Organisation, Retail stores, places, online, entertainment, ideas, challenges to Brand builders.
Brand Management-Meaning & Definition. Strategic Brand Management Process-Meaning, Steps in Brand Management Process Strong Indian Brands.

Module -2 Customer Based Brand Equity(CBBE) **5 hours**

Meaning, Model of CBBE, Brand Equity: Meaning, Sources, Steps in Building Brands, Brand building blocks Resonance, Judgments, Feelings, performance, imagery, salience-Brand Building Implications, David Aaker's Brand Equity Mo del. Brand Identity & Positioning: Meaning of Brand identity, Need for Identity & Positioning, Dimensions of brand identity, Brand identity prism, Brand positioning – Meaning, Point of parity & Point of difference, positioning guidelines Brand Value: Definition, Core Brand values, Brand mantras, Internal branding,

Module -3 Choosing Brand Elements to Build Brand Equity **7 hours**

Criteria for choosing brand elements, options & tactics for brand elements-Brand name, Naming guidelines, Naming procedure, Awareness, Brand Associations, Logos & Symbols & their benefits, Characters & Benefits, Slogans & Benefits, Packaging. Leveraging Brand Knowledge: Meaning of Brand Knowledge,
Dimensions of Brand Knowledge, Meaning of Leveraging Secondary Brand Knowledge & Conceptualizing the leverage process.

Module -4 Brand Value chain **7 hours**

Designing Brand Tracking studies, Establishing brand Equity Management Systems. 58 Methods for measuring Brand Equity-Quantitative Techniques & Quantitative Techniques, Comparative methods-Brand based comparisons, marketing based comparisons Conjoint Analysis, Holistic methods. Managing Brand Equity: Brand Reinforcement, Brand Revitalization, Brand Crisis

Module -5 Designing and sustaining branding strategies **7 hours**

Brand hierarchy, Branding strategy, Brand extension and brand transfer, Managing Brands overtime. Brand Architecture and brand consolidation. Brand Imitations: Meaning of Brand Imitation, Kinds of imitations, Factors affecting Brand Imitation, Imitation Vs Later market entry, First movers advantages, Free rider effects, Benefits for later entrants, Imitation Strategies.
Assignment: Measuring Brand Strength

Module – 6 Making Brands go Global **7 hours**

Making Brands go Global: Geographic extension, sources of opportunities for global brand, single name to global brand, consumers & globalization, conditions favouring marketing, barriers to globalization, managerial blockages, organization for a global brand, pathways to globalization. Luxury Brand Management: Luxury definition and relativity, luxury goods and luxury brands, basic psychological phenomena associated with luxury purchase, luxury marketing mix, luxury retail, International luxury markets: historical leaders and emerging countries.

Course outcomes:

At the end of the course the student will be able to:

1. Comprehend & correlate all the management functions which are happening around with fundamental concepts and principles of management.
2. Understand the overview of management, theory of management and practical applications of the same.
3. Effectively use their skills for self-grooming, working in groups and to achieve organizational goals .

4.Demonstrate their acumen in applying managerial and behavioral concept in real world/situation.
5.Understand and demonstrate their exposure on recent trends in management

Practical Component:

- Go to a supermarket and find the brand elements in various brands of soaps, mobiles, jeans, and other product.
- If you would start an MBA College, what would the positioning be with POP's and POD's?
- Pick up your college, analyse its positioning and how would you reposition it?
- Pick a multiproduct company and as completely as possible analyze its brand portfolio and brand extensions?
- Consider some groups like Tata's , Birla's, Infosys etc – what is their branding strategy.
- Students are supposed to assess the product life cycle and appraise alternative approaches to luxury brand management.
- Students can select any two popular brands and identify and examine the criteria for success in the luxury brand industry.

CO-PO MAPPING

CO	PO				
	PO1	PO2	PO3	PO4	PO5
CO1	X				
CO2	X				
CO3	X		X		X
CO4	X		X		X
CO5	X		X	X	

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have 8 full questions carrying equal marks.
- Each full question is for 20 marks.
- Each full question will have sub question covering all the topics under a Module.
- The students will have to answer five full questions; selecting four full question from question number one to seven and question number eight is compulsory.
- 100 percent theory in the SEE.

Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Strategic Brand Management, Building Measuring & Managing	Kevin Lane Keller	Pearson Education	Latest Edition
2	Brand Management -The Indian Context	Y L R Moorthi	Vikas Publication	Latest Edition
3	Strategic Brand Management	Jean, Noel, Kapferer	Kogan Page India	Latest Edition

4	M B Parameswaran	Brand Building and Advertising Concepts and Cases	Tata McGraw Hill Publication	Latest Edition
Reference Books				
1	Compendium Brand Management	Chunnawalla	HPH,	Latest Edition
2	Strategic Brand Management	Richard Elliott & Larry Perclu	Oxford Press	Latest Edition
3	Creating powerful brands	Chernatony	Elsevier	Latest Edition
4	Brand Management for B2B	Shard Sharin	Sage Publications	1/e, 2015

AGRI BUSINESS MARKETING			
Course Code	20MBAMM405	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	60
Credits	03	Exam Hours	03

Course Objectives

1. To provide a conceptual understanding on the Rural Marketing with special reference to Indian context.
2. To create awareness about the applicability of the concepts, techniques and processes of marketing in rural context.
3. To familiarize with the special problems related to sales in rural markets.

Module-1 Introduction to Indian Rural Marketing **7 hours**

Scope of rural marketing, concepts, classification of rural markets, rural vs. urban markets. Rural marketing environment: Population, occupation pattern, income generation, location of rural population, expenditure pattern, literacy level, land distribution, land use pattern, irrigation, development programs, infrastructure facilities, rural credit institutions, rural retail outlets, print media in rural areas, rural areas requirement, rural demand and rural market index, problems in rural marketing.

Module -2 Rural Consumer behaviour **7 hours**

Consumer buying behaviour models, Factors affecting Consumer Behaviour, Social factors, Technological Factors, Economic Factors, Political Factors, Characteristics of Rural consumer-Age and Stages of the Life cycle, Occupation and Income, Economic circumstances, Lifestyle, Personality and Brand Belief, Information Search and pre-purchase Evaluation, Rise of Consumerism, Consumer Buying Process, Opinion Leadership Process, Diffusion of Innovation, Brand Loyalty. 60 Researching Rural Market: Sensitizing rural market, Research design-reference frame, Research approach, Diffusion of innovation, Development studies, PRA approach, The need for PRA, Sampling, Operational aspects of data collection.

Module -3 Rural Marketing of FMCG's **7 hours**

Rural Marketing of FMCG's: Indian FMCG industry, characteristics of Indian FMCG sector, Challenges in the FMCG industry, Rural Marketing of FMCG's: Select case studies Rural Marketing of Consumer durables: Issues related to consumer durables in the rural market, Rural Marketing of Consumer durables: Select case studies Rural marketing of financial services: Marketing objectives and approaches, Evolution of rural banking after independence, Challenges in marketing for banking services in rural, opportunities for banking in rural areas, marketing strategies for banking services.

Module -4 Marketing of agricultural inputs **5 hours**

Indian tractor industry: A brief overview, Challenges for Indian tractor industry, factors suggesting better future prospects for tractor industry, marketing strategies for tractor industry Fertilizer industry in India: Marketing of fertilizer industry, classification of fertilizer industry, Challenges for marketing of fertilizer industry, marketing strategies for fertilizer industry.

Module -5 Marketing of agricultural products **7 hours**

Profiling of Indian agricultural produces marketing, challenges in marketing of agricultural produce, Strategies to promote marketing of agricultural produce. Corporate sector in agri-business: Reasons for increased interest of corporate sector in agribusiness, opportunities in the agri-business, benefits of corporate driven agri-business system involvement of corporate sector in agri-business.

Module - 6 Distribution and Communication Strategy **7 hours**

Distribution Strategy: Introduction Accessing Rural Markets, Coverage Status in Rural Markets, Channels of Distribution, Evolution of Rural Distribution Systems- Wholesaling, Rural Retail System, Vans, Rural Mobile Traders: The last Mile Distribution, Haats/Shandies, Public Distribution System, Co-operative Societies Behaviour of the Channel, Prevalent Rural Distribution Models- Distribution Models of FMCG Companies, Distribution Model of Durable Companies, Distribution of fake products, Emerging Distribution Models-Corporate –SHG Linkage, Satellite Distribution, Syndicated Distribution, ITC's Distribution Model, Petrol pumps and Extension counters.

Communication strategy: Challenges in Rural Communication, A view of Communication Process, Developing Effective- Profiling the Target Audience, Determining communication objectives, designing the message, selecting the communication channels, deciding the promotion mix, Creating advertisement for rural audiences

rural media- Mass media, Non-Conventional Media, Personalized media, Rural Media: The importance of the two-step flow of communication Media Typology, The Media Model, Media innovation, Influence of Consumer Behaviour on Communication strategies.

Live Project: Visit a Rural santhe in village setting (Producer market) and submit a report

Course outcomes:

At the end of the course the student will be able to:

1. Highlight the characteristics of Indian rural markets and describe the differences between rural and the urban economy.
2. Analyze the roadblocks of Indian rural market and advocate solutions for the problems of rural markets.
3. Emphasize the different strategies adopted by Indian companies for rural markets.
4. Apply the strategies to be adopted for influencing the rural consumers.

Practical Components:

- Visit to the various Micro Finance Institutes, who extend their services in catering rural market.
- Visit to a village and understand the market structure and also understand the functioning part of the rural markets.
- Students should come up with new product designing with the rural marketing mix 4 As (Awareness, Acceptability, Adaptability and Affordability).
- Students can do a survey on corporate farming and its effect on income of the rural farmer.

CO-PO MAPPING

CO	PO				
	PO1	PO2	PO3	PO4	PO5
CO1	X	X			
CO2	X			X	
CO3	X		X		X
CO4	X		X		X

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have 8 full questions carrying equal marks.
- Each full question is for 20 marks.
- Each full question will have sub question covering all the topics under a Module.
- The students will have to answer five full questions; selecting four full question from question number one to seven and question number eight is compulsory.
- 100 percent theory in SEE.

Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Rural Marketing	Pradeep Kashyap&	Biztantra.	2108
2	Rural marketing: Challenges and OpportModuleies	Dinesh Kumar & Punam Gupta	SAGE	2017
3	Rural Marketing	Gopal Swamy T. P	Vikas Publishing	2108

Reference Books

1	Rural Marketing	Dogra &KarminderGhuman	TMH	2018
2	Rural Marketing	Sanal Kumar Velayudhan	Response Publication	2014
3	Agricultural Marketing In India	Acharya	Oxford I B H.	2015

INTERNATIONAL MARKETING MANAGEMENT			
Course Code	20MBAMM406	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	60
Credits	03	Exam Hours	03

Course Objectives

1. To introduce students to the international marketing management process, design and theories
2. To develop skills relating to international trade.
3. To familiarize the steps involved in import export documentation.

Module -1 Introduction to International Marketing **5 hours**

Scope, Challenges, Reasons and Motivations, Concepts to the management of international marketing function, differences between international marketing and domestic marketing – transition from domestic to international markets - World Trade and India's foreign trade: an overview.

Module -2 International Trade Theories and Market research **5 hours**

International Trade Theories- Absolute cost-comparative Cost- H-O Theorem- New Trade Theories- Porter's Diamond Theory- Managerial Implications. Developing a global vision through market research : Breadth and scope of international marketing research , problems in availability and use of secondary data, problems in gathering primary data , multi cultural research – a special problem , research on internet – a new opportunity , estimating market demand, responsibility for conducting marketing research, communicating with decision makers. Identifying foreign markets – classification based on demand , based on the stage of development ,other basis for division of world markets.

Module -3 Planning and organization **7 hours**

Planning and organization: Global perspective – global gateways – global marketing management – an old debate and a new view – planning for global markets – alternative market entry strategies – organizing for global competition. Global marketing environment – cultural Environment Political and Legal Environment, Economic Environment- Modes of entry in to foreign business.

Module -4 International Product Policy for Consumers **9 hours**

: Quality – green marketing and product development, products and culture – analyzing product components for adaptation – products for consumers in global markets, product development, product adaptation, product standardization, Cross country segmentation, Product life cycle in International Marketing, International Packaging.

Product and services for businesses. Demand in global business to business markets- Quality and global standards – business services – tradeshows crucial part of business to business marketing – relationship markets in business to business context.

Module -5 International Pricing, Promotion and distribution decision **9 hours**

Pricing decision: global pricing frame work, pricing basics, marginal cost pricing and its importance. Transfer pricing, counter trade, systems pricing, pricing and positioning price quotation-INCO terms.

Promotion decision: International Advertising, Sales promotion in International, direct mailing, personal selling, exhibition – generic promotion in international marketing.

Global Distribution decision - Introduction, distribution as competitive advantage, rationalizing local channels, global channel design, Channel alternatives – Importance of Channel decision – Factors influencing the Channel decision – Channel Selection decision.

Assignment: Identifying a International luxury product and relate it to either pricing or promotion or distribution

Module – 6 Import –Export procedure and documentation **5 hours**

Import policy – procedure and Documentation - balance of trade and payments , Institutional infrastructure for exports promotions in India-India's trade policy- export assistance- exports documentation and procedures including different stages of documentations.

International Retailing.

International expansion of retailers – International retailing defined – retail format – variations in different markets – general merchandise at Retailing – issues in international retailing.

Course outcomes:

At the end of the course the student will be able to:

1. Understand the differences between domestic marketing and international marketing.
2. Understand the concept of international pricing and distribution decision.
3. Acquire the knowledge of import export documentation.

Practical Components:

- Studying organizational structures of any 10 companies and classifying them into different types of organizations which are studied in Module 2 and justifying why such structures are chosen by those organizations.
- Preparing the leadership profiles of any 5 business leaders and studying their leadership qualities and behaviors with respects to the trait, behavioural and contingency theories studied.
- Identifying any five job profiles and listing the various types, abilities required for those jobs and also the personality traits/attributes required for the jobs identified.

CO-PO MAPPING

CO	PO				
	PO1	PO2	PO3	PO4	PO5
CO1	X				
CO2	X		X	X	
CO3	X				X

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have 8 full questions carrying equal marks.
- Each full question is for 20 marks.
- Each full question will have sub question covering all the topics under a Module.
- The students will have to answer five full questions; selecting four full question from question number one to seven and question number eight is compulsory.
- 100 percent theory in SEE.

Recommended Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	International Marketing	Catero, Graham	TataMcGrawHill	Latest Edition
2	International Marketing	Varshney, Bhattacharya	S.Chand	Latest Edition
3	Global marketing management	Warren J.Keegan	Pearson	Latest Edition
4	International Marketing Management: Text and Cases	U C Mathur	SAGE	2008

Reference Books

1	International marketing: analysis and strategy	Sak Onkvisit, Johnshaw	Biztantra	Latest Edition
2	International marketing	Rakesh mohan Joshi	Oxford	Latest Edition
3	International marketing	Michael Czinkota, Illka A. Ronkainen	Cenage Learning	Latest Edition

FINANCE SPECIALISATION COURSES

RISK MANAGEMENT AND INSURANCE			
Course Code	20MBAFM401	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	60
Credits	03	Exam Hours	03

Course Objectives

1. To provide an understanding of different types of risk.
2. To provide an understanding of the risk identification and measurement.
3. To give an overview of role of Life Insurance in risk management.
4. To provide an understanding of general insurance contract.

Module -1 Introduction to Risk Management **5 hours**

and Risk Identification: Risk-Risk and Uncertainty-Types of Risk-Burden of Risk-Sources of Risk-Methods of handling Risk-Degree of Risk-Management of Risk. Risk Identification-Business Risk Exposures-Individual Exposures-Exposures of Physical Assets -Exposures of Financial Assets -Exposures of Human Assets - Exposures to Legal Liability - Exposure to Work-Related Injury. (Theory).

Module -2 Risk Measurement **7 hours**

Evaluating the Frequency and Severity of Losses-Risk Control-Risk Financing Techniques-Risk Management Decision Methods-Pooling Arrangements and Diversification of Risk. Advanced Issues in Risk Management: The Changing Scope of Risk Management-Insurance Market Dynamics-Loss Forecasting-Financial Analysis in Risk Management -- Decision Making Other Risk Management Tools. (Theory).

Module -3 Introduction to Insurance **7 hours**

Risk and Insurance- Definition and Basic Characteristics of Insurance-Requirements of an Insurable Risk-Adverse Selection and Insurance-Insurance vs. Gambling Insurance vs. Hedging Types of Insurance-Essentials of Insurance Contracts. Indian Insurance Industry -Historical Framework of Insurance, Insurance sector Reforms in India. IRDA-Duties and powers of IRDA-IRDA Act 1999. (Theory).

Module -4 Life Insurance **7 hours**

Basics of Life Insurance-Growth of Actuarial Science-Features of Life Insurance-Life Insurance Contract-Life Insurance Documents-Insurance Premium Calculations. Life Insurance Classification-Classification on the Basis –Duration-Premium Payment Participation in Profit-Number of Persons Assured-Payment of Policy Amount-Money Back Policies-Module Linked Plans. Annuities-Need of Annuity Contracts, Annuity V/s Life Insurance, Classification of Annuities. (Theory).

Module -5 General Insurance **7 hours**

Laws Related to General Insurance-General Insurance Contract-General Insurance Corporation (GIC). Health Insurance-Individual Medical Expense Insurance – Long Term Care Coverage – Disability Income Insurance – Medi-claim Policy – Group Medi-claim Policy – Personal Accident Policy – Child Welfare Policy-Employee Group Insurance – Features of Group Health Insurance – Group Availability Plan. Fire Insurance-Essentials of Fire Insurance Contracts, Types of Fire Insurance Policies, Fire Insurance Coverage. Marine Insurance-Types of Marine Insurance – Marine Insurance principles Important Clauses in Marine Insurance– Marine Insurance Policies –Marine Risks-Clauses in Marine Policy. Motor Vehicles Insurance-Need for Motor Insurance, Types of Motor Insurance, Factors to be considered for Premium Fixing. (Theory).

Module-6 Management of Insurance Companies **7 hours**

Functions and Organization of Insurers- Types of Insurance Organization, Organizational Structure of Insurance Companies-Functions of Insurers. Underwriting-Principles of Underwriting, Underwriting in Life Insurance, Underwriting in nonlife Insurance. Claims Management-Claim Settlement in General Insurance-Claim Settlement in Life Insurance. (Theory).

Course outcomes:

At the end of the course the student will be able to:

1. Understand various types of risks.
2. Assess the process of identifying and measuring the risk.
3. Acquaint with the functioning of life Insurance in risk management.
4. Understand general insurance contract.

Practical Component:

- Should visit insurance companies and undertand the types of policies
- Undesatnd how insurance premium are fixed
- Interact with insurance agents and understand the ground reality of insurance investors.
- Undesatnd how different insurance companies settles the accident claims/death claims
- Undesatnd the functioning and organisation structure of insurances companies.
- Compile and analyse General and Life insurance policies offered by Indian insurance companies (one public sector and one private sector)
- Visit policy bazaar portal and study the different types of insurance policies offered by the Indian insurance companies.
- Analyse the Systematic and unsystematic risk of any two companies
- Analyse the types of Risk in different sectors of India due to Covid- 19 Pandemic

CO-PO MAPPING

CO	PO				
	PO1	PO2	PO3	PO4	PO5
CO1	X				
CO2	X		X	X	
CO3	X	X			
CO4	X				

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have 8 full questions carrying equal marks.
- Each full question is for 20 marks.
- Each full question will have sub question covering all the topics under a Module.
- The students will have to answer five full questions; selecting four full question from question number one to seven and question number eight is compulsory.
- 100 percent theory in the SEE.

Textbooks

Sl. No.	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Principles of Risk Management and Insurance	George E Rejda	Pearson	12/e, 2009
2	Insurance and Risk Management	P.K. Gupta	Himalaya	1/e, 2010
Reference Books				
1	Principles and Practice of Insurance	P. Periasamy	Himalaya Publishing House	2/e, 2009
2	Introduction to Risk Management and Insurance	Dorfman, Mark S.	Prentice Hall India	10/e, 2008
3	Risk Management and Insurance	Scott E. Harrington, Gregory R Niehaus	TMH	2/e, 2007

FINANCIAL DERIVATIVES			
Course Code	20MBAFM402	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	60
Credits	03	Exam Hours	03

Course Objectives

1. To understand various concepts and terminologies used in various financial derivatives.
2. To explain and critically evaluate various financial derivatives such as forwards, futures, options, financial swaps, credit derivatives etc.
3. To apply various financial derivatives in hedging risk and analyse it.

Module-1 Financial Derivatives **5 hours**

Meaning, benefits, types (both exchange traded and OTC traded) and features of financial derivatives-Factors causing growth of derivatives-functions of derivatives market-Derivative market players (Hedgers, speculators and arbitragers)-Derivatives market in India. (Theory).

Module -2 Futures and Forwards **7 hours**

Futures and Forwards: Meaning, features and types of futures/forwards-Futures vs Forwards-Mechanics of buying and selling futures/forwards-Hedging through futures/forwards-Marking-to-market process-contract specifications of stock, index and commodity futures–valuation of futures/forwards using cost of carry model-Arbitrage process-Interest Rate Futures & options. (Numerical problems on MTM and valuation of futures/forwards). (Theory and Problems).

Module -3 Option Contracts **7 hours**

Option Contracts: Meaning, features and types of option contracts-Options vs futures/forwards-Mechanics of buying and selling option contracts-contract specifications of stock, index and commodity options-Option pricing-factors affecting option pricing-Valuation of option contracts using Black Scholes model and Binomial model-Put-call parity theory-Option Greeks-Option Trading strategies-Interest rate options-Exotic options. (Numerical problems on all aspects except exotic options). (Theory and Problems).

Module -4 Financial Swaps **7 hours**

Meaning, features and advantages of financial swaps-Types of financial swaps (Interest rate swap, currency swap, equity swap and commodity swap)-Mechanics of interest rate swaps– Triangular swap (Numerical problems only on interest rate swap including triangular swap)-valuation of interest rate swaps- Only theory. (Theory and Problems).

Module -5 Commodity Derivative Market **7 hours**

Commodity Derivative Market: Meaning of commodity derivatives-Commodity derivative exchanges (with commodities traded) in India-Trading and settlement system of commodity derivatives-SEBI Guidelines for commodity market-commodities traded. (Theory).

Module -6 Credit Derivatives and VaR **7 hours**

Credit Derivatives-Total Return Swap (TRS)-Credit Default Swap (CDS)-Types of CDS-Asset Backed Securities (ABS)-Collateralised Debt Obligation (CDO)-Sub-Prime Crisis-2007-Credit Spread Options-Probability of Default- Forward Rate Agreement (FRA)-Interest Rate Caps/Floors/Collars-Types of Interest Rates-Zero Rate-Forward Rate-Value-at-Risk-Meaning, VaR Models-Stress testing and back testing. (Numerical problems only on VaR, Zero Rate and Forward rate). (Theory and Problems).

Course outcomes:

At the end of the course the student will be able to:

- Understand the mechanism of forwards/futures, options, financial swaps, various credit derivatives and VaR with their features, merits and demerits.
- Assess the application of forwards/futures, options, financial swaps, various credit derivatives and VaR using numerical problems.
- Application of financial derivatives in risk management.
- Critically evaluate various financial derivatives.

Practical Component:

- Visit the website of FEDAI and understand the regulations for Commodity Exchanges
- Visit the MCX/NCDEX and understand the their trading and settlement
- Visit the banks and understand the their foreign exchange transactions.
- Undesatnd how different types of qoutations helpful to the participants in Forex

- Undesatnd what is the implication of financial derivatives.
- Compile and analyze few Futures, Forward Option contract documents
- Visit MCX portal and study its trading and settlement process
- Study the different types of option and Future contracts traded on NSE

CO-PO MAPPING

CO	PO				
	PO1	PO2	PO3	PO4	PO5
CO1	X				
CO2	X			X	
CO3	X			X	
CO4	X			X	

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have 8 full questions carrying equal marks.
- Each full question is for 20 marks.
- Each full question will have sub question covering all the topics under a Module.
- The students will have to answer five full questions; selecting four full question from question number one to seven and question number eight is compulsory.
- 40 percent theory and 60 percent problems in SEE.

Textbooks

Sl. No.	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Options, Futures & Other Derivatives	John C. Hull	Pearson Education	
2	Financial Derivatives-Text and Cases	Prakash Yaragol	Vikas Publishing House Pvt. Ltd.	1/e, 2019
Reference Books				
1	Options & Futures	Vohra & Bagri	TMH	2/e
2	Derivatives-Principles and Practice	Sundaram & Das	McGraw Hill	
3	Derivatives and Risk Management	Rajiv Srivastava	Oxford University	2010

INDIRECT TAXATION			
Course Code	20MBAFM403	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	60
Credits	03	Exam Hours	03

Course Objectives:

1. To provide an overview of GST in India
2. To provide an understanding of levy and collection of GST
3. To give an overview of customs duty in India
4. To provide an understanding of valuation for customs duty

Module-1 Introduction to Goods and Services Tax (GST) **7 hours**

Goods and Services Tax Act & Rules, Need for GST in India, Dual GST Model - Central Goods and Services Tax Act, 2017 (CGST) State Goods and Services Tax Act, 2017 (SGST) Union Territory Goods and Services Tax Act, 2017 (UTGST) Integrated Goods and Services Tax Act, 2017 (IGST) Goods and Services Tax Network (GSTN), GST Council Guiding principle and Functions of the GST Council. (Theory).

Module -2 Levy and Collection of Tax **7 hours**

Scope of Supply, Composite and Mixed Supplies, Levy and Collection, Composition Levy, Exemptions Person Liable to pay GST, Exemption from tax. (Simple problems on calculation of value of taxable supply and GST Levy). (Theory and Problems).

Module -3 Time and Value of Supply **7 hours**

Time of Supply, Change in Rate of Tax in respect of Supply of Goods or Services, Place of Supply and Value of Supply. (Simple problems on Time of supply, place of supply and value of supply) (Theory and Problems).

Module -4 Input Tax Credit **7 hours**

Introduction and Eligibility to avail Input Tax Credit (ITC). Registration under GST: Persons not liable for Registration, Compulsory Registration in Certain Cases, Procedure for Registration, Deemed Registration. Returns under GST: Furnishing of Returns, First Return, Revision of Returns and Penalty/Late Fee. (Theory).

Module -5 Customs Duty **7 hours**

Concept, Meaning of Customs Duty, Circumstances of Levy of Customs Duties and Types of Duties and Exemption from Customs Duty. Valuation under customs: Valuation of Imported Goods and Valuation of Export Goods.. (Problems on Valuation of Imported Goods). (Theory and Problems).

Module -6 Import and Export Procedure for Customs **5 hours**

Introduction to Baggage and General Free Allowance. Provisional Assessment of Duty, Due Dates for Payment of Duty, Penalties under Customs, Seizure of Goods, Confiscation of Goods. (Theory).

Course outcomes:

At the end of the course the student will be able to:

1. Have clarity about GST system in India
2. Understanding of levy and collection of GST in India
3. Have an overview of customs duty in India
4. Understanding of valuation for customs duty.

Practical Component:

- Compile and analyze documents pertaining to Registration under GST and Returns under GST
- How to file Online GST Returns
- How to Generate GSTR 1 & GSTR 3B, E way Bill and How to calculate and avail Input Tax Credit(ITC)
- Conduct a survey among local business community about compliance with GST regime.
- Encourage students to register for online GST Certification Course – Suggested.

CO-PO MAPPING

CO	PO				
	PO1	PO2	PO3	PO4	PO5
CO1	X				
CO2	X				
CO3	X				
CO4	X				X

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have 8 full questions carrying equal marks.
- Each full question is for 20 marks.
- Each full question will have sub question covering all the topics under a Module.
- The students will have to answer five full questions; selecting four full question from question number one to seven and question number eight is compulsory.
- 40 percent theory and 60 percent problems in the SEE

Textbooks

Sl. No.	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Indirect Taxes Law and practices	V S Datey	Taxmann's	*Latest Edition*
2	GST & Customs Law (University Edition)	K.M Bansal	Taxmann's	*Latest Edition*
Reference Books				
1	Principles of GST & Customs Law	V.S. Datey and Dr. Krishnan Sachdeva	Taxmann's	*Latest Edition*
2	Goods & Services Tax (GST) in India	B. Viswanathan	UBS Publishers	*Latest Edition*
3	Indirect Taxation	Raj K Agrawal & Shivangi Agrawal	Bharat Law House Pvt. Ltd	*Latest Edition*

MERGERS, ACQUISITIONS & CORPORATE RESTRUCTURING			
Course Code	20MBAFM404	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	60
Credits	03	Exam Hours	03

Course Objectives:

1. To understand various concepts and terminologies used in mergers and acquisition.
2. To explain and critically evaluate M&A with its different classifications, strategies, theories, synergy etc.
3. To apply and analyse financial evaluation and accounting aspects of M&A.

Module-1 Mergers and Acquisitions(M & A) 5 hours

Introduction of M & A: Meaning-types of mergers–Merger Motives-Theories of Mergers-Mergers and industry life cycle, Reasons for failures of M & A-synergy-types of synergy–value creation in M&A-SWOT analysis-BCG matrix. (Theory).

Module -2 Merger Process 7 hours

Procedure for effecting M & A-Five-stage model–Due diligence–Types, process and challenges of due diligence-HR aspects of M & A–Tips for successful mergers-Process of merger integration. (Theory).

Module -3 Financial Evaluation of M & A 7 hours

Merger as a capital budgeting-Business valuation approaches-asset based, market based and income based approaches-Exchange Ratio (Swap Ratio)-Methods of determining exchange rate. (Theory and Problems).

Module -4 Accounting aspects of Amalgamation 7 hours

: Types of amalgamations (Amalgamation in the nature of merger and amalgamation in the nature of purchase)-Methods of Accounting-Pooling of interest method and Purchase method)–Calculation of purchase consideration-Journal entries in the books of transferor & transferee company-Ledger accounts in the books of transferor and transferee companies. (Theory and Problems).

Module -5 Acquisitions/Takeovers 7 hours

Meaning and types of acquisition/takeovers (Friendly and Hostile takeovers)-Anti-takeover strategies-Anti-takeover amendments-Legal aspects of M & A-Combination and Competition Act-2002Competition Commission of India (CCI)-The SEBI Substantial Acquisition of Shares and Takeover (Takeover code-2011). (Theory).

Module -6 Corporate Restructuring 7 hours

Meaning, significance and forms of restructuring–sell-off, spin-off, divestitures, demerger, Equity Carve Out (ECO), Leveraged Buy Outs (LBO), Management Buy Out (MBO), Master Limited Partnership (MLP), Limited Liability Partnership (LLP) and joint ventures. (Theory).

Course outcomes:

At the end of the course the student will be able to:

1. Understand M&A with its different classifications, strategies, theories, synergy etc.
2. Conduct financial evaluation of M&A
3. Analyse the results after evaluation
4. Critically evaluate different types of M&A, takeover and antitakeover strategies

Practical Component:

- Choose any two latest M & A deal, announced/completed in the Indian corporate sector in 2019-20; Compile complete details of the deal;
- Study the deal in the light of the following:
  1. Nature of the deal: merger, amalgamation, acquisition, takeover, OR any program of corporate restructuring Valuation/Financials involved in the deal
  2. Synergies/benefits likely to emerge from the deal
  3. Challenges/Impact/Problems-associated with the deal.

CO-PO MAPPING

CO	PO				
	PO1	PO2	PO3	PO4	PO5
CO1	X				
CO2	X			X	
CO3	X			X	
CO4	X			X	

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have 8 full questions carrying equal marks.
- Each full question is for 20 marks.
- Each full question will have sub question covering all the topics under a Module.
- The students will have to answer five full questions; selecting four full question from question number one to seven and question number eight is compulsory.
- 60 percent theory and 40 percent problems in the SEE.

Textbooks

Sl. No.	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Mergers Acquisitions & Corporate Restructuring - Strategies & Practices	Rabi Narayan Kar and Minakshi	Taxmann's	3/e, 2017
2	Mergers and Acquisitions	Sheeba Kapil and Kanwal N. Kapil	Wiley	2/e, 2017
3	Mergers, Acquisitions and Corporate Restructuring: Text and Cases	Chandrashekar, Krishnamurti & Vishwanath S	Sage Publications	2/e, 2018
Reference Books				
1	Mergers, Acquisitions and Takeovers	H.R.Machiraju	New Age International Publishers	1/e, 2010
2	Mergers et.al.-Issues, Implications, and Case Law in Corporate Restructuring	Ramanujam S.	Tata McGraw Hill Publishing House	2000
3	Takeovers, Restructuring and Corporate Governance	Weston, Mitchell and Mulherin	Pearson Education	4/e , 2003.

CORPORATE VALUATION			
Course Code	20MBAFM405	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	60
Credits	03	Exam Hours	03

Course Objectives:

1. Identify the purpose of corporate valuation and to obtain an overview of the basic corporate valuation process
2. To familiarize the students with the standard techniques of corporate valuation.
3. To develop analytical skills and communication strategies for discussing corporate valuation.
4. To understand the valuation in the contexts of IPOs, M&As, Bankruptcy cases

Module -1 Corporate Valuation Overview **7 hours**

Approaches to Valuation-Features of the valuation process: Enterprise DCF Model-Analysing historical performance-Estimating the cost of Capital-Forecasting performance-Estimating the continuing value-Calculating and interpreting the results-Other DCF models: Equity DCF Model: Dividend discount model, free cash flow to Equity (FCFE) model-Adjusted present value model-Economic profit model-Applicability and Limitations of DCF analysis (Theory and problems).

Module -2 Non-DCF Approaches to Valuation **7 hours**

Book value approach, Adjusted book value approach, Stock and debt approach (numerical problems in each of these methods).Market efficiency and valuation. Call option based valuation (theory only because Numerical problems on Black and Scholes –Binomial methods are considered in Derivatives).Relative valuation-Steps involved in Relative valuation-Equity valuation multiples-Enterprise valuation multiples-Choice of multiple-Best practices using multiples-Assessment of relative evaluation. (Theory and problems).

Module -3 Advanced Issues in Valuation **7 hours**

Valuation of companies of different kinds-valuation in different contexts-Loose ends of valuation-Valuation of intangible assets: Patents, trademarks, copyrights and licenses; Franchises; Brands, WACCVs Flow to equity method. (Theory and problems).

Module -4 Strategic Financing Decisions **7 hours**

Strategic financing decisions: Valuation and financing Decisions in ideal capital markets, Capital structure and value in a perfect world, Information asymmetry, Share buyback and valuation. (Theory).

Module -5 Leverage decisions **7 hours**

, Agency costs of Debt, financial distress, Bankruptcy. Role of Government, securities Markets and financial institutions in IPO valuations and M&As. (Theory).

Module-6 Value Based Management **5 hours**

Value Based Management- Methods and Key premises of VBM-Marakon approach-Alcar approach-Mckinsey approach-Stern Stewart approach-BCG approach-Lessons from the experiences of VBM adopters. (Theory).

Course outcomes:

At the end of the course the student will be able to:

1. Understand corporate valuation and valuation process
2. Familiarize with the standard techniques of corporate valuation
3. Develop analytical skills relevant for corporate valuation and value based management
4. Critically evaluate IPOs, M&As, Bankruptacy cases

Practicaul Component:

- Obtain last three years' balance sheet of any TWO firms (from different sector) that has debt and equity.
- Find out the free cash flow to the firm (FCFF) and free cash flow to the equity (FCFE) for the last three years.
- Determine if there is any growth in the cash flows to the firm and to the equity holders.
- Find beta of the firm and Compute cost of equity and WACC.
- Finally find the value of the firm and interpret the findings.
- Discuss few case studies on Value-based management followed in Indian corporates.
- Study the IPO valuation by Indian financial institutions.

CO-PO MAPPING

CO	PO				
	PO1	PO2	PO3	PO4	PO5
CO1	X				
CO2	X				
CO3	X			X	
CO4	X			X	

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have 8 full questions carrying equal marks.
- Each full question is for 20 marks.
- Each full question will have sub question covering all the topics under a Module.
- The students will have to answer five full questions; selecting four full question from question number one to seven and question number eight is compulsory.
- 60 percent theory and 40 percent problems in the SEE.

Textbooks

Sl. No.	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Corporate Valuation and Value Creation	Prasanna Chandra	Tata McGraw Hill	2011
2	Damodaran on Valuation	Aswath Damodaran	John Wiley and Sons	2/e, 2006
Reference Books				
1	Corporate Valuation: A Guide for Managers and Investors	Philip R Daves, Michael C. Ehrhardt, and Ron E. Shrieves	Cengage Learning	2003
2	Corporate Valuation	David Frykman, Jakob Tolleryd	Prentice Hall	2003
3	The Valuation Handbook: Valuation Techniques from Today's Top Practitioners	Rawley Thomas, Benton E. Gup	John Wiley & Sons	2010

INTERNATIONAL FINANCIAL MANAGEMENT			
Course Code	20MBAFM406	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	60
Credits	03	Exam Hours	03

Course Objectives:

1. To understand the International Financial Environment and the Foreign Exchange market.
2. To learn hedging and Forex risk management.
3. To learn the Firm's Exposure to risk in International environment and various theories associated with it**.**

Module -1 International Financial Environment **7 hours**

Importance, rewards & risk of international finance- Goals of MNC- International Business methods. Balance of Payments (BoP), Fundamentals of BoP, Accounting components of BOP, Equilibrium & Disequilibrium, International Monetary System: Evolution, Gold Standard, Bretton Woods system, the flexible exchange rate regime, the current exchange rate arrangements, the Economic and Monetary Union (EMU).(Only Theory).

Module -2 Foreign Exchange Market **7 hours**

Function and Structure of the Forex markets, Foreign exchange market participants, Types of transactions and Settlements Dates, Exchange rate quotations, Determination of Exchange rates in Spot markets. Exchange rates determinations in Forward markets. Exchange rate behaviour-Cross Rates- - Bid – Ask – Spread (Theory & Problems).

Module -3 Foreign Exchange Risk Management **7 hours**

Hedging against foreign exchange exposure – Forward Market- Futures Market- Options Market- Currency Swaps-Interest Rate Swap- problems on both two-way and three-way swaps. (Theory & Problems).

Module -4 International Financial Markets and Instruments **5 hours**

: Foreign Portfolio Investment. International Bond & Equity market. GDR, ADR, International Financial Instruments: Foreign Bonds & Eurobonds, Global Bonds. Floating rate Notes, Zero coupon Bonds, International Money Markets, International Banking services –Correspondent Bank, Representative offices, Foreign Branches. Forward Rate Agreements. (Only Theory).

Module -5 Forecasting Foreign Exchange rate **7 hours**

International Parity Relationships, Measuring exchange rate movements-Exchange rate equilibrium –Factors effecting foreign exchange rate- Forecasting foreign exchange rates. Interest Rate Parity, Purchasing Power Parity &International Fisher effects, Arbitrage, Types of Arbitrage – Locational, Triangular and Covered Interest Arbitrage. (Theory & Problems).

Module-6 Foreign Exchange exposure **7 hours**

Foreign Exchange exposure: Management of Transaction exposure-Management of Translation exposure-Management of Economic exposure-Management of political Exposure- Management of Interest rate exposure.
International Capital Budgeting: Concept, Evaluation of a project.
(Theory & Problems).

Course outcomes:

At the end of the course the student will be able to:

1. The student will have an understanding of the International Financial Environment.
2. The student will learn about the foreign exchange market, participants and transactions.
3. The student will be able to use derivatives in foreign exchange risk management.
4. The student will be able to evaluate the Firm's Exposure to risk in International environment and various theories associated with it.

Practical Components:

- Visit the foreign exchange department of a bank, study the operations and submit a report
- Track and analyze the rupee exchange value against Dollar and Euro in spot and forward markets for one week and record the observations.
- Study the different types of swaps used in Foreign Exchange Market
- Visit the foreign exchange department of a bank, study the operations and submit a report
- Track and analyze the rupee exchange value against Dollar and Euro in spot and forward markets for one week and record the observations

CO-PO MAPPING

CO	PO				
	PO1	PO2	PO3	PO4	PO5
CO1	X				
CO2	X			X	X
CO3	X			X	
CO4	X		X		X

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have 8 full questions carrying equal marks.
- Each full question is for 20 marks.
- Each full question will have sub question covering all the topics under a Module.
- The students will have to answer five full questions; selecting four full question from question number one to seven and question number eight is compulsory.
- 40 percent theory and 60 percent problems in the SEE.

Textbooks

Sl. No.	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	International Corporate Finance	Jeff madura	Cengage Learning	10/e 2012
2	International Finance Management	Eun & Resnick	Tata McGraw Hill	4/e, 2014
3	Financing International Trade: Banking Theories and Applications	Gargi Sanati	Sage Publication	1/e, 2017
Reference Books				
1	International Financial Management	Apte P. G	Tata McGraw Hill	6/e, 2011
2	International Financial Management	MadhuVij	Excel Books	2010
3	International Financial Management	Thummuluri Siddaiah	Pearson India	1/e, 2009

HUMAN RESOURCE SPECIALISATION COURSES

ORGANISATIONAL LEADERSHIP			
Course Code	20MBAHR401	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	60
Credits	03	Exam Hours	03

Course Objectives

1. The student will be able to describe and Identify the application of Leadership styles and practices followed in the Organisation
2. The student will be able to describe and explain in her/his own words, the relevance and importance of various Leadership practices and style followed in the Organisation
3. The student will be able to apply and solve the workplace problems through Leadership practices
4. The student will be able to classify and categories different Leadership practices and styles followed in the Organisation
5. The student will be able to create and reconstruct Leadership required to manage the Human Resources in the Organisation
6. The student will be able to appraise and judge the practical applicability of Leadership practices followed in the Organisation

Module-1 Introduction **5 hours**

Concept of Leadership, Ways of Conceptualizing Leadership, Definition and Components, Leadership Described, Trait Versus Process Leadership, Assigned Versus Emergent Leadership. Leadership and Power, Leadership and Coercion, Leadership and Management.

Module -2 Model of Leadership - Part A **7 hours**

Trait Approach

Description, Intelligence, Self-Confidence, Determination, Integrity, Sociability, Five-Factor Personality Model and Leadership, Emotional Intelligence, How Does the Trait Approach Work?
Strengths, Criticisms, Application, Case Studies, Leadership Instrument

Skills Approach

Description, Three-Skill Approach, Technical Skill, Human Skill, Conceptual Skill, Summary of the Three-Skill Approach, Skills Model, Competencies, Individual Attributes, Leadership, Outcomes, Career Experiences, Environmental Influences, Summary of the Skills Model, How Does the Skills Approach Work? Strengths, Criticisms, Application, Case Studies, Leadership Instrument

Behavioral Approach

Description, The Ohio State Studies, The University of Michigan Studies, Blake and Mouton's Managerial (Leadership) Grid, Authority–Compliance (9,1), Country-Club Management (1,9) Impoverished Management (1,1), Middle-of-the-Road Management (5,5), Team Management (9,9), Paternalism/Maternalism, Opportunism, How Does the Behavioral Approach Work? Strengths, Criticisms, Application, Case Studies, Leadership Instrument

Situational Approach

Description, Leadership Styles, Development Levels, How Does the Situational Approach Work? Strengths, Criticisms, Application, Case Studies, Leadership Instrument

Module -3 Model of Leadership - Part B **7 hours**

Path–Goal Theory

Description, Leader Behaviors, Directive Leadership, Supportive Leadership, Participative Leadership, Achievement-Oriented Leadership, Follower Characteristics, Task Characteristics How Does Path–Goal Theory Work? Strengths, Criticisms, Application, Case Studies, Leadership Instrument

Leader–Member Exchange Theory

Description, Early Studies, Later Studies, Leadership Making, How Does LMX Theory Work? Strengths, Criticisms, Application, Case Studies, Leadership Instrument

Transformational Leadership

Description, Transformational Leadership Defined, Transformational Leadership and Charisma, A Model of Transformational Leadership, Transformational Leadership Factors, Transactional Leadership Factors, Non-leadership Factor, Other Transformational Perspectives Bennis and Nanus, Kouzes and Posner, How Does the Transformational Approach Work? Strengths, Criticisms, Application, Case Studies, Leadership Instrument

Authentic Leadership

Description, Authentic Leadership Defined, Approaches to Authentic Leadership, Practical Approach, Theoretical Approach, How Does Authentic Leadership Theory Work? Strengths, Criticisms, Application, Case Studies, Leadership Instrument

Psychodynamic Approach

Description, The Clinical Paradigm, History of the Psychodynamic Approach, Key Concepts and Dynamics Within the Psychodynamic Approach,

1. Focus on the Inner Theatre
2. Focus on the Leader-Follower Relationships

Social Defense Mechanisms, Mirroring and Idealizing, Identification With the Aggressor

3. Focus on the Shadow Side of Leadership Narcissism

How Does the Psychodynamic Approach Work? Strengths, Criticisms, Application, Case Studies, Leadership Instrument

Module -4 Leadership Instrument **7 hours**

Description, Culture Defined, Related Concepts, Ethnocentrism, Prejudice, Dimensions of Culture, Uncertainty Avoidance, Power Distance, Institutional Collectivism, In-Group, Collectivism, Gender Egalitarianism, Assertiveness, Future Orientation, Performance Orientation, Humane Orientation, Clusters of World Cultures, Characteristics of Clusters, Anglo, Confucian Asia, Eastern Europe, Germanic Europe, Latin America, Latin Europe, Middle East, Nordic Europe, Southern Asia, Sub-Saharan Africa, Leadership Behavior and Culture, Clusters, Eastern Europe Leadership Profile, Latin America Leadership Profile, Latin Europe Leadership Profile, Confucian Asia Leadership Profile, Nordic Europe Leadership Profile, Anglo Leadership Profile, Sub-Saharan Africa Leadership Profile, Southern Asia Leadership Profile, Germanic Europe Leadership Profile, Middle East Leadership Profile, Universally Desirable and Undesirable Leadership Attributes, Strengths, Criticisms, Application, Case Studies on Leadership Instrument

Module -5 Ethical Leadership **7 hours**

Description, Ethics Defined ;Level 1. Preconventional Morality ;Level 2. Conventional Morality;
Level 3. Postconventional Morality; Ethical Theories, Centrality of Ethics to Leadership, Heifetz's Perspective on Ethical Leadership; Burns's Perspective on Ethical Leadership, The Dark Side of Leadership, Principles of Ethical Leadership, Ethical Leaders Respect Others, Ethical Leaders Serve Others, Ethical Leaders Are Just, Ethical Leaders Are Honest, Ethical Leaders Build CommModuley, Strengths, Criticisms, Application, Case Studies, Leadership Instrument.

Module – 6 Leadership Practices **7 hours**

Select Case of Successful Leadership Practices; TATA Group; Reliance; Infosys; WIPRO; and Organisations which are listed as Fortune Companies. Survey Report analysis of NHRD; NIPM; CII; FICCI; Conference Board; CCL - Centre of Creative Leadership.

Course Outcomes:

1. Understand the fundamental concepts and principles, theories of Organizational Leadership.
2. Analyze the organizational leadership style, approaches and traits, its impact on the followers by using leadership theories and instruments.
3. Developing better insight in understanding the leadership traits that influence them to work effectively in group.
4. Demonstrate their ability to apply of their knowledge in organizational leadership.

Practical Components:

- Meet any Leader- Organisation or Academic and ask 10 questions related to Leadership. Than analysis the type of leadership style adopted.
- Meet 4-5 Leaders from different roles and compare - contrast the different style son leadership.
- Meet Gender specific leaders and try analysing who makes the best leader in which type of set-up.

Note: Faculty can either identify the organizations/ leaders/job profile or students can be allowed to choose the same.

CO-PO MAPPING

CO	PO				
	PO1	PO2	PO3	PO4	PO5
CO1	X				
CO2	X		X	X	X
CO3	X		X	X	
CO4	X		X		X

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have 8 full questions carrying equal marks.
- Each full question is for 20 marks.
- Each full question will have sub question covering all the topics under a Module.
- The students will have to answer five full questions; selecting four full question from question number one to seven and question number eight is compulsory.
- 100 percent theory in the SEE.

Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Leadership: Theory and Practices Leadership for Organisations	Peter G. Northouse	Sage Publication	7/e, 2016
2	Management: Leading People and Organisations in the 21st Century	Gary Dessler	Prentice Hall	2001
3	Charismatic Leadership in Organisations	Jay A. Conger, Rabindra N. Kanungo	Sage Publications	1998

Reference Books

1	Leadership: Theory and Practice	Peter G. Northouse	Sage	2010
2	Management: Leading People and Organisations in the 21st Century	Gary Dessler	Prentice Hall	2001
3	The Leadership Code: Five Rules to Lead	Dave Ulrich, Norm Smallwood, Kate Sweetman	Harvard Business Pres	2008
4	Leadership for Organisations	David A. Waldman, Charles O'Reilly	Sage Publications	2019

PERSONAL GROWTH AND INTERPERSONAL EFFECTIVENESS			
Course Code	20MBAHR402	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	60
Credits	03	Exam Hours	03

Course Objectives

1. The student will be able to describe and Identify the application of various PG and IE framework
2. The student will be able to describe and explain in her/his own words, the relevance and importance of various PG and IE to be adopted in the Organisation
3. The student will be able to apply and improve the workplace effectiveness through various PG and IE
4. The student will be able to classify and categorise different PG and IE practices and to be followed in the Organisation
5. The student will be able to create and reconstruct Leadership required to manage the Human Resources in the Organisation
6. The student will be able to appraise and judge the practical applicability of various PG and IE practices to be followed in the Organisation

Module-1 Dynamics of Personal Growth **4 hours**

Dynamics of Personal Growth Meaning, nature and scope of personal growth. Self-awareness and self-esteem, life roles, social roles and organisational roles, role clarity and role boundaries. Ego states- Id, ego and super ego and defense mechanism. Developing a self-improvement plan.

Module -2 Interpersonal Trust **4 hours**

Openness, confidentiality, blind spot and unknown part of personality. Self-disclosure, seeking feedback, self-reflection and practicing new behaviors. Discovering facets of interpersonal trust through Johari Window.

Module -3 Understanding Human Personality and Neuro Functioning **7 hours**

Personality theories, Carl Jung's theory of personality types and Myers Briggs Type Indicator test (MBTI), Trait theories- Guilford Peogut, PF 16 and Type A and B, Emotional intelligence. **Basic functions of mind:** Creativity and innovation. Blocks to creativity. Creativity processes and tools- convergent and divergent thinking. Six thinking Hats, Neuro Linguistic Programming.

Module -4 Attitudes, Beliefs, Values and their impact on Behaviour **7 hours**

Personal change meaning, nature and requisites. Social adjustments and habit formation. Locus of control. Habits of personal effectiveness. Seven habits of highly effective people.

Module -5 **9 hours**

Interpersonal relations and personal growth: Interpersonal needs for openness, inclusion and control. Discovering the interpersonal orientation through FIRO-B. Conflict resolution and negotiation, time management and honouring the commitments

Module – 6 Transactional Analysis **9 hours**

Ego states, types of transactions and time structuring. Life position, scripts and games; T-group sensitivity training, encounter groups, appreciative enquiry and group relations conference (students may go through three days personal growth lab for experiential learning)

Course Outcomes:

1. Have in-depth understanding the various personality traits which promotes personal growth.
2. Analyze the concepts of human personality, behaviour and functioning of mind
3. Learn and apply the psychometrics tests in understanding the personality traits.
4. Develop the greater insight of self, and others through various theories and prepare the developmental plan for interpersonal effectiveness.

Practical Components:

- Students are expected to conduct an in-depth study about various personality traits & TA and submit a detailed report.
- Students must undergo psychometric test like MBTI, FIRO-B, Big Five etc, conduct SWOT analysis and prepare a personal growth plan based on the results
- Ask the individual students to seek multisource feedback about their interpersonal effectiveness from peers, teachers, and parents; understand and reflect the feedback and prepare a development plan for interpersonal

effectiveness.

- Discuss a Johari Window case in the class to identify how it can help each individual student to promote his/ her personal growth.
- Organize a workshop on MBTI for the students to know their type and to understand the type dynamics.
- Organize a Neuro linguistic programming workshop for the participation of all HR students.

CO-PO MAPPING

CO	PO				
	PO1	PO2	PO3	PO4	PO5
CO1	X		X		
CO2	X		X	X	X
CO3	X	X	X		
CO4	X	X	X		X

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have 8 full questions carrying equal marks.
- Each full question is for 20 marks.
- Each full question will have sub question covering all the topics under a Module.
- The students will have to answer five full questions; selecting four full question from question number one to seven and question number eight is compulsory.
- 100 percent theory in the SEE.

Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Organisational Behaviour: Human Behaviour at work	John W. Newstrom and Keith Davis	Tata McGraw Hill	11/e, 2003
2	Human Relations in organisations	Robert N. Lussier	Mc- Graw Hill Education	6/e
3	Development of Management Skills	Whetten & Cameron	PHI	7/e
4	Competency Mapping Assessment and Growth	Naik G. P	IIHRM	2010

Reference Books

1	Understanding OB	Udai Pareek	Oxford University Press	
2	Theories of Personality	Calvin S Hall	Wiley India Pvt. Ltd	4/e
3	Seven habits of highly effective people	Stephen R Covey	Pocket Books.	
4	Training in interpersonal Skills	Stephen Robbins	Pearson Education	

INTERNATIONAL HUMAN RESOURCES MANAGEMENT			
Course Code	20MBAHR403	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	60
Credits	03	Exam Hours	03

Course Objectives

1. The student will be able to describe and Identify the application of IHRM in managing and developing an Organisation
2. The student will be able to describe and explain in her/his own words, the relevance and importance of IHRM in managing and developing an Organisation
3. The student will be able to apply and solve the workplace problems involving International issues
4. The student will be able to classify and categorise different Laws related to IHRM
5. The student will be able to create and reconstruct HRM System to be adopted in the Organisation related to International employees
6. The student will be able to appraise and judge the practical applicability of various strategy and approaches in managing International Organisation

Module-1 Introduction **7 hours**

Meaning and Definition IHRM: Evolution, Challenges, Objectives, IHRM Versus Single Nation-centric HRM IHRM: Approaches Emergence of Global HR Manager IHRM;Culture and Cross-Cultural Management-Introduction, Studies on culture in management Positivist views: 'Culture and values' Interpretive views: 'Culture and meanings' Critical views: 'Culture and power"; Comparative Human Resource Management - Globalisation and HRM, The importance of context, Differences in HRM practice; Approaches to International Human Resource Management - Review of IHRM approaches, The concept of HRM, Are IHRM models applicable to other contexts? What factors affect HRM approaches internationally? What are the implications of change for IHRM approaches?

Module -2 IHRM Policies and Practices - Part A **7 hours**

Managing Knowledge in Multinational Firms: Introduction, Different types of knowledge, Factors influencing knowledge sharing How to stimulate knowledge sharing Gaining access to external knowledge, Knowledge retention From the management of knowledge to innovation

Training and Development: Developing Global Leaders and Expatriates

Training and Development: Domestic Versus International Organisations International Training Management: Basic Concepts and Models Leadership Training and Development in International Organisations Technology in International Training Management.

Module -3 IHRM Policies and Practices - Part B **7 hours**

Global Performance Management

Introduction, Key components of PMSs Factors affecting PMSs Culture and PMSs, PMSs in six leading economies: China, India, Japan, South Korea, UK and USA, PMS for expatriates

Total Rewards in the International Context

Recap: differentiating between PCNs, TCNs and HCNs Introduction: the current state of total rewards Complexities faced by IHR managers, International total rewards objectives for the MNC Newer forms of international assignments, Key components of global total rewards programs. Approaches to international compensation Repatriation issues, International trends in global total rewards.

Module -4 International Assignments And Employment Practices **5 hours**

Introduction Staffing policies, Motives for international transfers, Alternative forms of international assignments. The international assignment process Dimensions of international assignment success

Multinational Companies and the Host Country Environment Introduction, Varieties of host country environments, Sustainability of divergent, employment arrangements Understanding how MNCs act in diverse host country, environments Host country effects on IHRM practices of MNC subsidiaries

Module -5 Employment Practices **7 hours**

Regulation and Multinational Corporations: The Changing Context of Global Employment Relations

Importance of regulation and political context, Political agendas to de-regulate, Political and institutional drivers of de-regulation, Problems with de-regulation in a global context. Human Resource Management in Cross-Border Mergers and Acquisitions. Cultural differences and cross-border M&A performance, Managing cross-border integration: the HRM implications.

Module – 6 Diversity Management and CSR **7 hours**

Equal opportunities, Diversity Management, Work–life balance: practices and discourses; International Culture Management: Model Organisational Culture and Innovation, Models of Culture, Hofstede's Four, Cultural Dimensions, Trompenaar's Seven Cultural Dimensions, Globe's Nine Cultural Dimensions, Edgar Schein's Model of Culture Deal and Kennedy's Culture Model, Schneider's Culture Model, Cameron and Quinn's Model of Culture Charles Handy's Model of Culture Denison's Model of Culture, Profile of Organisational Culture in International Organizations Managing International Culture. Corporate Social Responsibility and Sustainability through Ethical HRM practices. Ethics and corporate social responsibility International labour standards.

Course Outcomes:

1. Gain conceptual knowledge and practical experience in understanding the HR concepts globally.
2. Comprehend and correlate the strategic approaches to HR aspects amongst PCN's, TCN's and HCN's.
3. Develop knowledge and apply the concepts of HR in global perspective
4. Have a better insight of HR concepts, policies and practices by critically analysing the impact of contemporary issues globally.

Practical Components:

- A visit to Organisation and interact with HR Manager and list out the roles played by HR manager.
- Meet Recruitment Manager and ask- 10 questions one asks during Interview.
- Meet Training and Development Manager and list out various training given to employees; basis of training program; Need analysis.
- Visit any Service Organisation and observe HR functions; List them.

CO-PO MAPPING

CO	PO				
	PO1	PO2	PO3	PO4	PO5
CO1	X		X		X
CO2	X		X		X
CO3	X	X	X		
CO4	X		X	X	X

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have 8 full questions carrying equal marks.
- Each full question is for 20 marks.
- Each full question will have sub question covering all the topics under a Module.
- The students will have to answer five full questions; selecting four full question from question number one to seven and question number eight is compulsory.
- 100 percent theory in the SEE.

Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	International Human Resource Management	Srinivas R. Kandula	Sage Publication India Pvt. Ltd.	2018
2	International Human Resource Management	Anne-Wil Harzing, Ashly H. Pinnington	Sage Publication India Pvt. Ltd.	4/e, 2015
3	Diversity at Work	Arthur P Brief	Cambridge University Press	2008

Reference Books				
1	Strategic Human Resource Management: An International Perspective	Gary Rees, Paul E. Smith	Sage Publication India Pvt. Ltd.	2014
2	Global Talent Management: An Integrated Approach	Sonal Minocha and Dean Hristov	Sage Publication India Pvt. Ltd.	2019
3	International Human Resource Management	Anne-Wil Harzing, Ashly Pinnington	Sage Publication India Pvt. Ltd.	2011

ORGANISATIONAL CHANGE AND DEVELOPMENT			
Course Code	20MBAHR404	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	60
Credits	03	Exam Hours	03

Course Objectives

1. The student will be able to describe and Identify the application of various OC/D framework
2. The student will be able to describe and explain in her/his own words, the relevance and importance of various OC/D intervention to be adopted in the Organisation
3. The student will be able to apply and improve the workplace effectiveness through various OC/D Intervention
4. The student will be able to classify and categorise different OC/D practices and intervention followed in the Organisation
5. The student will be able to create and reconstruct OC/D intervention and process required to manage the Organisation
6. The student will be able to appraise and judge the practical applicability of various OC/D intervention, process and practices to be followed in the Organisation

Module-1 Changing Organisations 5 **hours**

Nature of 21st Century Organisation, Defining Organisational Change, The Roots of Organisation Change, Environmental Forces, Driving Change Today, The Implications of Worldwide Trends for Change Management, Four Types of Organisational Change, Planned Changes and Intended Results, Organisation Change Roles, Change Initiators, Change Implementers, Change Facilitators, Change Recipients, The Requirements for Becoming a Successful Change Leader, Application of Lewin's Model of Change, OD Practitioners.

Module -2 Building and Energising the Need for Change **7 hours**

Organisations as Systems, Levels and Characteristics of Organisational Change, Models of Organisational Change, Systems Theory and Social Construction Approaches, Developing a Knowledge for the Need for Change, Seek Out and Make Sense of Internal - External Data, The Organisations' Readiness for Change, Creating Awareness of the Need for Change, Factors That Block People From Recognising the Need for Change, Creating a Powerful Vision for Change, The Difference Between an Organisational Vision and a Change Vision.

Module -3 Measuring Change: Designing Effective Control Systems **7 hours**

Using Control Processes to Facilitate Change, Selecting and Deploying Measures, Use Measures that Lead to Challenging but Achievable Goals, Use Measures and Controls that are Perceived as Fair and Appropriate, Ensure Accurate Data, Control Systems and Change Management, Controls During Design and Early Stages of the Change Project, Measurement Tools to use in Change Process, Strategy Maps, The Balanced Scorecard, Risk Exposure Calculator, Organisational Change Agent, Orienting Yourself to Organisation Change, Data Gathering, Diagnosis and Feedback.

Module -4 Models of Change **7 hours**

Kurt Lewin's Three-step Model (1950–1952), Six-box Model of Marvin Weisbord, The McKinsey 7-S Model, Huse's Model of Planned Organizational Change, Action Research Model, David Nadler and Michael Tushman Model , Porras and Silvers Model (1991), The Burke–Litwin Causal Model, John Kotter's Eight-step Theory , Organizational Intelligence Model (2004), Managing Change with ADKAR Model, Integrated Model of Change , Comparison and Critical Analysis of Change Models Plan the Work, Selecting the Correct Path, Engage Others in Action Planning, Working the Plan Ethically and Adaptively, Developing a Communication Plan, Key Principles in Communicating for Change, Transition Management. Ensure Alignment in Your Action Planning, Action Planning Tools: 1) To-Do Lists; 2) Responsibility Charting; 3) Contingency Planning; 4) Surveys and Survey Feedback;5) Project Planning and Critical Path Methods;6) Force Field and Stakeholder Analysis; 7) Leverage Analysis and 8) Other Change-Management Tools.

Module -5 Organisation Development(OD) **7 hours**

Concept of O D, History of O D, OD in India, OD Activities, Values, Beliefs and Assumptions of OD, Laboratory Training and T-Groups Action Research and Survey Feedback, Employee Involvement, Organisational Culture, Reengineering Organisational Learning, Organisational Effectiveness and Employee Engagement, Defining Values, Values Important to the OD Practitioner, Core Values of O D, Changes to OD Values, Values Statement of O D, Ethical Issues of OD.

Module – 6 OD Practitioner and Consulting Process **7 hours**

Changing Workforce Demographics, Changing Nature of Work, The Consulting Relationship and Types of Consulting, Consulting Model, OD Practitioners, The Organisation Development Consulting Profession, The OD Consulting Process and Action Research, Data Gathering - Data Gathering Methods and Process, Ethical Issues With Data Gathering, Diagnosis and Feedback, assessment, Ethical Issues With Diagnosis and Giving Feedback, OD Intervention-Team Interventions, Quality, Performance Management, Communication in OD process, Coaching, Mentoring, 360 Feedback, Career Planning and Development. Merger and Acquisition, Organisational Health, OD Association in India.

Course Outcomes:

1. Gain conceptual insight of change management models, OD processes and interventions.
2. Develop the understanding of OD to apply OD aspects in private and public sectors in India.
3. Analyse the tools and techniques available to implement changes in the organization environment
4. Handle the OD interventions by analysing the role of OD consultant.

Practical Components:

- A visit to Organisation and interact with OD and Change Manager and list out the roles played by OD/C manager.
- Meet and Interact with OD and Change Manager and ask- 10 questions related to Change and Development issues
- Meet OD and Change Manager and list out various OC/D Intervention practised and how they impact the Organisational Growth
- Visit Organisation and Interact with Employees in the organisation and discuss Culture Impact on Change process and how it can be managed.

CO-PO MAPPING

CO	PO				
	PO1	PO2	PO3	PO4	PO5
CO1	X				X
CO2	X		X	X	X
CO3	X		X	X	
CO4	X		X	X	

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have 8 full questions carrying equal marks.
- Each full question is for 20 marks.
- Each full question will have sub question covering all the topics under a Module.
- The students will have to answer five full questions; selecting four full question from question number one to seven and question number eight is compulsory.
- 100 percent theory in the SEE.

Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Change Management and Organisational Development	Ratan Raina	SAGE Texts	2018
2	Organisational Change- An Action-Oriented Toolkit	Gene Deszca, Cynthia Ingols, Tupper F. Cawsey	SAGE Publications, Inc	2019

3	Organisation Development: The process of Leading Organisational Change	Donald L. Anderson	Sage Publication India Pvt. Ltd.	2/e, 2012
Reference Books				
1	Organisation Development	Donald L. Anderson	SAGE South Asia	2013
2	Toolkit for Organisational Change	T. F. Cawsey, Gene Deszca	SAGE Text	2007
3	Organisation Development and Organisational Change	Donald L. Anderson and Tupper F. Cawsey	SAGE Publications	1/e, 2014

HUMAN RECOURSE AUDIT			
Course Code	20MBAHR405	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	60
Credits	03	Exam Hours	03

Course Objectives

1. The student will be able to describe and Identify the application of various HR Audit methodology
2. The student will be able to describe and explain in her/his own words, the relevance and importance of various HR Audit approach adopted in the Organisation
3. The student will be able to apply and improve the workplace effectiveness through various HR Audit approach, practices and interventions
4. The student will be able to classify and categories different HR Audit approach and practices followed in the Organisation
5. The student will be able to create and reconstruct HR Audit framework and Model required to manage the Human Resources in the Organisation
6. The student will be able to appraise and judge the practical applicability of various HR Audit approach and practices to be followed in the Organisation

Module-1 Human Resource Development(HRD) 5 hours

H R D -Strategies and Systems; HR as Strategic Partner ; Need for HR Accounting and HR Auditing; Good Industrial Relation Index; Components of HRD Audit; HR Policies and Practices; Elements of good HRD; Role of HR Manager in HRD

Module -2 Human Resource(HR) Audit 7 hours

The Audit System; Need; Advantage and Challenges; Basic concepts and components; Understanding the concept of HR Audit; Identifying goal of HR Audit; Forming Audit team; Approaches to measuring HR; Audit Strategies; HR Systems; HR Competencies; Benefits of HR Audit; Process; Preparation of Audit Report; Methodology of Conducting Audit; Documents for HR Audit; Competency required for HR Audit.

Module -3 Areas for HR Audit 7 hours

Audit of HR Planning; Training and Development; Industrial Relations; Managerial compliance and Corporate strategies; Culture; Quality; Communication; Competencies; Decision Making; Engagement; Relational Audit; Task; Systems; HRIS System; Measuring impact of HR policies on the corporate goals; Creating HR Dashboard and Metric.

Module -4 HR Audit process 7 hours

Audit Methodology- Planning questions; Interview; Observation; Questionnaire; Collecting Audit data; Analysing and interpreting data; Assessing organisation ability to change; Action Plan; Audit Report; Developing Credibility of HR Dept; Internal - External Audit; Attitude Survey; Job Satisfaction Survey; Approaches to HR Audit - (i) Cooperative approach, (ii) Outside authority approach, (iii) Statistical approach, (iv) Compliance approach and (v) Management by objectives (MBO)

Module -5 HR Scorecard approach 7 hours

Measuring Business Impact; Components of HR scorecard ;How to use HR Scorecard for Audit ; Measuring HR effectiveness through HR Scorecard; Balanced scorecard; HR Research; HRD Audit as OD Intervention.

Module – 6 HR Audit for Legal Compliance 7 hours

Using scorecard approach in formulating workplace policies; Recruitment and Selection: Formulating FIR Audit for Start-up companies; HR Audit in practice: Cases in manufacturing industry, Service industry; Extracts of an Illustrative Audit Report.

Course Outcomes:

1. Gain conceptual knowledge and practical experience in understanding the HR Audit.
2. Comprehend and correlate the strategic approaches to HR Audit aspects
3. Develop knowledge and apply the concepts of HR Audit in the organisation
4. Have a better insight of HR Audit concepts, policies and practices by critically analysing the impact of contemporary issues in the organisation.

Practical Components:

- A visit to Organisation and interact with HR Manager/ list out Audit Methodology followed.
- Can design an HR Audit for an Small Scale Organisation.
- Can have Video recording of Attitude and Job Satisfaction Survey of Employees and how Audit can be improved.
- Visit any Service Organisation and observe HR Audit process; List them, and critically can give feedback for further improvement.

CO-PO MAPPING

CO	PO				
	PO1	PO2	PO3	PO4	PO5
CO1	X		X		X
CO2	X		X		
CO3	X		X	X	X
CO4	X		X	X	X

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have 8 full questions carrying equal marks.
- Each full question is for 20 marks.
- Each full question will have sub question covering all the topics under a Module.
- The students will have to answer five full questions; selecting four full question from question number one to seven and question number eight is compulsory.
- 100 percent theory in the SEE.

Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	HRD Audit: Evaluating the Human Resource Function for Business Improvement	TV Rao	Sage Response	2/e, 2014
2	HR Audit	Durdana Ovais Rajni Gyanchandani	Everest Publishing House	2017
3	The HR Scorecard: Linking People, Strategy and Performance		Harvard Business Review Press	1/e, 2001

Reference Books

1	Auditing Your Human Resources Department: A Step-by-Step Guide to Assessing the Key Areas of Your Program	John Mcconnell	AMACOM	2/e, 2011
2	HRD Score Card 2500: Based on HRD Audit	TV Rao	Sage Response	1/e, 2005
3	7 Easy Steps to Conduct a Human Resources Audit and Protect Your Company!	Vanessa Nelson	Lulu Publication	2016

MANAGEMENT CONSULTING FOR BUSINESS EXCELLENCE			
Course Code	20MBAHR406	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	60
Credits	03	Exam Hours	03

Course Objectives

1. To prepare professionals for a career in Management Consulting
2. To impart basic understanding of the requirements of the profession
3. To equip professionals with knowledge, skills and attitude desirable for a career in Management Consulting
4. How to Scale the business and transform it into established firm
5. To prepare professionals working in industry, service sector, development sector and Not for Profit Organisations for Internal Consulting Roles

Module-1 Introduction **7 hours**

Management Consultancy in India- Indian Management Consulting Scenario, Concept, Nature, Dynamics, Opportunity Modules, Challenges, Consultancy as Profession, Strategic planning process for long-term success through Consultancy; Proactive client relationships for repeat business; Organisational Study and Consultancy- Align organisational vision and strategy; Changing Business Models and Business Strategy; Consultancy Agenda; Economics of Consulting; Client development, Client engagement, Basic and Advanced tools, techniques and frameworks used by management consultants- simulation analysis, decomposition analysis, feasibility analysis and sensitivity analysis/ rankings, scenario analysis, representative element analysis, decision tree, Theory of constraints, Critical chain; issue tree, bottom-up approach, top-down approach, backward reasoning, 80/20 rule, benchmarking, cost drivers, opportunity tree; Ethics of Consulting; Pre requisite needed for Consultancy as Profession.

Module -2 Consultancy Areas - Part A **5 hours**

Corporate Governance: Role of Management Consultants Play; Consulting Experience in Brand Management; Experience in M and A Consulting; E-Governance and its Relevance to India; Information Technology Consulting: Bytes of Reality; Management Consultancy in Infrastructure Projects; Implications for Management Consultants.

Module -3 Consultancy Areas - Part B **7 hours**

Project Finance: New Investment, Diversification and Growth; Mentoring In Entrepreneurship; Strengthening Contribution of NGOs in Social Development: Consultancy in Communication Research; Developing strategy for financial restructuring; Management consulting in investment banking, legal, real estate, accounting, financial services, advertising, IT consulting, engineering consulting, HR consulting, R&D, education, architecture, AI, Block chain; Customer relations' management.

Module -4 Consulting Services **7 hours**

Consulting Services to design and implement policies, systems and processes in functional and cross-functional areas of business. Project Feasibility studies and appraisal; Performance measurement and evaluation of public and corporate sectors; Designing project planning, monitoring and control systems; Designing and implementing manufacturing execution system; Designing and implementing supply chain models; Total quality management; System analysis and design; Enterprise Resource Planning (ERP); Information Technology strategies and architectures; Business Process Reengineering (BPR); E-Governance; Strategic restructuring through alliances and Joint ventures.

Module -5 Careers and Firms in Consultancy **7 hours**

Career in Consulting - Future Jobs; Top consulting firms McKinsey, BCG, Bain and AT Kearney, PwC, EY, Accenture, Career Growth for Management Consultants area like- Strategy Consulting; Operations Consulting; Financial Advisory Consulting; Risk & Compliance Consulting; Business Coach; Industry-Specific Consulting like steel, FMCG, supply-chain, public sector, etc.; Legal Management Consultancy; Skills and Competency- Research and analysis, Industry analysis, Project preparation, Strategic and design thinking, Technology, Communication skills, Presentation, Business negotiations, ability to think logically and structure, current affairs in the industry and general news around the world, problem solving, business-analytics skills, writing proposals, managing projects, prising strategy, initiating relationship, growing client organisation relationship, corporate valuation and integration, sharp knowledge and strong networking skills, global culture.

Module – 6 HR Consultancy **7 hours**

Creating Winning People Strategy; Strategy Maps; Structure, Process and Governance; HR Service Delivery Design; Consulting in Executive Search and Building a Management Team; HR Audit; HR Annual Survey; HR Systems Design; HR Process Re-engineering; Creating HPWS- High Performance Work System and Culture; Developing leadership, Succession, Empowering line managers to take on HR role, 360 degree feedback, Assessment and development Centre's, Value and culture building, Human potential utilisation, Manpower planning; Development and Improvement of performance appraisal system; talent management, Organisational restructuring, Developing heterogeneous HR policies, Managing Gen Y and Gen Z employees, Attrition control and employee retention management, Work-life balance, Executive coaching, Performance management, Employee engagement, Integration and assimilation of new recruits, Expectation management, T and D, Stress management, healthy living and building future.

Course Outcomes:

1. Gain the practical insight of various principles and practices of Consultant and Consultancy
2. Acquire knowledge of latest conceptual framework used by Consultant and Consultancy process and procedure applied in various sectors
3. Illustrate the application of Consultant and Consultancy tools and techniques in various sectors.
4. Develop a greater understanding about strategies adopted/undertaken by Consultant and Consultancy.

Practical Components:

- Visit management consulting firm and identify opportunities and challenges of the firm.
- Help consulting firm to increase profitability by making an SWOT analysis.
- Design strategies for Lifetime Fitness to enter foreign markets.

CO-PO MAPPING

CO	PO				
	PO1	PO2	PO3	PO4	PO5
CO1	X		X		X
CO2	X		X		
CO3	X		X		X
CO4	X		X	X	X

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have 8 full questions carrying equal marks.
- Each full question is for 20 marks.
- Each full question will have sub question covering all the topics under a Module.
- The students will have to answer five full questions; selecting four full question from question number one to seven and question number eight is compulsory.
- 100 percent theory in the SEE.

Texbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Management Consulting in India-Practice and Experiences for Business Excellence	U. K. Srivastava; Pramila Srivastava	SAGE Response	2012
2	An Introduction to Management Consultancy	Marc Baaij	SAGE Publications Ltd	2013
3	Management Consultancy Insights and Real Consultancy Projects	Book by Graham Manville	Routledge	2018

Reference Books				
1	The McKinsey way	Ethan M. Rasiel	KOBO	1999
2	The Boston Consulting Group on Strategy: Classic Concepts and New Perspectives	Carl W. Stern, Michael S. Deimler	John WILEY and Sons	2006
3	Competitive Strategy: Techniques for Analyzing Industries and Competitors	Michael E. Porter	The Free Press	1980

RUBRICS FOR CONTINUOUS INTERNAL EVALUATION (CIE) FOR 40 MARKS

Particulars	Marks	Procedure
Internal Assessment Test	50+50= 100/4=25	Average of two best performances out of three internal assessments tests shall be considered.
Seminar/Presentation	05	Document for the same must be maintained
Subject Viva-Voce/ Oral Examination	05	Document for the same must be maintained
Assignment/ Quiz	05	Document for the same must be maintained
Note: Course Instructor may introduce/use any activity other than the above three activities to award 15 marks. The activities used by the course instructor must be measurable and documented for inspection by VTU.		

QUESTION PAPER PATTERN FOR SEE

Q.No.1 to7 PART -A	Marks
a	3 marks
b.	7 marks
c.	10 marks
Total (4/7) 4X20	80 marks
PART-B Case-Compulsory	20 marks

Note: For III Sem SEE 20% marks allocated to application oriented questions from practical Components.

GUIDELINES FOR 6 WEEK PROJECT WORK 20MBAPR407
(BETWEEN 3RD AND 4TH SEMESTER MBA)

PROJECT REPORT			
Course Code	20MBAPR407	CIE Marks	40
Teaching Hours/Week (L:T:P)	0:0:12	SEE Marks	60
Credits	06	Exam Hours	00

Objective

To expose the students to understand the working of the organization/company / industry and take up an in-depth study of an issue / problem in the area of specialization.

General Guidelines

- The project work shall be for a period of 6 weeks immediately after the completion of 3rd SEE but before the commencement of the 4th semester classes.
- The Course code of the project report shall be 20MBAPR407 and shall be compulsory for all the students opting for all specializations.
- The University shall receive 2 copies of project reports prior to the commencement of the 4th semester examination. Copies of the project report should be sent to the concerned Regional Office with intimation to the Registrar (Evaluation).
- By keeping the business trend in the present scenario, university has given an option to the students to select the research problem either from business organization or they can carry out the project on freelance basis subject to the approval of department committee.
- It is the total responsibility of the internal guide to monitor the freelance project.
- In case, business problem selected from a Company, no two students of an institute shall work on the same problem in the same organization.
- The student shall seek the guidance of the internal guide on a continuous basis, and the guide shall give a certificate to the effect that the candidate has worked satisfactorily under his/her guidance.
- On completion of the project work, student shall prepare a report with the following format.
- The Project report shall be prepared using word processor viz. MS Word with New Times Roman, 12 font size.
- All the reports shall be printed in the A4 size 1" margin on all the sides.
- The report shall be hard bound facing sheet of royal blue color indicating the title of college and month & year of admission (spiral binding not permitted).
- A certificate by the guide, HOD and Head of the institution indicating the bonafide performance of the project by the student to be enclosed.
- An undertaking by the student to the effect that the work is independently carried out by him/her.
- The certificate from the organization if applicable (if its Freelance project, certificate is not required and Internal guide can issue a certificate for successful completion).
- Acknowledgement
- Executive Summary .

Schedule to be followed before commencement of Project

Activity	Timeline	Remarks
Identifying the organization Problem identification	First week	Student individually identifies an organization OR identifies problem for his/her study, according to his/her interest.
Problem statement Research Design	Second week	His/ Her interests are discussed with project guides. Discussion with Internal Guide to decide on suitable design for the research
Synopsis Preparation	Third week	Preparation of Synopsis* & formulating the objectives
Presentation of Synopsis	Fourth Week	The student will present the synopsis with the detailed execution plan to the Internal Guide and HOD who will review and may: a. Approve b. Approve with modification or c. Reject for fresh synopsis
Approval Status	Fifth & Sixth week	The approval status is submitted to HOD who will officially give concurrence for the execution of the Project

Synopsis: Three page hard copy to be submitted to the HOD with the signatures of the Guide and the student

Page 1	Title, Contact Address of student- with details of Internal and External Guide (if applicable).
Page 2	Short introduction with objectives and summary (300 words). Review of Articles / Literature about the topic with source of information.
Page 3	Time Activity Chart.

Schedule to be followed during Project work

Activity	Time Line	Remarks
Understanding Structure, Culture and functions of the organization /identifying of business problem from the Industry from the literature study	First week of Project	Student should understand products/services and the problems of the organization.
Preparation of Research design and Research instrument for data collection	2nd week of Project	Discussion with the guide for finalization of research design and instrument in his/her domain and present the same to the guide. (First Presentation).
Data collection	3rd week of Project	Date collected to be edited, coded, tabulated and presented to the guide for suggestions for analysis. (Second Presentation).
Analysis and finalization of report	4th & 5th week of project	Students must use appropriate and latest statistical tools and techniques for analyzing the data. (It is must to use of Statistical Package whose result should be shown in the report) (Third Presentation).
Submission of Report	6th week of Project	Final Report should be submitted to the University before one week of the commencement of theory examination.

Project Report Evaluation:

- Internal evaluation will be done by the internal guide.
- External valuation shall be done by a faculty member of other institute drawn from VTU affiliated institute with minimum of 10 years experience.
- Viva-Voce / Presentation: A viva-voce examination shall be conducted at the respective Institution where a student is expected to give a presentation of his/ her work.
- The viva –voce examination will be conducted by the respective HOD / Senior Professor of the department and an expert drawn from the VTU affiliated institutes with minimum of 10 years of experience as appointed by the University.
- Project work carries 100 marks consisting of 40 marks for internal marks by the internal guide, average of 30 marks from both internal and external evaluation and 30 marks for viva-voce examination. Minimum passing marks of the Project work is 50% in each of the components such as Internal Marks, report evaluation and viva-voce examination.
- Format of the project report shall be prepared using the word processor viz., MS Word, Times New Roman font sized 12, on a page layout of A4 size with 1inch margin all sides (1.5inch on left side) and 1.5 line spacing. The Project report shall not exceed 100 pages.
- Submission of Report: Students should submit the Project Report in electronic data form only, in PDF file (Un-editable Format) to the Institute. The Institute in turn shall submit all the CD's of their students along with a consolidated master list as per specialization containing USN, Name of the student, and Title of the Report to Registrar Evaluation) one week before the commencement of the Theory Examinations or as per notification given for this purpose.
- Plagiarism: Plagiarism is considered as academically fraudulent, and an offence against University academic discipline. The University considers plagiarism to be a major offence, and subject to the corrective procedures. It is compulsory for the student to get the plagiarism check done before submission of the project report. Plagiarism of up to 25% is allowed in the project work and report should consist 75% of original content/work.
- Publication of Research Findings: Students are expected to present their research findings in Seminars/ Conferences/ Technical/ Management Fests or publish their research work in Journals in association with their Internal Guide. Appropriate Weightage should be given to this in the internal evaluation as well as in the viva voce examination of the project report.

Contents of the Project Report

- Cover page
- Certificate from the Organization (scanned copy if applicable)
- Certificate from the guide, HOD and Head of the Institution (scanned copy) indicating bonafide performance of Project by the student
- Declaration by the student (scanned copy)
- Acknowledgement
- Table of contents
- List of tables and graphs
- Executive summary

Chapter 1: Introduction

Introduction, Industry profile and company profile: Promoters, vision, Mission & Quality Policy. Products / services profile areas of operation, infrastructure facilities, competitor's information, SWOT Analysis, Future growth and prospects and Financial Statement

Chapter 2: Conceptual background and Literature review

Theoretical background of the study, Literature review with research gap (with minimum 20 literature reviews).

Chapter 3: Research Design

Statement of the problem, Need for the study, Objectives, Scope of the study, Research methodology, Hypotheses, Limitations, Chapter scheme.

Chapter 4: Analysis and Interpretation

Analysis and interpretation of the data- collected with relevant tables and graphs. Results obtained by the using statistical tools must be included.

Chapter 5: Findings, Conclusion and Suggestions

Summary of findings, Conclusion and Suggestions / Recommendations

Bibliography: Books, Articles names, etc. to be mentioned as per APA style.

Annexures: Relevant to the project such as figures, graphs, photographs etc.,

Rubrics for Project Work (Common to core and Dual Specializations)

Sl.No	Particulars	Marks Allotted
1	Internal Assessment by the Guide- Based on three Presentations by Students	**40**
2	Report Evaluation by the Guide & External Examiner Average of the marks awarded by the two Examiners shall be the final evaluation marks for the Dissertation.	**30**
3	Viva-Voce Examination to be conducted by the Guide and an External examiner from the Industry/ Institute (Joint Evaluation)	**30**
Total		**100**

Rubrics for Project Evaluation and Viva voce Examination

A. Internal Assessment by the Guide- Based on three Presentations by Students

SL No	Aspects	Marks Allotted
1	First Presentation	5
2	Second Presentation	5
3	Third Presentation	5
4	Introduction and Methodology	5
5	Industry and Company Profile	5
6	Theoretical background of study	5
7	Data analysis and interpretation	5
8	Summary of findings, suggestions and conclusion	5
	Total	40

B. Report Evaluation by the Guide & External Examiner. Average of the marks awarded by the two Examiners shall be the final evaluation marks for the Dissertation.

SL No	Aspects	Marks Allotted
1	Introduction & Relevance of the project	5
2	Conceptual background and literature review	5
3	Research design	5
4	Analysis and interpretation	10
5	Summary of findings, suggestions and conclusion	5
	Total	**30**

C. Viva-Voce Examination to be conducted by the HOD/ Guide and an External examiner from the Industry/ Institute (Joint Evaluation)

SL No	Aspects	Marks Allotted
1	Presentation skills	5
2	Communication skills	5
3	Subject knowledge	5
4	Objectives of the study and Methodology	5
5	Analysis using statistical tools and statistical packages	5
6	Findings and appropriate suggestions	5
	Total	**30**

Formats for Project Report and Evaluation

- Format of Cover Page
- Format of certificate by Company/Institution or from both
- Format of Declaration Page
- Format of Contents
- Format of List of Tables and Charts
- Format of Bibliography
- Format for Internal Evaluation, External Evaluation and Viva voce

(Title of the Report)

Submitted by

(Student Name)
(USN)

Submitted to
VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELGAVI
In partial fulfillment of the requirements for the award of the degree of

MASTER OF BUSINESS ADMINISTRATION

Under the guidance of

INTERNAL GUIDE	**EXTERNAL GUIDE**
(Name & Designation)	**(Name & Designation)**

(Institute Logo)

Department of MBA
(Institute Name with Address)
(Month & Year of submission)

CERTIFICATE

This is to certify that (Name of the Student) bearing USN (xxxx), is a bonafide student of Master of Business Administration course of the Institute (Batch), affiliated to Visvesvaraya Technological University, Belgaum. Project report on "(Title of Report)"is prepared by Him/her under the guidance of (Name of the Guide), in partial fulfillment of the requirements for the award of the degree of Master of Business Administration of Visvesvaraya Technological University, Belagavi Karnataka.

Signature of Internal Guide **Signature of HOD** **Signature of Principal**

DECLARATION

I, (Student Name), hereby declare that the Project report entitled "(Title)" with reference to ―(Organization with place) prepared by me under the guidance of (Guide Name), faculty of M.B.A Department, (Institute name) and external assistance by (External Guide Name, Designation and Organization). I also declare that this Project work is towards the partial fulfillment of the university Regulations for the award of degree of Master of Business Administration by Visvesvaraya Technological University, Belgaum. I have undergone a summer project for a period of Twelve weeks. I further declare that this Project is based on the original study undertaken by me and has not been submitted for the award of any degree/diploma from any other University / Institution.

Place: **Signature of the Student**

Date:

Table of Contents

List of Tables

List of Figures/ Charts/ Graphs

Sl.No	Particulars	Page No's.
1	Graph showing ABC Analysis	XXXXX
2	Graph showing FSN Analysis	XXXXX
3	Graph showing EOQ	XXXXX
4	Graph showing stock of Raw materials	XXXXX

BIBLIOGRAPHY

BOOKS:
Name of the Author, Title of the Book, Name of the Publisher, Edition, year of Publication.
ARTICLES:
Name of the Author, Title of the article, Name of the Journal, Volume/Issue Number, Year, Page Number (pp).
WEBLIOGRAPHY
Name of the Author, Title of the article. Retrieved on dd/mm/yyyy from URL.

MARKS SHEET FORMATS

1. Internal Assessment by the Guide- Based on three Presentations by Students

Visvesvaraya Technological University
Marks Sheet for MBA Project Work (20MBAPR407)

Name of the College: **College Code:**
Internal Marks Allocation for Project Work (20MBAPR407)

SL No	Aspects	Marks Allotted
1	First Presentation	5
2	Second Presentation	5
3	Third Presentation	5
4	Introduction and Methodology	5
5	Industry and Company Profile	5
6	Theoretical background of study	5
7	Data analysis and interpretation	5
8	Summary of findings, suggestions and conclusion	5
	Total	**40**

Marks Sheet

Sl. No	USN	1	2	3	4	5	6	7	8	Total
1										
2										
3										
4										
5										

Signature of the Internal Guide with Name, Address & Date

Note:

1. Total Internal Evaluation Marks of the Project report should be sent along with the other subject internal marks and the above marks sheet should be maintained by the Department/Institution for verification on demand.
2. Total Internal Evaluation Marks of the Project report should be uploaded to VTU by the Internal guide after thorough evaluation of the project report and the copy of the mark sheet downloaded after the entry must be maintained in the department as well as sent to VTU along with the remuneration bill.

2. Report Evaluation by the Guide & External Examiner. Average of the marks awarded by the two Examiners shall be the final evaluation marks for the Dissertation.

Visvesvaraya Technological University
Marks Sheet for MBA Project Work (20MBAPR407)

Name of the College: **College Code:**
External Evaluation Marks Allocation for Project Work (20MBAPR407)

SL No	Aspects	Marks Allotted
1	Introduction & Relevance of the project	5
2	Conceptual background and literature review	5
3	Research design	5
4	Analysis and interpretation	10
5	Summary of findings, suggestions and conclusion	5
	Total	**30**

Marks Sheet

Sl. No	USN	1	2	3	4	5	Total
1							
2							
3							
4							
5							

Signature of External Examiner with affiliation

Note:
1. Total External Evaluation Marks of the Project report should be uploaded to VTU by the External examiner appointed by VTU after thorough evaluation of the project report and the copy of the mark sheet downloaded after the entry must be sent to VTU along with the remuneration bill.
3. Viva-Voce Examination to be conducted by the HOD/ Guide and an External examiner from the Industry/ Institute (Joint Evaluation)

Visvesvaraya Technological University
Marks Sheet for MBA Project Work (20MBAPR407)

Name of the College: **College Code:**
Viva voce Marks Allocation for Project Work (20MBAPR407)

(Viva voce conducted by HOD/Internal Guide and an Expert from VTU.)

SL No	Aspects	Marks Allotted
1	Presentation skills	5
2	Communication skills	5
3	Subject knowledge	5
4	Objectives of the study and Methodology	5
5	Analysis using statistical tools and statistical packages	5
6	Findings and appropriate suggestions	5
	Total	**30**

Marks Sheet

Sl. No	USN	1	2	3	4	5	6	Total
1								
2								
3								
4								
5								

Signature of Internal Exam **Signature of External Examiner with affiliation**

Note: Marks may be finalized based on the joint evaluation by internal examiner and External examiner.

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI

B.E. in Electronics and Communication Engineering (ECE)

Scheme of Teaching and Examinations 2021

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

(Effective from the academic year 2021 - 22)

III SEMESTER

Sl. No	Course and Course Code	Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
				Theory Lecture	Tutorial	Practical/ Drawing	Self -Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	T	P	S					
1	BSC 21MAT31	Mathematics Course (Common to all)	TD- Maths PSB-Maths					03	50	50	100	3
2	IPCC 21EC32	Digital System Design using Verilog	TD: ECE PSB: ECE	3	0	2		03	50	50	100	4
3	IPCC 21EC33	Basic Signal Processing	TD: ECE PSB: ECE	3	0	2		03	50	50	100	4
4	PCC 21EC34	Analog Electronic Circuits	TD: ECE PSB: ECE	3	0	0	1	03	50	50	100	3
5	PCC 21ECL35	Analog and Digital Electronics Lab	TD: ECE PSB: ECE	0	0	2		03	50	50	100	1
6	UHV 21UH36	Social Connect and Responsibility	Any Department	0	0	1		01	50	50	100	1
7	HSMC 21KSK37/47	Samskrutika Kannada	TD and PSB HSMC	1	0	0		01	50	50	100	1
	HSMC 21KBK37/47	Balake Kannada										
	OR											
	HSMC 21CIP37/47	Constitution of India and Professional Ethics										
8	AEC 21EC38X	Ability Enhancement Course - III	TD: Concerned department PSB: Concerned Board	If offered as Theory Course				01	50	50	100	1
				1	0	0						
				If offered as lab. course				02				
				0	0	2						
								Total	**400**	**400**	**800**	**18**

9	**Scheduled activities for III to VIII semesters**	NMDC 21NS83	National Service Scheme (NSS)	NSS	All students have to register for any one of the course namely National Service Scheme, Physical Education (PE)(Sports and Athletics) and Yoga with the concerned coordinator of the course during the first week of III semester. The activities shall be carried out between III semester to VIII semester (for 5 semesters). SEE in the above courses shall be conducted during VIII semester examinations and the accumulated CIE marks shall be added to the SEE marks. Successful completion of the registered course is mandatory for the award of the degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the calendar prepared for the NSS, PE and Yoga activities.
		NMDC 21PE83	Physical Education (PE)(Sports and Athletics)	PE	
		NMDC 21YO83	Yoga	Yoga	

Course prescribed to lateral entry Diploma holders admitted to III semester B.E./B.Tech programs

1	NCMC 21MATDIP31	Additional Mathematics - I	Maths	02	02	--	--	---	100	---	100	0

Note: BSC: Basic Science Course, **IPCC:** Integrated Professional Core Course, **PCC:** Professional Core Course, **INT** –Internship, **HSMC:** Humanity and Social Science & Management Courses, **AEC**–Ability Enhancement Courses. **UHV:** Universal Human Value Course.
L –Lecture, **T –** Tutorial, P- Practical/ Drawing, **S –** Self Study Component, **CIE:** Continuous Internal Evaluation, **SEE:** Semester End Examination.**TD-**Teaching Department, **PSB**: Paper Setting department

21KSK37/47 Samskrutika Kannada is for students who speak, read and write Kannada and **21KBK37/47** Balake Kannada is for non-Kannada speaking, reading, and writing students.

Integrated Professional Core Course (IPCC): Refers to Professional Theory Core Course Integrated with practical of the same course. Credit for IPCC can be 04 and its Teaching–Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper. For more details, the regulation governing the Degree of Bachelor of Engineering /Technology (B.E./B.Tech.) 2021-22 may be referred.

21INT49Inter/Intra Institutional Internship: All the students admitted to engineering programs under the lateral entry category shall have to undergo a mandatory 21INT49 Inter/Intra Institutional Internship of 03 weeks during the intervening period of III and IV semesters. The internship shall be slated for CIE only and will not have SEE. The letter grade earned through CIE shall be included in the IV semester grade card. The internship shall be considered as a head of passing and shall be considered for vertical progression and for the award of degree. Those, who do not take up / complete the internship shall be declared fail and shall have to complete during subsequently after satisfying the internship requirements. The faculty coordinator or mentor shall monitor the students' internship progress and interact with them for the successful completion of the internship.

Non–credit mandatory courses (NCMC):

(A) Additional Mathematics I and II:

(1) These courses are prescribed for III and IV semesters respectively to lateral entry Diploma holders admitted to III semester of B.E./B.Tech., programs. They shall attend the classes during the respective semesters to complete all the formalities of the course and appear for the Continuous Internal Evaluation (CIE). In case, any student fails to register for the said course/fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have secured an F grade. In such a case, the student has to fulfill the course requirements during subsequent semester/s to earn the qualifying CIE marks. These courses are slated for CIE only and have no SEE.

(2) Additional Mathematics I and II shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses shall be mandatory for the award of degree.

(3) Successful completion of the courses Additional Mathematics I and II shall be indicated as satisfactory in the grade card. Non-completion of the courses Additional Mathematics I and II shall be indicated as Unsatisfactory.

(B) National Service Scheme/Physical Education (Sport and Athletics)/ Yoga:

(1) Securing 40 % or more in CIE,35 % or more marks in SEE and 40 % or more in the sum total of CIE + SEE leads to successful completion of the registered course.

(2) In case, students fail to secure 35 % marks in SEE, they have to appear for SEE during the subsequent examinations conducted by the University.

(3) In case, any student fails to register for NSS, PE or Yoga/fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have not completed the requirements of the course. In such a case, the student has to fulfill the course requirements during subsequent semester/s to earn the qualifying CIE marks.

(4) Successful completion of the course shall be indicated as satisfactory in the grade card. Non-completion of the course shall be indicated as Unsatisfactory.

(5) These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses shall be mandatory for the award of degree.

Ability Enhancement Course - III			
21EC381	LD (Logic Design) Lab using Pspice / MultiSIM	21EC383	LIC (Linear Integrated Circuits) Lab using Pspice / MultiSIM
21EC382	AEC (Analog Electronic Circuits) Lab	21EC384	LabVIEW Programming Basics

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI

B.E. in Electronics and Communication Engineering (ECE)

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Outcome-Based Education (OBE) and Choice Based Credit System (CBCS)

(Effective from the academic year 2021 - 22)

IV SEMESTER

Sl. No	Course and Course Code	Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
				Theory Lecture	Tutorial	Practical/ Drawing	Self -Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	T	P	S					
1	BSC **21EC41**	Maths for Communication Engineers	TD, PSB-Maths					03	50	50	100	3
2	IPCC 21EC42	Digital Signal Processing	TD: ECE PSB: ECE	3	0	2		03	50	50	100	4
3	IPCC 21EC43	Circuits & Controls	TD: ECE PSB: ECE	3	0	2		03	50	50	100	4
4	PCC 21EC44	Communication Theory	TD: ECE PSB: ECE	3	0	0	1	03	50	50	100	3
5	AEC 21BE45	Biology For Engineers	BT, CHE, PHY	2	0	0		02	50	50	100	2
6	PCC 21ECL46	Communication Laboratory I	TD: ECE PSB: ECE	0	0	2		03	50	50	100	1
7	HSMC 21KSK37/47	Samskrutika Kannada	HSMC	1	0	0		01	50	50	100	1
	HSMC 21KBK37/47	Balake Kannada										
	OR											
	HSMC 21CIP37/47	Constitution of India & Professional Ethics										
8	AEC 21EC48X	Ability Enhancement Course- IV	TD and PSB: Concerned department	If offered as theory Course: 1	0	0		01	50	50	100	1
				If offered as lab. course: 0	0	2		02				
9	UHV 21UH49	Universal Human Values	Any Department	1	0	0		01	50	50	100	1
10	INT 21INT49	Inter/Intra Institutional Internship	Evaluation By the appropriate authorities	Completed during the intervening period ofII and III semesters by students admitted to first year of BE./B.Tech and during the intervening period of III and IV semesters by Lateral entry students admitted to III semester.				3	100	--	100	2
								Total	**550**	**450**	**1000**	**22**

Course prescribed to lateral entry Diploma holders admitted to III semester of Engineering programs

1	NCMC 21MATDIP41	Additional Mathematics - II	Maths	02	02	--	--	--	100	--	100	0

Note: BSC: Basic Science Course, IPCC: Integrated Professional Core Course, PCC: Professional Core Course, AEC –Ability Enhancement Courses, HSMC: Humanity and Social Science and Management Courses, UHV- Universal Human Value Courses.
L –Lecture, T – Tutorial, P- Practical/ Drawing, S – Self Study Component, CIE: Continuous Internal Evaluation, SEE: Semester End Examination.

21KSK37/47 Samskrutika Kannada is for students who speak, read and write Kannada and 21KBK37/47 Balake Kannada is for non-Kannada speaking, reading, and writing students.

Integrated Professional Core Course (IPCC): Refers to Professional Theory Core Course Integrated with Practicals of the same course. Credit for IPCC can be 04 and its Teaching – Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from practical part of IPCCshall be included in the SEE question paper.For more details the regulation governing the Degree of Bachelor of Engineering /Technology (BE/B.Tech.) 2021-22 may be referred.

Non – credit mandatory course (NCMC):

Additional Mathematics - II:

(1) Lateral entry Diploma holders admitted to III semester of B.E./B.Tech., shall attend the classes during the IV semester to complete all the

formalities of the course and appear for the Continuous Internal Evaluation (CIE). In case, any student fails to register for the said course/fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have secured an F grade. In such a case, the student has to fulfill the course requirements during subsequent semester/s to earn the qualifying CIE marks. These courses are slated for CIE only and have no SEE.

(2) Additional Mathematics I and II shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses shall be mandatory for the award of degree.

(3) Successful completion of the course Additional Mathematics II shall be indicated as satisfactory in the grade card. Non-completion of the courses Additional Mathematics II shall be indicated as Unsatisfactory.

Ability Enhancement Course - IV

21EC481	Embedded C Basics	21EC483	Octave / Scilab for Signals
21EC482	C++ Basics	21EC484	DAQ using LabVIEW

Internship of 04 weeks during the intervening period of IV and V semesters; 21INT68Innovation/ Entrepreneurship/ Societal based Internship.

(1) All the students shall have to undergo a mandatory internship of 04 weeks during the intervening period of IV and V semesters. The internship shall be slated for CIE only and will not have SEE. The letter grade earned through CIE shall be included in the VI semester grade card.The internship shall be considered as a head of passing and shall be considered for vertical progression and for the award of degree. Those, who do not take up / complete the internship shall be considered under F (fail) grade and shall have to complete during subsequently after satisfying the internship requirements.

(2) Innovation/ Entrepreneurship Internship shall be carried out at industry, State and Central Government /Non-government organizations (NGOs), micro, small and medium enterprise (MSME), Innovation centres or Incubation centres. Innovation need not be a single major breakthrough; it can also be a series of small or incremental changes. Innovation of any kind can also happen outside of the business world.

Entrepreneurship internships offers a chance to gain hands on experience in the world of entrepreneurship and helps to learn what it takes to run a small entrepreneurial business by performing intern duties with an established company. This experience can then be applied to future business endeavours. Start-ups and small companies are a preferred place to learn the business tack ticks for future entrepreneurs as learning how a small business operates will serve the intern well when he/she manages his/her own company. Entrepreneurship acts as a catalyst to open the minds to creativity and innovation. Entrepreneurship internship can be from several sectors, including technology, small and medium-sized, and the service sector.

(3) Societal or social internship.

Urbanization is increasing on a global scale; and yet, half the world's population still resides in rural areas and is devoid of many things that urban population enjoy. Rural internship is a work-based activity in which students will have a chance to solve/reduce the problems of the rural place for better living.

As proposed under the AICTE rural internship programme, activities under Societal or social internship, particularly in rural areas, shall be considered for 40 points under AICTE activity point programme.

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V SEMESTER

Sl. No	Course and Course Code	Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
				Theory Lecture	Tutorial	Practical/ Drawing	Self-Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	T	P	S					
1	BSC 21EC51	Digital Communication	TD: ECE PSB: ECE	3	0	0	1	03	50	50	100	3
2	IPCC 21EC52	Object Oriented Programming with Java & Data Structures	TD: ECE, CSE PSB: ECE	3	0	2		03	50	50	100	4
3	PCC 21EC53	Computer Communication Networks	TD: ECE PSB: ECE	3	0	0	1	03	50	50	100	3
4	PCC 21EC54	Microwave Theory & Antennas	TD: ECE PSB: ECE	3	0	0		03	50	50	100	3
5	PCC 21ECL55	Communication Lab II		0	0	2		03	50	50	100	1
6	AEC 21EC56	Research Methodology & Intellectual Property Rights	TD: Any Department PSB: As identified by University	2	0	0		02	50	50	100	2
7	HSMC 21CIV57	Environmental Studies	TD: Civil/ Environmental /Chemistry/ Biotech. PSB: Civil Engg	1	0	0		1	50	50	100	1
8	AEC 21EC58X	Ability Enhancement Course-V	Concerned Board	If offered as Theory courses: 1	0	0		01	50	50	100	1
				If offered as lab. courses: 0	0	2		02				
								Total	**400**	**400**	**800**	**18**

Ability Enhancement Course - V

21EC581	IoT (Internet of Things) Lab	21EC583	Antenna Design & Testing
21EC582	Communication Simulink Toolbox	21EC584	Microwaves toolbox

Note: BSC: Basic Science Course, PCC: Professional Core Course, IPCC: Integrated Professional Core Course, AEC –Ability Enhancement Course INT – Internship, HSMC: Humanity and Social Science & Management Courses.
L –Lecture, T – Tutorial, P- Practical/ Drawing, S – Self Study Component, CIE: Continuous Internal Evaluation, SEE: Semester End Examination.

Integrated Professional Core Course (IPCC): refers to Professional Theory Core Course Integrated with Practical of the same course. Credit for IPCC can be 04 and its Teaching – Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). Theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by CIE only and there shall be no SEE. For more details the regulation governing the Degree of Bachelor of Engineering /Technology (BE/B.Tech.) 2021-22 may be referred.

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VI SEMESTER

Sl. No	Course and Course Code	Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
				Theory Lecture	Tutorial	Practical/ Drawing	Self -Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	T	P	S					
1	HSMC 21EC61	Technological Innovation Management and Entrepreneurship	Any Department	3	0	0	0	03	50	50	100	3
2	IPCC 21EC62	Computer Organization & ARM Microcontrollers	TD: ECE PSB: ECE	3	0	2		03	50	50	100	4
3	PCC 21EC63	VLSI Design & Testing	TD: ECE PSB: ECE	3	0	0		03	50	50	100	3
4	PEC 21EC64x	Professional Elective Course-I	TD: ECE PSB: ECE					03	50	50	100	3
5	OEC 21EC65x	Open Elective Course-I	Concerned Department					03	50	50	100	3
6	PCC 21ECL66	VLSI Laboratory		0	0	2		03	50	50	100	1
7	MP 21ECMP67	Mini Project		Two contact hours /week for interaction between the faculty and students.				--	100	--	100	2
8	INT 21INT68	Innovation/Entrepreneurship /Societal Internship	Completed during the intervening period of IV and V semesters.					--	100	--	100	3
								Total	**500**	**300**	**800**	**22**

Professional Elective – I

21EC641	Artificial Neural Networks (L:T:P :: 2:2:0)	21EC643	Python Programming (L:T:P :: 2:0:2)
21EC642	Cryptography (L:T:P :: 2:2:0)	21EC644	Micro Electro Mechanical Systems (L:T:P :: 3:0:0)

Open Electives – I offered by the Department to other Department students

21EC651	Communication Engineering (L:T:P :: 3:0:0)	21EC653	Basic VLSI Design (L:T:P :: 3:0:0)
21EC652	Microcontrollers (L:T:P :: 3:0:0)	21EC654	Electronic Circuits with Verilog (L:T:P :: 2:0:2)
21EC655	Sensors & Actuators (L:T:P :: 3:0:0)		

Note: HSMC: Humanity and Social Science & Management Courses, **IPCC:** Integrated Professional Core Course, **PCC:** Professional Core Course, **PEC:** Professional Elective Courses, O**EC**–Open Elective Course, **MP** –Mini Project, INT –Internship.
L –Lecture, **T** – Tutorial, **P** - Practical / Drawing, **S** – Self Study Component, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Examination.

Integrated Professional Core Course (IPCC): Refers to Professional Theory Core Course Integrated with Practical of the same course. Credit for IPCC can be 04 and its Teaching – Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by CIE only and there shall be no SEE. For more details, the regulation governing the Degree of Bachelor of Engineering /Technology (BE/B.Tech) 2021-22 may be referred.

Professional Elective Courses(PEC):
A professional elective (PEC) course is intended to enhance the depth and breadth of educational experience in the Engineering and Technology curriculum. Multidisciplinary courses that are added supplement the latest trend and advanced technology in the selected stream of engineering. Each group will provide an option to select one course out of five courses. The minimum students' strength for offering professional electives is 10. However, this conditional shall not be applicable to cases where the admission to the programme is less than 10.

Open Elective Courses:
Students belonging to a particular stream of Engineering and Technology are not entitled for the open electives offered by their parent Department. However, they can opt an elective offered by other Departments, provided they satisfy the prerequisite condition if any. Registration to open electives shall be documented under the guidance of the Program Coordinator/ Advisor/Mentor.
Selection of an open elective shall **not be allowed** if,

(i) The candidate has studied the same course during the previous semesters of the program.
(ii) The syllabus content of open electives is similar to that of the Departmental core courses or professional electives.
(iii) A similar course, under any category, is prescribed in the higher semesters of the program.

In case, any college is desirous of offering a course (not included in the Open Elective List of the University) from streams such as Law, Business

(MBA), Medicine, Arts, Commerce, etc., can seek permission, at least one month before the commencement of the semester, from the University by submitting a copy of the syllabus along with the details of expertise available to teach the same in the college.
The minimum students' strength for offering open electives is 10. However, this conditional shall not be applicable to cases where the admission to the programme is less than 10.

Mini-project work: Mini Project is a laboratory-oriented course which will provide a platform to students to enhance their practical knowledge and skills by the development of small systems/applications.
Based on the ability/abilities of the student/s and recommendations of the mentor, a single discipline or a multidisciplinary Mini- project can be assigned to an individual student or to a group having not more than 4 students.
CIE procedure for Mini-project:
(i) Single discipline: The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two faculty members of the Department, one of them being the Guide. The CIE marks awarded for the Mini-project work shall be based on the evaluation of project report, project presentation skill, and question and answer session in the ratio of 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.
(ii) Interdisciplinary: Continuous Internal Evaluation shall be group-wise at the college level with the participation of all the guides of the project.
The CIE marks awarded for the Mini-project, shall be based on the evaluation of project report, project presentation skill, and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.
No SEE component for Mini-Project.

VII semester Class work and Research Internship /Industry Internship (21INT82)

Swapping Facility
Institutions can swap VII and VIII Semester Scheme of Teaching and Examinations to accommodate research internship/ industry internship after the VI semester**.**
(2) Credits earned for the courses of VII and VIII Semester Scheme of Teaching and Examinations shall be counted against the corresponding semesters whether VII or VIII semester is completed during the beginning of IV year or later part of IV year of the program.
Elucidation:
At the beginning of IV year of the programme i.e., after VI semester, VII semester classwork and VIII semester Research Internship /Industrial Internship shall be permitted to be operated simultaneously by the University so that students have ample opportunity for internship. In other words, a good percentage of the class shall attend VII semester classwork and similar percentage of others shall attend to Research Internship or Industrial Internship.
Research/Industrial Internship shall be carried out at an Industry, NGO, MSME, Innovation centre, Incubation centre, Start-up, Centers of Excellence (CoE), Study Centre established in the parent institute and /or at reputed research organizations / institutes. The intership can also be rural internship.
The mandatory Research internship /Industry internship is for 24 weeks. The internship shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not take up/complete the internship shall be declared fail and shall have to complete during the subsequent University examination after satisfying the internship requirements.

INT21INT82Research Internship/ Industry Internship/Rural Internship
Research internship: A research internship is intended to offer the flavour of current research going on in the research field. It helps students get familiarized with the field and imparts the skill required for carrying out research.
Industry internship: Is an extended period of work experience undertaken by students to supplement their degree for professional development. It also helps them learn to overcome unexpected obstacles and successfully navigate organizations, perspectives, and cultures. Dealing with contingencies helps students recognize, appreciate, and adapt to organizational realities by tempering their knowledge with practical constraints.

The faculty coordinator or mentor has to monitor the students' internship progress and interact with them to guide for the successful completion of the internship.
The students are permitted to carry out the internship anywhere in India or abroad. University shall not bear any expenses incurred in respect of internship.

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Swappable VII and VIII SEMESTER

VII SEMESTER

Sl. No	Course and Course Code	Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
				Theory Lecture	Tutorial	Practical/ Drawing	Self -Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	T	P	S					
1	PCC 21EC71	Advanced VLSI	TD: ECE PSB: ECE	3	0	0		3	50	50	100	3
2	PCC 21EC72	Optical & Wireless Communication	TD: ECE PSB: ECE	2	0	0		3	50	50	100	2
3	PEC 21EC72X	Professional elective Course-II	TD: ECE PSB: ECE					3	50	50	100	3
4	PEC 21EC73X	Professional elective Course-III	TD: ECE PSB: ECE					3	50	50	100	3
5	OEC 21EC74X	Open elective Course-II	Concerned Department					3	50	50	100	3
6	Project 21ECP75	Project work		Two contact hours /week for interaction between the faculty and students.				3	100	100	200	10
								Total	**350**	**350**	**700**	**24**

VIII SEMESTER

Sl. No	Course and Course Code		Course Title	Teaching Department	Teaching Hours /Week				Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Self -Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	Seminar 21EC81		Technical Seminar		One contact hour /week for interaction between the faculty and students.				--	100	--	100	01
2	INT 21INT82		Research Internship/ Industry Internship		Two contact hours /week for interaction between the faculty and students.				03 (Batch wise)	100	100	200	15
3	NCMC	21NS83	National Service Scheme (NSS)	NSS	Completed during the intervening period of III semester to VIII semester.				--	50	50	100	0
		21PE83	Physical Education (PE) (Sports and Athletics)	PE									
		21YO83	Yoga	Yoga									
									Total	**250**	**150**	**400**	**16**

Professional Elective - II

21EC721	Advanced Design Tools for VLSI (L:T:P :: 2:0:2)	21EC724	Biomedical Signal Processing (L:T:P :: 3:0:0)
21EC722	Digital Image Processing (L:T:P :: 2:0:2)	21EC725	Speech Signal Processing (L:T:P :: 3:0:0)
21EC723	DSP Algorithms & Architecture (L:T:P :: 3:0:0)		

Professional Elective - III

21EC731	IoT & Wireless Sensor Networks (L:T:P :: 3:0:0)	21EC734	Machine Learning with Python (L:T:P :: 2:0:2)
21EC732	Network Security (L:T:P :: 3:0:0)	21EC735	Multimedia Communication (L:T:P :: 2:0:2)
21EC733	Fabrication technology (L:T:P :: 3:0:0)		

Open Electives - II offered by the Department to other Department students			
21EC741	Optical & Satellite Communication (L:T:P :: 3:0:0)	21EC744	Basic Digital Signal Processing (L:T:P :: 2:0:2)
21EC742	ARM Embedded Systems (L:T:P :: 3:0:0)	21EC745	E-waste Management (L:T:P :: 3:0:0)
21EC743	Basic Digital Image Processing (L:T:P :: 2:0:2)		

Note: PCC: Professional Core Course, **PEC:** Professional Elective Courses, **OEC**–Open Elective Course, **AEC** –Ability Enhancement Courses.
L –Lecture, T – Tutorial, P- Practical / Drawing, S – Self Study Component, CIE: Continuous Internal Evaluation, SEE: Semester End Examination.

Note: VII and VIII semesters of IV year of the programme

(1) Institutions can swap VII and VIII Semester Scheme of Teaching and Examinations to accommodate research internship/ industry internship after the VI semester**.**

(2) Credits earned for the courses of VII and VIII Semester Scheme of Teaching and Examinations shall be counted against the corresponding semesters whether VII or VIII semester is completed during the beginning of IV year or later part of IV year of the programme.

PROJECT WORK (21XXP75): The objective of the Project work is

(i) To encourage independent learning and the innovative attitude of the students.
(ii) To develop interactive attitude, communication skills, organization, time management, and presentation skills.
(iii) To impart flexibility and adaptability.
(iv) To inspire team working.
(v) To expand intellectual capacity, credibility, judgment and intuition.
(vi) To adhere to punctuality, setting and meeting deadlines.
(vii) To install responsibilities to oneself and others.
(viii) To train students to present the topic of project work in a seminar without any fear, face the audience confidently, enhance communication skills, involve in group discussion to present and exchange ideas.

CIE procedure for Project Work:

(1) Single discipline: The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide.

The CIE marks awarded for the project work, shall be based on the evaluation of project work Report, project presentation skill, and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

(2) Interdisciplinary: Continuous Internal Evaluation shall be group-wise at the college level with the participation of all guides of the college. Participation of external guide/s, if any, is desirable. The CIE marks awarded for the project work, shall be based on the evaluation of project work Report, project presentation skill, and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

SEE procedure for Project Work: SEE for project work will be conducted by the two examiners appointed by the University. The SEE marks awarded for the project work shall be based on the evaluation of project work Report, project presentation skill, and question and answer session in the ratio 50:25:25.

TECHNICAL SEMINAR (21XXS81): The objective of the seminar is to inculcate self-learning, present the seminar topic confidently, enhance communication skill, involve in group discussion for exchange of ideas. Each student, under the guidance of a Faculty, shall choose, preferably, a recent topic of his/her interest relevant to the programme of Specialization.

(i) Carry out literature survey, systematically organize the content.
(ii) Prepare the report with own sentences, avoiding a cut and paste act.
(iii) Type the matter to acquaint with the use of Micro-soft equation and drawing tools or any such facilities.
(iv) Present the seminar topic orally and/or through PowerPoint slides.
(v) Answer the queries and involve in debate/discussion.
(**vi)** Submit a typed report with a list of references.

The participants shall take part in the discussion to foster a friendly and stimulating environment in which the students are motivated to reach high standards and become self-confident.

Evaluation Procedure:

The CIE marks for the seminar shall be awarded (based on the relevance of the topic, presentation skill, participation in the question and answer session, and quality of report) by the committee constituted for the purpose by the Head of the Department. The committee shall consist of three teachers from the department with the senior-most acting as the Chairman.

Marks distribution for CIE of the course:

Seminar Report:50 marks
Presentation skill:25 marks
Question and Answer: 25 marks. ■No SEE component for Technical Seminar

Non – credit mandatory courses (NCMC):

National Service Scheme/Physical Education (Sport and Athletics)/ Yoga:

(1) Securing 40 % or more in CIE,35 % or more marks in SEE and 40 % or more in the sum total of CIE + SEE leads to successful completion of the registered course.

(2) In case, students fail to secure 35 % marks in SEE, they has to appear for SEE during the subsequent examinations conducted by the University.

(3) In case, any student fails to register for NSS, PE or Yoga/fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have not completed the requirements of the course. In such a case, the student has to fulfill the course requirements during subsequently to earn the qualifying CIE marks subject to the maximum programme period.

(4) Successful completion of the course shall be indicated as satisfactory in the grade card. Non-completion of the course shall be indicated as Unsatisfactory.

(5) These course shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses shall be mandatory for the award of degree.

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III Semester

Digital System Design Using Verilog			
Course Code	**21EC32**	CIE Marks	50
Teaching Hours/Week (L: T: P: S)	(3:0:2:0)	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 13 Lab slots	Total Marks	100
Credits	04	Exam Hours	03

Course objectives: This course will enable students to:

1. To impart the concepts of simplifying Boolean expression using K-map techniques and Quine-McCluskey minimization techniques.
2. To impart the concepts of designing and analyzing combinational logic circuits.
3. To impart design methods and analysis of sequential logic circuits.
4. To impart the concepts of Verilog HDL-data flow and behavioral models for the design of digital systems.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

- Lecture method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
- Show Video/animation films to explain the different concepts of Linear Algebra & Signal Processing.
- Encourage collaborative (Group) Learning in the class .
- Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking.
- Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
- Topics will be introduced in a multiple representation.
- Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
- Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.
- Adopt Flipped class technique by sharing the materials / Sample Videos prior to the class and have discussions on the that topic in the succeeding classes.
- Give Programming Assignments.

Module-1

Principles of Combinational Logic: Definition of combinational logic, Canonical forms, Generation of switching equations from truth tables, Karnaugh maps- up to 4 variables, Quine-McCluskey Minimization Technique. Quine-McCluskey using Don't Care Terms. (Section 3.1 to 3.5 of Text 1).

Teaching-Learning Process	Chalk and Talk, YouTube videos **RBT Level:** L1, L2, L3

Module-2

Logic Design with MSI Components and Programmable Logic Devices: Binary Adders and Subtractors, Comparators, Decoders, Encoders, Multiplexers, Programmable Logic Devices (PLDs)
(Section 5.1 to 5.7 of Text 2)

Teaching-Learning Process	Chalk and Talk, YouTube videos **RBT Level:** L1, L2, L3

Module-3	
Flip-Flops and its Applications: The Master-Slave Flip-flops (Pulse-Triggered flip-flops): SR flip-flops, JK flip flops, Characteristic equations, Registers, Binary Ripple Counters, Synchronous Binary Counters, Counters based on Shift Registers, Design of Synchronous mod-n Counter using clocked T, JK, D and SR flip-flops. (Section 6.4, 6.6 to 6.9 (Excluding 6.9.3) of Text 2)	
Teaching-Learning Process	Chalk and Talk, YouTube videos **RBT Level:** L1, L2, L3
Module-4	
Introduction to Verilog: Structure of Verilog module, Operators, Data Types, Styles of Description. (Section 1.1 to 1.6.2, 1.6.4 (only Verilog), 2 of Text 3) **Verilog Data flow description:** Highlights of Data flow description, Structure of Data flow description. (Section 2.1 to 2.2 (only Verilog) of Text 3)	
Teaching-Learning Process	Chalk and Talk, YouTube videos, Programming assignments **RBT Level:** L1, L2, L3
Module-5	
Verilog Behavioral description: Structure, Variable Assignment Statement, Sequential Statements, Loop Statements, Verilog Behavioral Description of Multiplexers (2:1, 4:1, 8:1). (Section 3.1 to 3.4 (only Verilog) of Text 3) **Verilog Structural description**: Highlights of Structural description, Organization of structural description, Structural description of ripple carry adder. (Section 4.1 to 4.2 of Text 3)	
Teaching-Learning Process	Chalk and Talk, YouTube videos, Programming assignments **RBT Level:** L1, L2, L3

PRACTICAL COMPONENT OF IPCC

Using suitable simulation software, demonstrate the operation of the following circuits:

Sl.No	Experiments
1	To simplify the given Boolean expressions and realize using Verilog program.
2	To realize Adder/Subtractor (Full/half) circuits using Verilog data flow description.
3	To realize 4-bit ALU using Verilog program.
4	To realize the following Code converters using Verilog Behavioral description a) Gray to binary and vice versa b) Binary to excess3 and vice versa
5	To realize using Verilog Behavioral description: 8:1 mux, 8:3 encoder, Priority encoder
6	To realize using Verilog Behavioral description: 1:8 Demux, 3:8 decoder, 2-bit Comparator
7	To realize using Verilog Behavioral description: Flip-flops: a) JK type b) SR type c) T type and d) D type
8	To realize Counters - up/down (BCD and binary) using Verilog Behavioral description.
Demonstration Experiments (For CIE only – not to be included for SEE) Use FPGA/CPLD kits for downloading Verilog codes and check the output for interfacing experiments.	
9	Verilog Program to interface a Stepper motor to the FPGA/CPLD and rotate the motor in the specified direction (by N steps).
10	Verilog programs to interface a Relay or ADC to the FPGA/CPLD and demonstrate its working.
11	Verilog programs to interface DAC to the FPGA/CPLD for Waveform generation.
12	Verilog programs to interface Switches and LEDs to the FPGA/CPLD and demonstrate its working.

Course Outcomes

At the end of the course the student will be able to:

1. Simplify Boolean functions using K-map and Quine-McCluskey minimization technique.
2. Analyze and design for combinational logic circuits.
3. Analyze the concepts of Flip Flops (SR, D, T and JK) and to design the synchronous sequential circuits using Flip Flops.
4. Model Combinational circuits (adders, subtractors, multiplexers) and sequential circuits using Verilog descriptions.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

CIE for the theory component of IPCC

Two Tests each of **20 Marks (duration 01 hour**)

- First test at the end of 5th week of the semester
- Second test at the end of the 10th week of the semester

Two assignments each of **10 Marks**

- First assignment at the end of 4th week of the semester
- Second assignment at the end of 9th week of the semester

Scaled-down marks of two tests and two assignments added will be CIE marks for the theory component of IPCC for **30 marks**.

CIE for the practical component of IPCC

- On completion of every experiment/program in the laboratory, the students shall be evaluated and marks shall be awarded on the same day. The **15 marks** are for conducting the experiment and preparation of the laboratory record, the other **05 marks shall be for the test** conducted at the end of the semester.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to 15 marks.
- The laboratory test **(duration 03 hours)** at the end of the 15th week of the semester /after completion of all the experiments (whichever is early) shall be conducted for 50 marks and scaled down to 05 marks**.**

Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **20 marks**.

SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (duration 03 hours)

- The question paper will have ten questions. Each question is set for 20 marks.
- There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
- The students have to answer 5 full questions, selecting one full question from each module.

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper shall include questions from the practical component.

- The minimum marks to be secured in CIE to appear for SEE shall be the 12 (40% of maximum marks-30) in the theory component and 08 (40% of maximum marks -20) in the practical component. The laboratory component of the IPCC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be included**.** The maximum of 04/05 questions to be set from the practical component of IPCC, the total marks of all questions should not be more than the 20 marks.

SEE will be conducted for 100 marks and students shall secure 35% of the maximum marks to qualify in the SEE. Marks secured out of 100 will be scaled down to 50 marks.

Suggested Learning Resources:

Text Books

1. Digital Logic Applications and Design by John M Yarbrough, Thomson Learning, 2001.

2. Digital Principles and Design by Donald D Givone, McGraw Hill, 2002.

3. HDL Programming VHDL and Verilog by Nazeih M Botros, 2009 reprint, Dreamtech press.

Reference Books:

1. Fundamentals of logic design, by Charles H Roth Jr., Cengage Learning

2. Logic Design, by Sudhakar Samuel, Pearson/ Sanguine, 2007

3. Fundamentals of HDL, by Cyril P R, Pearson/Sanguine 2010

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

Programming Assignments / Mini Projects can be given to improve programming skills.

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B.E: Electronics & Communication Engineering / B.E: Electronics & Telecommunication Engineering
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(Effective from the academic year 2021 – 22)

III Semester

Basic Signal Processing			
Course Code	**21EC33**	CIE Marks	50
Teaching Hours/Week (L: T: P: S)	(3:0:2:0)	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 13 Lab slots	Total Marks	100
Credits	04	Exam Hours	03

Course objectives: This course will enable students to:

Preparation: To prepare students with fundamental knowledge/ overview in the field of Signal Processing with Familiarization with the concept of Vector spaces and orthogonality with a qualitative insight into applications in communications.

Core Competence: To equip students with a basic foundation of Signal Processing by delivering the basics of quantitative parameters for Matrices & Linear Transformations, the mathematical description of discrete time signals and systems, analyzing the signals in time domain using convolution sum, classifying signals into different categories based on their properties, analyzing Linear Time Invariant (LTI) systems in time and transform domains

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

- Lecture method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
- Show Video/animation films to explain the different concepts of Linear Algebra & Signal Processing.
- Encourage collaborative (Group) Learning in the class.
- Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking.
- Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
- Topics will be introduced in a multiple representation.
- Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
- Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.
- Adopt Flipped class technique by sharing the materials / Sample Videos prior to the class and have discussions on the that topic in the succeeding classes.
- Give Programming Assignments.

Module-1

Vector Spaces: Vector spaces and Null subspaces, Rank and Row reduced form, Independence, Basis and dimension, Dimensions of the four subspaces, Rank-Nullity Theorem, Linear Transformations Orthogonality: Orthogonal Vectors and Subspaces, Projections and Least squares, Orthogonal Bases and Gram-Schmidt Orthogonalization procedure

(Refer Chapters 2 and 3 of Text 1)

Teaching-Learning Process	Chalk and Talk, YouTube videos, Flipped Class Technique, Programming assignments **RBT Level:** L1, L2, L3

Module-2	
Eigen values and Eigen vectors: Review of Eigen values and Diagonalization of a Matrix, Special Matrices (Positive Definite, Symmetric) and their properties, Singular Value Decomposition. **(Refer Chapter 5, Text 1)**	
Teaching-Learning Process	Chalk and Talk, YouTube videos, Flipped Class Technique, Programming assignments **RBT Level:** L1, L2, L3
Module-3	
Introduction and Classification of signals: Definition of signal and systems with examples, Elementary signals/Functions: Exponential, sinusoidal, step, impulse and ramp functions **Basic Operations on signals:** Amplitude scaling, addition, multiplication, time scaling, time shift and time reversal. Expression of triangular, rectangular and other waveforms in terms of elementary signals **System Classification and properties:** Linear-nonlinear, Time variant -invariant, causal-noncausal, static-dynamic, stable-unstable, invertible. **(Text 2) [Only for Discrete Signals & Systems]**	
Teaching-Learning Process	Chalk and Talk, YouTube videos, Flipped Class Technique, Programming assignments **RBT Level:** L1, L2, L3
Module-4	
Time domain representation of LTI System: Impulse response, convolution sum. Computation of convolution sum using graphical method for unit step and unit step, unit step and exponential, exponential and exponential, unit step and rectangular, and rectangular and rectangular. **LTI system Properties in terms of impulse response:** System interconnection, Memory less, Causal, Stable, Invertible and Deconvolution and step response **(Text 2) [Only for Discrete Signals & Systems]**	
Teaching-Learning Process	Chalk and Talk, YouTube videos, Flipped Class Technique, Programming assignments **RBT Level:** L1, L2, L3
Module-5	
The Z-Transforms: Z transform, properties of the region of convergence, properties of the Z-transform, Inverse Z-transform by partial fraction, Causality and stability, Transform analysis of LTI systems. **(Text 2)**	
Teaching-Learning Process	Chalk and Talk, YouTube videos, Flipped Class Technique, Programming assignments **RBT Level:** L1, L2, L3

PRACTICAL COMPONENT OF IPCC	
Sl.No	**Experiments**
1	a. Program to create and modify a vector (array). b. Program to create and modify a matrix.
2	Programs on basic operations on matrix.
3	Program to solve system of linear equations.
4	Program for Gram-Schmidt orthogonalization.
5	Program to find Eigen value and Eigen vector.
6	Program to find Singular value decomposition.

7	Program to generate discrete waveforms.
8	Program to perform basic operation on signals.
9	Program to perform convolution of two given sequences.
10	a. Program to perform verification of commutative property of convolution. b. Program to perform verification of distributive property of convolution. c. Program to perform verification of associative property of convolution.
11	Program to compute step response from the given impulse response.
12	Programs to find Z-transform and inverse Z-transform of a sequence.

Course outcomes (Course Skill Set)

At the end of the course the student will be able to :

1. Understand the basics of Linear Algebra
2. Analyse different types of signals and systems
3. Analyse the properties of discrete-time signals & systems
4. Analyse discrete time signals & systems using Z transforms

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

CIE for the theory component of IPCC

Two Tests each of **20 Marks (duration 01 hour**)

- First test at the end of 5th week of the semester
- Second test at the end of the 10th week of the semester

Two assignments each of **10 Marks**

- First assignment at the end of 4th week of the semester
- Programming assignment at the end of 9th week of the semester, which can be implemented using programming languages like C++/Python/Java/Scilab

Scaled-down marks of two tests and two assignments added will be CIE marks for the theory component of IPCC for **30 marks**.

CIE for the practical component of IPCC

- On completion of every experiment/program in the laboratory, the students shall be evaluated and marks shall be awarded on the same day. The **15 marks** are for conducting the experiment and preparation of the laboratory record, the other **05 marks shall be for the test** conducted at the end of the semester.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to 15 marks.
- The laboratory test **(duration 03 hours)** at the end of the 15th week of the semester /after completion of all the experiments (whichever is early) shall be conducted for 50 marks and scaled down to 05 marks**.**

Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **20 marks**.

SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (duration 03 hours)

- The question paper will have ten questions. Each question is set for 20 marks.
- There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
- The students have to answer 5 full questions, selecting one full question from each module.

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper shall include questions from the practical component.

- The minimum marks to be secured in CIE to appear for SEE shall be the 12 (40% of maximum marks-30) in the theory component and 08 (40% of maximum marks -20) in the practical component. The laboratory component of the IPCC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be included**.** The maximum of 04/05 questions to be set from the practical component of IPCC, the total marks of all questions should not be more than the 20 marks.

SEE will be conducted for 100 marks and students shall secure 35% of the maximum marks to qualify in the SEE. Marks secured out of 100 will be scaled down to 50 marks.

Suggested Learning Resources:

Text Books

1. Gilbert Strang, "Linear Algebra and its Applications", Cengage Learning, 4th Edition, 2006, ISBN 97809802327
2. Simon Haykin and Barry Van Veen, "Signals and Systems", 2nd Edition, 2008, Wiley India. ISBN9971-51-239-4.

Reference Books:

1. **Michael Roberts,** "Fundamentals of Signals & Systems",2nd edition, Tata McGraw-Hill, 2010, ISBN978-0-07-070221-9.
2. **Alan** V **Oppenheim, Alan** S **WiIlsky and** S **Hamid Nawab,** "Signals and Systems" Pearson Education Asia / PHI, 2"" edition, 1997. Indian Reprint 2002.
3. **H P Hsu, R Ranjan,** "Signals and Systems", Schaum's outlines, TMH, 2006.
4. **B P Lathi,** "Linear Systems and Signals", Oxford University Press, 2005.
5. **Ganesh Rao and Satish Tunga,** "Signals and Systems", Pearson/Sanguine.
6. **Seymour Lipschutz, Marc Lipson**, "Schaums Easy Outline of Linear Algebra", 2020.

Web links and Video Lectures (e-Resources):

Video lectures on Signals and Systems by Alan V Oppenheim

Lecture 1, Introduction | MIT RES.6.007 Signals and Systems, Spring 2011 - YouTube

Lecture 2, Signals and Systems: Part 1 | MIT RES.6.007 Signals and Systems, Spring 2011 - YouTube

NPTEL video lectures signals and system:

https://www.youtube.com/watch?v=7Z3LE5uM-6Y&list=PLbMVogVj5nJQQZbah2uRZIRZ_9kfoqZyx

Video lectures on Linear Algebra by Gilbert Strang

https://www.youtube.com/watch?v=ZK3O402wf1c&list=PL49CF3715CB9EF31D&index=1

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

Programming Assignments / Mini Projects can be given to improve programming skills

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III Semester

Analog Electronic Circuits			
Course Code	**21EC34**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:1	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course objectives: This course will enable students to

- Explain various BJT parameters, connections and configurations.
- Design and demonstrate the diode circuits and transistor amplifiers.
- Explain various types of FET biasing and demonstrate the use of FET amplifiers.
- Analyze Power amplifier circuits in different modes of operation.
- Construct Feedback and Oscillator circuits using FET.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1.Lecture method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
2.Show Video/animation films to explain evolution of communication technologies.
3. Encourage collaborative (Group) Learning in the class
4.Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking
5.Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
6.Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
7.Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

BJT Biasing: Biasing in BJT amplifier circuits: The Classical Discrete circuit bias (Voltage-divider bias), Biasing using a collector to base feedback resistor.

Small signal operation and Models: Collector current and transconductance, Base current and input resistance, Emitter current and input resistance, voltage gain, Separating the signal and the DC quantities, The hybrid Π model, The T model.

MOSFETs: Biasing in MOS amplifier circuits: Fixing VGS, Fixing VG, Drain to Gate feedback resistor.

Small signal operation and modeling: The DC bias point, signal current in drain, voltage gain, small signal equivalent circuit models, transconductance, The T equivalent circuit model.

[Text 1: 3.5(3.5.1, 3.5.3), 3.6(3.6.1 to 3.6.7), 4.5(4.5.1, 4.5.2, 4.5.3), 4.6(4.6.1 to 4.6.7)]

Teaching-Learning Process	Chalk and talk method, Power Point Presentation. **Self-study topics:**Basic BJT Amplifier Configurations- Design of Common Emitter and Common collector amplifier circuits. **RBT Level:** L1, L2, L3

Module-2

MOSFET Amplifier configuration: Basic configurations, characterizing amplifiers, CS amplifier with and without source resistance RS, Source follower.

MOSFET internal capacitances and High frequency model: The gate capacitive effect, Junction capacitances, High frequency model.

Frequency response of the CS amplifier: The three frequency bands, high frequency response, Low frequency response.

Oscillators: FET based Phase shift oscillator, LC and Crystal Oscillators (no derivation) [Text 1: 4.7(4.7.1 to 4.7.4, 4.7.6) 4.8(4.8.1, 4.8.2, 4.8.3), 4.9, 12.2.2, 12.3.1, 12,3,2]	
Teaching-Learning Process	Chalk and talk method, Power Point Presentation. **Self-study topics:**Discrete Circuit MOS Amplifier – The common source amplifier and the source follower. **RBT Level:** L1, L2, L3
Module-3	
Feedback Amplifier: General feedback structure, Properties of negative feedback, The Four Basic Feedback Topologies, The series-shunt, series-series, shunt-shunt and shunt-series amplifiers (Qualitative Analysis). **Output Stages and Power Amplifiers:** Introduction, Classification of output stages, Class A output stage, Class B output stage: Transfer Characteristics, Power Dissipation, Power Conversion efficiency, Class AB output stage, Class C tuned Amplifier. [Text 1: 7.1, 7.2, 7.3, 7.4.1, 7.5.1, 7.6 (7.6.1 to 7.6.3), 13.1, 13.2, 13.3(13.3.1, 13.3.2, 13.3.3, 13.4, 13.7)]	
Teaching-Learning Process	Chalk and talk method, Power Point Presentation. **Self-study topics:**Class D power amplifier. **RBT Level:** L1, L2, L3
Module-4	
Op-Amp Circuits: Op-amp DC and AC Amplifiers, DAC - Weighted resistor and R-2R ladder, ADC-Successive approximation type, Small Signal half wave rectifier, Absolute value output circuit, Active Filters, First and second order low-pass and high-pass Butterworth filters, Band-pass filters, Band reject filters. **555 Timer and its applications:** Monostable and Astable Multivibrators. [Text 2: 6.2, 8.11(8.11.1a, 8.11.1b), 8.11.2a, 8.12.2,8.13 7.2, 7.3, 7.4, 7.5, 7.6, 7.8, 7.9, 9.4.1, 9.4.1(a), 9.4.3, 9.4.3(a)]	
Teaching-Learning Process	Chalk and talk method, Power Point Presentation. **Self-study topics:**Clippers and Clampers, Peak detector, Sample and hold circuit. **RBT Level:** L1, L2, L3
Module-5	
Overview of Power Electronic Systems: Power Electronic Systems, Power Electronic Converters and Applications. **Thyristors:** Static Anode-Cathode characteristics and Gate characteristics of SCR, Turn-ON methods, Turn-off Mechanism, Turn-OFF Methods: Natural and Forced Commutation – Class A without design consideration. **Gate Trigger Circuit:** Resistance Firing Circuit, Resistance capacitance firing circuit, Unijunction Transistor: Basic operation and UJT Firing Circuit. [Text 3: 1.3, 1.5,1.6, 2.2,2.3,2.4,2.6, 2.7,2.9, 2.10,3.2,3.5.1, 3.5.2, 3.6.1, 3.6.3,3.6.4]	
Teaching-Learning Process	Chalk and talk method, Power Point Presentation. **Self-study topics:** Basic Construction, working and applications of DIAC, TRIAC, IGBT, GTO. **RBT Level:** L1, L2, L3

Course Outcomes (Course Skill Set)

At the end of the course the student will be able to :

1. Understand the characteristics of BJTs and FETs for switching and amplifier circuits.
2. Design and analyze FET amplifiers and oscillatorswith different circuit configurations and biasing conditions.
3. Understand the feedback topologies and approximations in the design of amplifiers and oscillators.
4. Design of circuits using linear ICs for wide range applications such as ADC, DAC, filters and timers.
5. Understand the power electronic device components and its functions for basic power electronic circuits.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%.

The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored out of 100 shall be proportionally reduced to 50 marks.

Suggested Learning Resources:

Books

1. Microelectronic Circuits, Theory and Applications, Adel S Sedra, Kenneth C Smith, 6thEdition, Oxford, 2015.ISBN:978-0-19-808913-1
2. Op-Amps and Linear Integrated Circuits, Ramakant A Gayakwad, 4thEdition, Pearson Education, 2018. ISBN: 978-93-325-4991-3
3. **MD Singh and K B Khanchandani, Power Electronics, 2nd Edition, Tata Mc-Graw Hill, 2009, ISBN: 0070583897'**

Web links and Video Lectures (e-Resources):

- Integrated Electronics: Analog and Digital Circuits and Systems, Jacob Millman, Christos C. Halkias, McGraw-Hill, 2015.
- Electronic Devices and Circuit, Boylestad & Nashelsky, Eleventh Edition, Pearson, January 2015.

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III Semester

Analog and Digital Electronics Lab			
Course Code	**21ECL35**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0:0:2:0	SEE Marks	50
Credits	1	Exam Hours	3

Course objectives:

This laboratory course enables students to

- Understand the electronic circuit schematic and its working
- Realize and test amplifier and oscillator circuits for the given specifications
- Realize the opamp circuits for the applications such as DAC, implement mathematical functions and precision rectifiers.
- Study the static characteristics of SCR and test the RC triggering circuit.
- Design and test the combinational and sequential logic circuits for their functionalities.
- Use the suitable ICs based on the specifications and functions.

Sl.No.	**Experiments**
1	Design and set up the BJT common emitter voltage amplifier with and without feedback and determine the gain- bandwidth product, input and output impedances.
2	Design and set-up BJT/FET i) Colpitts Oscillator, ii) Crystal Oscillator and iii) RC Phase shift oscillator
3	Design and set up the circuits using opamp: i) Adder, ii) Integrator, iii) Differentiator and iv) Comparator
4	Obtain the static characteristics of SCR and test SCR Controlled HWR and FWR using RC triggering circuit.
5	Design and implement (a) Half Adder & Full Adder using basic gates and NAND gates, (b) Half subtractor & Full subtractor using NAND gates, (c) 4-variable function using IC74151(8:1MUX).
6	Realize (i) Binary to Gray code conversion & vice-versa (IC74139), (ii) BCD to Excess-3 code conversion and vice versa
7	a) Realize using NAND Gates: i) Master-Slave JK Flip-Flop, ii) D Flip-Flop and iii) T Flip-Flop b) Realize the shift registers using IC7474/7495: (i) SISO (ii) SIPO (iii) PISO (iv) PIPO (v) Ring counter and (vi) Johnson counter.
8	Realize a) Design Mod – N Synchronous Up Counter & Down Counter using 7476 JK Flip-flop b) Mod-N Counter using IC7490 / 7476 c) Synchronous counter using IC74192

9	Design 4-bit R – 2R Op-Amp Digital to Analog Converter (i) for a 4-bit binary input using toggle switches (ii) by generating digital inputs using mod-16
10	Pseudorandom sequence generator using IC7495
11	Test the precision rectifiers using opamp: i) Half wave rectifier ii) Full wave rectifier
12	Design and test Monostable and Astable Multivibrator using 555 Timer

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

1. Design and analyze the BJT/FET amplifier and oscillator circuits.
2. Design and test Opamp circuits to realize the mathematical computations, DAC and precision rectifiers.
3. Design and test the combinational logic circuits for the given specifications.
4. Test the sequential logic circuits for the given functionality.
5. Demonstrate the basic electronic circuit experiments using SCR and 555 timer.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 35% (18 Marks out of 50) in the semester-end examination (SEE).

Continuous Internal Evaluation (CIE):

CIE marks for the practical course is **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment to be evaluated for conduction with observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled downed to 30 marks (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8th week of the semester and the second test shall be conducted after the 14th week of the semester.
- In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability. Rubrics suggested in Annexure-II of Regulation book
- The average of 02 tests is scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and average marks of two tests is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

SEE marks for the practical course is 50 Marks.

SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University

All laboratory experiments are to be included for practical examination.

(Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.

Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.

Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)

Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.

The duration of SEE is 03 hours

Rubrics suggested in Annexure-II of Regulation book

Suggested Learning Resources:

1. Fundamentals of Electronic Devices and Circuits Lab Manual, David A Bell, 5th Edition, 2009, Oxford University Press.
2. Op-Amps and Linear Integrated Circuits, Ramakant A Gayakwad, 4th Edition, Pearson Education, 2018. ISBN: 978-93-325-4991-3.
3. Fundamentals of Logic Design, Charles H Roth Jr., Larry L Kinney, Cengage Learning, 7th Edition.

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III Semester

LD (Logic Design) Lab using Pspice / MultiSIM			
Course Code	**21EC381**	CIE Marks	50
Teaching Hours/Week (L: T:P: S)	0:0:2:0	SEE Marks	50
Credits	1	Exam Hours	03

Course objectives:

- Impart the concepts of De Morgan's Theorem, SOP, POS forms.
- Impart the concepts of designing and analyzing combinational logic circuits.
- Impart the concepts of analysis of sequential logic circuits.
- Analyze and design any given synchronous sequential circuits.

Sl.No	**Experiments**
1	Implementation of De Morgan's theorem and SOP/POS expressions using Pspice/Multisim.
2	Implementation of Half Adder, Full Adder, Half Subtractor and Full Subtractor using Pspice/ Multisim.
3	Design and implementation of 4-bit Parallel Adder/ Subtractor using IC 7483 and BCD to Excess-3 code conversion and vice-versa using Pspice/Multisim.
4	Design and implement of IC 7485 5-bit magnitude comparator using Pspice/Multisim.
5	To Realize Adder & Subtractor using IC 74153 (4:1 MUX) and 4-variable function using IC74151 (8:1MUX) using Pspice/Multisim.
6	To realize Adder and Subtractor using IC 74139/ 74155N (Demux/Decoder) and Binary to Gray code conversion & vice versa using 74139/ 74155N using Pspice/Multisim.
7	SR, Master-Slave JK, D & T flip-flops using NAND Gates using Pspice/Multisim.
8	Design and realize the Synchronous counters (up/down decade/binary) using Pspice/Multisim.
9	Realize the shift registers and their modes (SISO, PISO, PIPO, SIPO) using 7474/7495 using Pspice/Multisim.
10	Design Pseudo Random Sequence generator using 7495 using Pspice/Multisim.
11	Design Serial Adder with Accumulator and simulate using Pspice/Multisim.
12	Design using Pspice/Multisim Mod-N Counters.

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

1. Demonstrate the truth table of various expressions and combinational circuits using logic gates.
2. Design various combinational circuits such as adders, subtractors, comparators, multiplexers and code converters.
3. Construct flips-flops, counters and shift registers.
4. Design and implement synchronous counters.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall

be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 35% (18 Marks out of 50) in the semester-end examination (SEE).

Continuous Internal Evaluation (CIE):

CIE marks for the practical course is **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment to be evaluated for conduction with observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled downed to 30 marks (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8th week of the semester and the second test shall be conducted after the 14th week of the semester.
- In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability. Rubrics suggested in Annexure-II of Regulation book
- The average of 02 tests is scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and average marks of two tests is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

SEE marks for the practical course is 50 Marks.

SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University

All laboratory experiments are to be included for practical examination.

(Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.

Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.

Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)

Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.

The duration of SEE is 03 hours

Rubrics suggested in Annexure-II of Regulation book

Suggested Learning Resources:

- Digital Logic Applications and Design by John M Yarbrough, Thomson Learning, 2001
- Digital Principles and Design by Donald D Givone, McGraw Hill, 2002.

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III Semester

AEC (Analog Electronic Circuits) Lab			
Course Code	21EC382	CIE Marks	50
Teaching Hours/Week (L: T:P: S)	0:0:2:0	SEE Marks	50
Credits	1	Exam Hours	2

Course objectives:

- To provide practical exposure to the students on designing, setting up, executing and debugging various electronic circuits using simulation software.
- To give the knowledge and practical exposure on simple applications of analog electronic circuits.

Sl.No	**Experiments using Pspice/MultiSIM software**
1	Experiments to realize diode clipping (single, double ended) circuits.
2	Experiments to realize diode clamping (positive, negative) circuits.
3	Experiments to realize Full wave rectifier without filter (and set-up to measure the ripple factor, Vp-p, Vrms, etc.).
4	Design and conduct an experiment on Series Voltage Regulator using Zener diode to determine line/load regulation characteristics.
5	Realize BJT Darlington Emitter follower without bootstrapping and determine the gain, input and output impedances (other configurations of emitter follower can also be considered).
6	Set-up and study the working of complementary symmetry class B push pull power amplifier (other power amplifiers can also be suitably considered) and calculate the efficiency.
7	Design and set-up the oscillator circuits (Hartley, Colpitts, etc. using BJT/FET) and determine the frequency of oscillation.
8	Design and set-up the crystal oscillator and determine the frequency of oscillation.
9	Experiment to realize Input and Output characteristics of BJT Common emitter configuration and evaluation of parameters.
10	Experiments to realize Transfer and drain characteristics of a MOSFET.
11	Experiments to realize UJT triggering circuit for Controlled Full wave Rectifier.
12	Design and simulation of Regulated power supply.

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

1. Understand the circuit schematic and its working.
2. Study the characteristics of different electronic devices.
3. Design and test simple electronic circuits as per the specifications using discrete electronic components.
4. Compute the parameters from the characteristics of active devices.
5. Familiarize with EDA software which can be used for electronic circuit simulation.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 35% (18 Marks out of 50) in the semester-end examination (SEE).

Continuous Internal Evaluation (CIE):

CIE marks for the practical course is **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment to be evaluated for conduction with observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled downed to 30 marks (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8th week of the semester and the second test shall be conducted after the 14th week of the semester.
- In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability. Rubrics suggested in Annexure-II of Regulation book
- The average of 02 tests is scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and average marks of two tests is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

SEE marks for the practical course is 50 Marks.

SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University.

All laboratory experiments are to be included for practical examination.

(Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.

Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.

Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners).

Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.

The duration of SEE is 03 hours.

Rubrics suggested in Annexure-II of Regulation book.

Suggested Learning Resources:

1. David A Bell, "Fundamentals of Electronic Devices and Circuits Lab Manual, 5th Edition, 2009, Oxford University Press.
2. Muhammed H Rashid, "Introduction to PSpice using OrCAD for circuits and electronics", 3rd Edition, Prentice Hall, 2003.

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III Semester

LIC (Linear Integrated Circuits) Lab using Pspice / MultiSIM			
Course Code	**21EC383**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0:0:2:0	SEE Marks	50
Credits	1	Exam Hours	03

Course objectives:

- To apply operational amplifiers in linear and nonlinear applications.
- To acquire the basic knowledge of special function ICs.
- To use Multisim/Pspice software for circuit design and simulation

Sl.No	**Experiments using Pspice / MultiSIM** Every experiment has to be designed, circuit to be drawn / constructed and executed in the specified software. Results are also to be noted and inferred.
	Note: Standard design procedure to be adopted.
1	To realize using op-amp an Inverting Amplifier and Non-Inverting Amplifier
2	To realize using op-amps i) Summing Amplifier ii)Difference amplifier
3	To realize using op-amps an Instrumentation Amplifier
4	To realize using op-amps i) Differentiator ii)Integrator
5	To realize using op-amps a Full wave Precision Rectifier
6	To realize using op-amps • Inverting and Non-Inverting Zero Crossing Detectors • Positive and Negative Voltage level detectors
7	To realize using op-amp an Inverting Schmitt Trigger
8	To realize using op-amp an Astable Multivibrator
9	To design and implement using op-amps • Butterworth I & II order Low Pass Filter • Butterworth I & II order High Pass Filter
10	To design and implement using op-amp a RC Phase Shift Oscillator
11	To design and implement Mono-stable Multivibrator using 555 timer
12	To design and implement 4 - bit R-2R Digital to Analog Converter

Course outcomes (Course Skill Set):

After studying this course, students will be able to;

1. Sketch/draw circuit schematics, construct circuits, analyze and troubleshoot circuits containing op-amps, resistors, diodes, capacitors and independent sources.
2. Relate to the manufacturer's data sheets of IC 555 timer and IC µa741 op-amp.
3. Realize and verify the operation of analog integrated circuits like Amplifiers, Precision Rectifiers, Comparators and Waveform generators.
4. Design and implement analog integrated circuits like Oscillators, Active filters, Timer circuits, Data converters and compare the experimental results with theoretical values.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 35% (18 Marks out of 50) in the semester-end examination (SEE).

Continuous Internal Evaluation (CIE):

CIE marks for the practical course is **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment to be evaluated for conduction with observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled downed to 30 marks (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8th week of the semester and the second test shall be conducted after the 14th week of the semester.
- In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability. Rubrics suggested in Annexure-II of Regulation book
- The average of 02 tests is scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and average marks of two tests is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

SEE marks for the practical course is 50 Marks.

SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University

All laboratory experiments are to be included for practical examination.

(Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.

Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.

Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)

Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.

The duration of SEE is 03 hours

Rubrics suggested in Annexure-II of Regulation book

Suggested Learning Resources:

Op-Amps and Linear Integrated Circuits, Ramakant A Gayakwad, 4th Edition, Pearson Education, 2018.

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III Semester

LabVIEW Programming Basics			
Course Code	**21EC384**	CIE Marks	50
Teaching Hours/Week (L: T:P: S)	0:0:2:0	SEE Marks	50
Credits	1	Exam Hours	03

Course objectives:

- Aware of various front panel controls and indicators.
- Connect and manipulate nodes and wires in the block diagram.
- Locate various toolbars and pull-down menus for the purpose of implementing specific functions.
- Locate and utilize the context help window.
- Familiar with LabVIEW and different applications using it.
- Run a Virtual Instrument (VI).

Sl.No	**VI Programs (using LabVIEW software) to realize the following:**
1	Basic arithmetic operations: addition, subtraction, multiplication and division
2	Boolean operations: AND, OR, XOR, NOT and NAND
3	Sum of 'n' numbers using 'for' loop
4	Factorial of a given number using 'for' loop
5	Determine square of a given number
6	Factorial of a given number using 'while 'loop
7	Sorting even numbers using 'while' loop in an array
8	Finding the array maximum and array minimum
	Demonstration Experiments (For CIE)
9	Build a Virtual Instrument that simulates a heating and cooling system. The system must be able to be controlled manually or automatically.
10	Build a Virtual Instrument that simulates a Basic Calculator (using formula node).
11	Build a Virtual Instrument that simulates a Water Level Detector.
12	Demonstrate how to create a basic VI which calculates the area and perimeter of a circle.

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

1. Use Lab VIEW to create data acquisition, analysis and display operations
2. Create user interfaces with charts, graph and buttons
3. Use the programming structures and data types that exist in Lab VIEW
4. Use various editing and debugging techniques

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course.

The student has to secure not less than 35% (18 Marks out of 50) in the semester-end examination (SEE).

Continuous Internal Evaluation (CIE):

CIE marks for the practical course is **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment to be evaluated for conduction with observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled downed to 30 marks (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8th week of the semester and the second test shall be conducted after the 14th week of the semester.
- In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability. Rubrics suggested in Annexure-II of Regulation book
- The average of 02 tests is scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and average marks of two tests is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

SEE marks for the practical course is 50 Marks.

SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University

All laboratory experiments are to be included for practical examination.

(Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.

Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.

Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)

Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.

The duration of SEE is 03 hours

Rubrics suggested in Annexure-II of Regulation book

Suggested Learning Resources:

1. Virtual Instrumentation using LABVIEW, Jovitha Jerome, PHI, 2011
2. Virtual Instrumentation using LABVIEW, Sanjay Gupta, Joseph John, TMH, McGraw Hill, Second Edition, 2011.

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IV Semester

Maths for Communication Engineers			
Course Code	**21EC41**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	3:0:0:1	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

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IV Semester

Digital Signal Processing			
Course Code	21EC42	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:2:0	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 8-10 Lab slots	Total Marks	100
Credits	04	Exam Hours	03

Course objectives:

1. **Preparation:** To prepare students with fundamental knowledge/ overview in the field of Digital Signal Processing
2. **Core Competence:** To equip students with a basic foundation of Signal Processing by delivering the basics of Discrete Fourier Transforms & their properties, design of filters and overview of digital signal processors

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecture method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
2. Show Video/animation films to explain the different concepts of Digital Signal Processing
3. Encourage collaborative (Group) Learning in the class
4. Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
6. Topics will be introduced in a multiple representation.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.
9. Adopt Flipped class technique by sharing the materials / Sample Videos prior to the class and have discussions on the that topic in the succeeding classes
10. Give Programming Assignments

Module-1

Discrete Fourier Transforms (DFT): Frequency domain sampling and Reconstruction of Discrete Time Signals, The Discrete Fourier Transform, DFT as a linear transformation, Properties of the DFT: Periodicity, Linearity and Symmetry properties, Multiplication of two DFTs and Circular Convolution **[Text 1]**

Teaching-Learning Process	Chalk and Talk, YouTube videos, Programming assignments **RBT Level:** L1, L2, L3

Module-2

Additional DFT Properties, **Linear filtering methods based on the DFT:** Use of DFT in Linear Filtering, Filtering of Long data Sequences. Fast-Fourier-Transform (FFT) algorithms: Efficient Computation of the DFT: Radix-2 FFT algorithms for the computation of DFT and IDFT decimation in-time **[Text 1]**

Teaching-Learning Process	Chalk and Talk, YouTube videos, Programming assignments **RBT Level:** L1, L2, L3

Module-3

Design of FIR Filters: Characteristics of practical frequency-selective filters, Symmetric and Anti-symmetric FIR filters, Design of Linear-phase FIR (low pass and High pass) filters using windows - Rectangular, Hamming, Hanning, Bartlett windows. Structure for FIR Systems: Direct form, Cascade form and Lattice structures **[Text1]**

Teaching-Learning Process	Chalk and Talk, YouTube videos, Programming assignments **RBT Level:** L1, L2, L3

Module-4

IIR Filter Design: Infinite Impulse response Filter Format, Bilinear Transformation Design Method, Analog Filters using Low pass prototype transformation, Normalized Butterworth Functions, Bilinear Transformation and Frequency Warping, Bilinear Transformation Design Procedure, Digital Butterworth (Lowpass and Highpass) Filter Design using BLT. Realization of IIR Filters in Direct form I and II **[Text 2]**

Teaching-Learning Process	Chalk and Talk, YouTube videos, Programming assignments **RBT Level:** L1, L2, L3

Module-5

Digital Signal Processors: DSP Architecture, DSP Hardware Units, Fixed point format, Floating point Format, IEEE Floating point formats, Fixed point digital signal processors, FIR and IIR filter implementations in Fixed point systems. **[Text 2]**

Teaching-Learning Process	Chalk and Talk, YouTube videos, Programming assignments **RBT Level:** L1, L2, L3

PRACTICAL COMPONENT OF IPCC

List of Programs to be implemented & executed using any programming languages like C++/Python/Java/Scilab / MATLAB/CC Studio (but not limited to)

1. Computation of N point DFT of a given sequence and to plot magnitude and phase spectrum.
2. Computation of circular convolution of two given sequences and verification of commutative, distributive and associative property of convolution.
3. Computation of linear convolution of two sequences using DFT and IDFT.
4. Computation of circular convolution of two given sequences using DFT and IDFT
5. Verification of Linearity property, circular time shift property & circular frequency shift property of DFT.
6. Verification of Parseval's theorem
7. Design and implementation of IIR (Butterworth) low pass filter to meet given specifications.
8. Design and implementation of IIR (Butterworth) high pass filter to meet given specifications.
9. Design and implementation of low pass FIR filter to meet given specifications.
10. Design and implementation of high pass FIR filter to meet given specifications.
11. To compute N- Point DFT of a given sequence using DSK 6713 simulator
12. To compute linear convolution of two given sequences using DSK 6713 simulator
13. To compute circular convolution of two given sequences using DSK 6713 simulator

Course outcomes (Course Skill Set)

At the end of the course the student will be able to:

1. Determine response of LTI systems using time domain and DFT techniques
2. Compute DFT of real and complex discrete time signals
3. Compute DFT using FFT algorithms
4. Design FIR and IIR Digital Filters
5. Design of Digital Filters using DSP processor

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

CIE for the theory component of IPCC

Two Tests each of **20 Marks (duration 01 hour**)

- First test at the end of 5th week of the semester
- Second test at the end of the 10th week of the semester

Two assignments each of **10 Marks**

- First assignment at the end of 4th week of the semester
- Programming assignment at the end of 9th week of the semester, which can be implemented using programming languages like C++/Python/Java/Scilab

Scaled-down marks of two tests and two assignments added will be CIE marks for the theory component of IPCC for **30 marks**.

CIE for the practical component of IPCC

- On completion of every experiment/program in the laboratory, the students shall be evaluated and marks shall be awarded on the same day. The **15 marks** are for conducting the experiment and preparation of the laboratory record, the other **05 marks shall be for the test** conducted at the end of the semester.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to 15 marks.
- The laboratory test **(duration 03 hours)** at the end of the 15th week of the semester /after completion of all the experiments (whichever is early) shall be conducted for 50 marks and scaled down to 05 marks**.**

Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **20 marks**.

SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (duration 03 hours)

- The question paper will have ten questions. Each question is set for 20 marks.
- There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
- The students have to answer 5 full questions, selecting one full question from each module.

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper shall include questions from the practical component.

- The minimum marks to be secured in CIE to appear for SEE shall be the 12 (40% of maximum marks-30) in the theory component and 08 (40% of maximum marks -20) in the practical component. The laboratory component of the IPCC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be included**.** The maximum of 04/05 questions to be set from the practical component of IPCC, the total marks of all questions should not be more than the 20 marks.

SEE will be conducted for 100 marks and students shall secure 35% of the maximum marks to qualify in the SEE. Marks secured will be scaled down to 50.

Suggested Learning Resources:

Text Books:

1. Proakis & Manolakis, “Digital Signal Processing - Principles Algorithms & Applications”, 4th Edition, Pearson education, New Delhi, 2007. ISBN: 81-317-1000-9.
2. Li Tan, Jean Jiang, “Digital Signal processing - Fundamentals and Applications”, Academic Press, 2013, ISBN: 978-0-12-415893.

Reference Books:

1. Sanjit K Mitra, “Digital Signal Processing, A Computer Based Approach”, 4th Edition, McGraw Hill Education, 2013,
2. Oppenheim & Schaffer, “Discrete Time Signal Processing", PHI, 2003.
3. D Ganesh Rao and Vineeth P Gejji, “Digital Signal Processing" Cengage India Private Limited, 2017, ISBN: 9386858231

Web links and Video Lectures (e-Resources):

By Prof. S. C. Dutta Roy, IIT Delhi

https://nptel.ac.in/courses/117102060

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

Programming Assignments / Mini Projects can be given to improve programming skills

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IV Semester

Circuits & Controls			
Course Code	**21EC43**	CIE Marks	50
Teaching Hours/Week (L: T: P: S)	(3:0:2:0)	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 12 Lab slots	Total Marks	100
Credits	04	Exam Hours	03

Course objectives: This course will enable students to:

1. Apply mesh and nodal techniques to solve an electrical network.
2. Solve different problems related to Electrical circuits using Network Theorems and Two port network.
3. Familiarize with the use of Laplace transforms to solve network problems.
4. Understand basics of control systems and design mathematical models using block diagram reduction, SFG, etc.
5. Understand Time domain and Frequency domain analysis.
6. Familiarize with the State Space Model of the system.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

- Lecture method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
- Show Video/animation films to explain the different concepts of Linear Algebra & Signal Processing.
- Encourage collaborative (Group) Learning in the class .
- Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking.
- Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
- Topics will be introduced in a multiple representation.
- Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
- Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.
- Adopt Flipped class technique by sharing the materials / Sample Videos prior to the class and have discussions on the that topic in the succeeding classes.
- Give Programming Assignments.

Module-1

Basic concepts and network theorems

Types of Sources, Loop analysis, Nodal analysis with independent DC and AC Excitations.
(Textbook 1: 2.3, 4.1, 4.2, 4.3, 4.4, 10.6)

Super position theorem, Thevenin's theorem, Norton's Theorem, Maximum Power transfer Theorem.
(Textbook 2: 9.2, 9.4, 9.5, 9.7)

Teaching-Learning Process	Chalk and Talk, YouTube videos, Demonstrate the concepts using circuits **RBT Level:** L1, L2, L3

Module-2	
Two port networks: Short- circuit Admittance parameters, Open- circuit Impedance parameters, Transmission parameters, Hybrid parameters (Textbook 3: 11.1, 11.2, 11.3, 11.4, 11.5) **Laplace transform and its Applications**: Step Ramp, Impulse, Solution of networks using Laplace transform, Initial value and final value theorem (Textbook 3: 7.1, 7.2, 7.4, 7.7, 8.4)	
Teaching-Learning Process	Chalk and Talk **RBT Level:** L1, L2, L3
Module-3	
Basic Concepts and representation: Types of control systems, effect of feedback systems, differential equation of physical systems (only electrical systems), Introduction to block diagrams, transfer functions, Signal Flow Graphs (Textbook 4: Chapter 1.1, 2.2, 2.4, 2.5, 2.6)	
Teaching-Learning Process	Chalk and Talk, YouTube videos **RBT Level:** L1, L2, L3
Module-4	
Time Response analysis: Time response of first order systems. Time response of second order systems, time response specifications of second order systems (Textbook 4: Chapter 5.3, 5.4) **Stability Analysis:** Concepts of stability necessary condition for stability, Routh stability criterion, relative stability Analysis (Textbook 4: Chapter 5.3, 5.4, 6.1, 6.2, 6.4, 6.5)	
Teaching-Learning Process	Chalk and Talk, Any software tool to show time response **RBT Level:** L1, L2, L3
Module-5	
Root locus: Introduction the root locus concepts, construction of root loci (Textbook 4: 7.1, 7.2, 7.3) **Frequency Domain analysis and stability**: Correlation between time and frequency response and Bode plots (Textbook 4: 8.1, 8.2, 8.4) **State Variable Analysis:** Introduction to state variable analysis: Concepts of state, state variable and state models. State model for Linear continuous –Time systems, solution of state equations. (Textbook 4: 12.2, 12.3, 12.6)	
Teaching-Learning Process	Chalk and Talk, Any software tool to plot Root locus, Bode plot **RBT Level:** L1, L2, L3

PRACTICAL COMPONENT OF IPCC

Using suitable hardware and simulation software, demonstrate the operation of the following circuits:

Sl.No	Experiments
1	Verification of Superposition theorem
2	Verification of Thevenin's theorem
3	Speed torque characteristics of i)AC Servomotor ii) DC Servomotors
4	Determination of time response specification of a second order Under damped System, for different damping factors.
5	Determination of frequency response of a second order System
6	Determination of frequency response of a lead lag compensator
7	Using Suitable simulation package study of speed control of DC motor using i) Armature control ii) Field control

8	Using suitable simulation package, draw Root locus & Bode plot of the given transfer function.
Demonstration Experiments (For CIE only, not for SEE)	
9	Using suitable simulation package, obtain the time response from state model of a system.
10	Implementation of PI, PD Controllers.
11	Implement a PID Controller and hence realize an Error Detector.
12	Demonstrate the effect of PI, PD and PID controller on the system response.

Course Outcomes

At the end of the course the student will be able to:

1. Analyse and solve Electric circuit, by applying, loop analysis, Nodal analysis and by applying network Theorems.
2. Evaluate two port parameters of a network and Apply Laplace transforms to solve electric networks.
3. Deduce transfer function of a given physical system, from differential equation representation or Block Diagram representation and SFG representation.
4. Calculate time response specifications and analyse the stability of the system.
5. Draw and analyse the effect of gain on system behaviour using root loci.
6. Perform frequency response Analysis and find the stability of the system.
7. Represent State model of the system and find the time response of the system.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

CIE for the theory component of IPCC

Two Tests each of **20 Marks (duration 01 hour**)

- First test at the end of 5th week of the semester
- Second test at the end of the 10th week of the semester

Two assignments each of **10 Marks**

- First assignment at the end of 4th week of the semester
- Second assignment at the end of 9th week of the semester

Scaled-down marks of two tests and two assignments added will be CIE marks for the theory component of IPCC for **30 marks**.

CIE for the practical component of IPCC

- On completion of every experiment/program in the laboratory, the students shall be evaluated and marks shall be awarded on the same day. The **15 marks** are for conducting the experiment and preparation of the laboratory record, the other **05 marks shall be for the test** conducted at the end of the semester.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to 15 marks.
- The laboratory test **(duration 03 hours)** at the end of the 15th week of the semester /after completion of all the experiments (whichever is early) shall be conducted for 50 marks and

scaled down to 05 marks**.**

Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **20 marks**.

SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (duration 03 hours)

- The question paper will have ten questions. Each question is set for 20 marks.
- There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
- The students have to answer 5 full questions, selecting one full question from each module.

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper shall include questions from the practical component.

- The minimum marks to be secured in CIE to appear for SEE shall be the 12 (40% of maximum marks-30) in the theory component and 08 (40% of maximum marks -20) in the practical component. The laboratory component of the IPCC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be included**.** The maximum of 04/05 questions to be set from the practical component of IPCC, the total marks of all questions should not be more than the 20 marks.

SEE will be conducted for 100 marks and students shall secure 35% of the maximum marks to qualify in the SEE. Marks secured out of 100 shall be reduced proportionally to 50.

Suggested Learning Resources:

Text Books

1. Engineering circuit analysis, William H Hayt, Jr, Jack E Kemmerly, Steven M Durbin, Mc Graw Hill Education, Indian Edition 8e.
2. Networks and Systems, D Roy Choudhury, New age international Publishers, second edition.
3. Network Analysis, M E Van Valkenburg, Pearson, 3e.
4. Control Systems Engineering, I J Nagrath, M. Gopal, New age international Publishers, Fifth edition.

Web links and Video Lectures (e-Resources):

- https://nptel.ac.in/courses/108106098
- https://nptel.ac.in/courses/108102042

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

Programming Assignments / Mini Projects can be given to improve programming skills

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IV Semester

Communication Theory			
Course Code	**21EC44**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:1	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course objectives: This course will enable students to

- Understand and analyse concepts of Analog Modulation schemes viz; AM, FM., Low pass sampling and Quantization as a random process.
- Understand and analyse concepts digitization of signals viz; sampling, quantizing and encoding.
- Evolve the concept of SNR in the presence of channel induced noise and study Demodulation of analog modulated signals.
- Evolve the concept of quantization noise for sampled and encoded signals and study the concepts of reconstruction from these samples at a receiver.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecture method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
2. Show Video/animation films to explain evolution of communication technologies.
3. Encourage collaborative (Group) Learning in the class.
4. Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
6. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
7. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

AMPLITUDE MODULATION: Introduction, Amplitude Modulation: Time & Frequency Domain description, Switching modulator, Envelop detector.

DOUBLE SIDE BAND-SUPPRESSED CARRIER MODULATION: Time and Frequency Domain description, Ring modulator, Coherent detection, Costas Receiver, Quadrature Carrier Multiplexing.

SINGLE SIDE–BAND AND VESTIGIAL SIDEBAND METHODS OF MODULATION: SSB Modulation, VSB Modulation, Frequency Translation, Frequency Division Multiplexing, Theme Example: VSB Transmission of Analog and Digital Television.

[Text1: 3.1 to 3.8]

Teaching-Learning Process	Chalk and talk method, Power Point Presentation. **Self-study topics:** Properties of the Fourier Transform, Dirac Delta Function. **RBT Level:** L1, L2, L3

Module-2

ANGLE MODULATION: Basic definitions, Frequency Modulation: Narrow Band FM, Wide Band FM, Transmission bandwidth of FM Signals, Generation of FM Signals, Demodulation of FM Signals, FM Stereo Multiplexing, Phase–Locked Loop: Nonlinear model of PLL, Linear model of PLL, Nonlinear Effects in FM

Systems. The Superheterodyne Receiver [Text1: 4.1 to 4.6]	
Teaching-Learning Process	Chalk and talk method, Power Point Presentation, YouTube videos. **Self-study topics:** FM Broadcasting System [Ref1] **RBT Level:** L1, L2, L3
Module-3	
NOISE: Shot Noise, Thermal noise, White Noise, Noise Equivalent Bandwidth. **NOISE IN ANALOG MODULATION**: Introduction, Receiver Model, Noise in DSB-SC receivers. Noise in AM receivers, Threshold effect, Noise in FM receivers, Capture effect, FM threshold effect, FM threshold reduction, Preemphasis and De-emphasis in FM (Text1: 5.10, 6.1 to 6.6)	
Teaching-Learning Process	Chalk and talk method, Power Point Presentation, YouTube videos. **Self-study topics:** Mean, Correlation and Covariance functions of Random Processes **RBT Level:** L1, L2, L3
Module-4	
SAMPLING AND QUANTIZATION: Introduction, Why Digitize Analog Sources? The Low pass Sampling process Pulse Amplitude Modulation. Time Division Multiplexing, Pulse-Position Modulation, Generation of PPM Waves, Detection of PPM Waves. (Text1: 7.1 to 7.7)	
Teaching-Learning Process	Chalk and talk method, Power Point Presentation, YouTube videos. **Self-study topics:** T1 carrier systems [Ref1] **RBT Level:** L1, L2, L3
Module-5	
SAMPLING AND QUANTIZATION (Contd): The Quantization Random Process, Quantization Noise, Pulse–Code Modulation: Sampling, Quantization, Encoding, Regeneration, Decoding, Filtering, Multiplexing; Delta Modulation (Text1: 7.8 to 7.10), Application examples - (a) Video + MPEG (Text1:7.11) and (b) Vocoders (refer Section 6.8 of Reference Book 1)	
Teaching-Learning Process	Chalk and talk method, Power Point Presentation, YouTube videos. **Self-study topics:** Digital Multiplexing. [Ref1] **RBT Level:** L1, L2, L3

Course Outcomes (Course Skill Set)

At the end of the course the student will be able to:

1. Understand the amplitude and frequency modulation techniques and perform time and frequency domain transformations.
2. Identify the schemes for amplitude and frequency modulation and demodulation of analog signals and compare the performance.
3. Characterize the influence of channel noise on analog modulated signals.
4. Understand the characteristics of pulse amplitude modulation, pulse position modulation and pulse code modulation systems.
5. Illustration of digital formatting representations used for Multiplexers, Vocoders and Video transmission.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module. Marks scored out of 100 shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Books

1. Simon Haykins & Moher, Communication Systems, 5th Edition, John Wiley, India Pvt. Ltd, 2010, ISBN 978 – 81 – 265 – 2151 – 7.

Reference Books

1. B P Lathi and Zhi Ding, Modern Digital and Analog Communication Systems, Oxford University Press., 4th edition, 2010, ISBN: 97801980738002.
2. Simon Haykins, An Introduction to Analog and Digital Communication, John Wiley India Pvt. Ltd., 2008, ISBN 978–81–265–3653–5.
3. H Taub & D L Schilling, Principles of Communication Systems, TMH, 2011.

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IV Semester

Communication Laboratory I			
Course Code	**21ECL46**	CIE Marks	50
Teaching Hours/Week (L: T: P: S)	0:0:2:0	SEE Marks	50
Credits	1	Exam Hours	3

Course objectives:

This laboratory course enables students to

- Model an analog communication system signal transmission and reception.
- Realize the electronic circuits to perform analog and pulse modulations and demodulations.
- Verify the sampling theorem and relate the signal and its spectrum before and after sampling.
- Understand the process of PCM and delta modulations.
- Understand the PLL operation.

Sl.No.	**Experiments**
1	Design of active second order Butterworth low pass and high pass filters.
2	Amplitude Modulation and Demodulation of (a) Standard AM and (b) DSBSC (LM741 and LF398 ICs can be used)
3	Frequency modulation and demodulation
4	Design and test Time Division Multiplexing and Demultiplexing of two bandlimited signals.
5	Design and test i) Pulse sampling, flat top sampling and reconstruction. ii) Pulse amplitude modulation and demodulation.
6	Design and test BJT/FET Mixer
7	Pulse Code Modulation and demodulation
8	Phase locked loop Synthesis
9	Illustration of (a) AM modulation and demodulation and display the signal and its spectrum. (b) DSB-SC modulation and demodulation and display the signal and its spectrum. (Use MATLAB/SCILAB)
10	Illustration of FM modulation and demodulation and display the signal and its spectrum. (Use MATLAB/SCILAB)
11	Illustrate the process of sampling and reconstruction of low pass signals. Display the signals and its spectrums of both analog and sampled signals. (Use MATLAB/SCILAB).
12	Illustration of Delta Modulation and the effects of step size selection in the design of DM encoder. (Use MATLAB/SCILAB)

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

1. Demonstrate the AM and FM modulation and demodulation by representing the signals in time and frequency domain.
2. Design and test the sampling, Multiplexing and PAM with relevant circuits.
3. Demonstrate the basic circuitry and operations used in AM and FM receivers.
4. Illustrate the operation of PCM and delta modulations for different input conditions.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 35% (18 Marks out of 50) in the semester-end examination (SEE).

Continuous Internal Evaluation (CIE):

CIE marks for the practical course is **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment to be evaluated for conduction with observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled downed to 30 marks (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8th week of the semester and the second test shall be conducted after the 14th week of the semester.
- In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability. Rubrics suggested in Annexure-II of Regulation book
- The average of 02 tests is scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and average marks of two tests is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

SEE marks for the practical course is 50 Marks.

SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University

All laboratory experiments are to be included for practical examination.

(Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.

Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.

Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by

examiners.
General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners).
Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.
The duration of SEE is 03 hours.

Rubrics suggested in Annexure-II of Regulation book

Suggested Learning Resources:

1. Louis E Frenzel, Principles of Electronic Communication Systems, McGraw Hill Education (India) Private Limited, 2016.
2. B P Lathi, Zhi Ding, Modern Digital and Analog Communication Systems, Oxford University Press, 2015.

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IV Semester

Embedded C Basics			
Course Code	**21EC481**	CIE Marks	50
Teaching Hours/Week (L: T:P: S)	0:0:2:0	SEE Marks	50
Credits	1	Exam Hours	3

Course objectives:

- Understand the basic programming of Microprocessor and microcontroller.
- To develop the microcontroller-based programs for various applications.

Sl.No	**Experiments**
	Conduct the following experiments by writing C Program using Keil microvision simulator (any 8051 microcontroller can be chosen as the target).
1	Write a 8051 C program to multiply two 16 bit binary numbers.
2	Write a 8051 C program to find the sum of first 10 integer numbers.
3	Write a 8051 C program to find factorial of a given number.
4	Write a 8051 C program to add an array of 16 bit numbers and store the 32 bit result in internal RAM
5	Write a 8051 C program to find the square of a number (1 to 10) using look-up table.
6	Write a 8051 C program to find the largest/smallest number in an array of 32 numbers
7	Write a 8051 C program to arrange a series of 32 bit numbers in ascending/descending order
8	Write a 8051 C program to count the number of ones and zeros in two consecutive memory locations.
9	Write a 8051 C program to scan a series of 32 bit numbers to find how many are negative.
10	Write a 8051 C program to display “Hello World” message (either in simulation mode or interface an LCD display).
11	Write a 8051 C program to convert the hexadecimal data 0xCFh to decimal and display the digits on ports P0, P1 and P2 (port window in simulator).

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

1. Write C programs in 8051 for solving simple problems that manipulate input data using different instructions of 8051 C.
2. Develop testing and experimental procedures on 8051 Microcontroller, analyze their operation under different cases.
3. Develop programs for 8051 Microcontroller to implement real world problems.
4. Design and Develop Mini projects

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 35% (18 Marks out of 50) in the semester-end examination (SEE).

Continuous Internal Evaluation (CIE):

CIE marks for the practical course is **50 Marks**.
The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.
Each experiment to be evaluated for conduction with observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.
Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
Total marks scored by the students are scaled downed to 30 marks (60% of maximum marks).
Weightage to be given for neatness and submission of record/write-up on time.
Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8th week of the semester and the second test shall be conducted after the 14th week of the semester.
In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
The suitable rubrics can be designed to evaluate each student's performance and learning ability. Rubrics suggested in Annexure-II of Regulation book
The average of 02 tests is scaled down to **20 marks** (40% of the maximum marks).
The Sum of scaled-down marks scored in the report write-up/journal and average marks of two tests is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

SEE marks for the practical course is 50 Marks.
SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University
All laboratory experiments are to be included for practical examination.
(Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.
Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.
Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.
General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)
Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.
The duration of SEE is 03 hours
Rubrics suggested in Annexure-II of Regulation book

Suggested Learning Resources:

"The 8051 Microcontroller: Hardware, Software and Applications", V Udayashankara and M S Mallikarjuna Swamy, McGraw Hill Education, 1st edition, 2017.

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IV Semester

C++ Basics			
Course Code	**21EC482**	CIE Marks	50
Teaching Hours/Week (L: T:P: S)	0:0:2:0	SEE Marks	50
Credits	1	Exam Hours	03

Course objectives:

- Understand object-oriented programming concepts, and apply them in solving problems.
- To create, debug and run simple C++ programs.
- Introduce the concepts of functions, friend functions, inheritance, polymorphism and function overloading.
- Introduce the concepts of exception handling and multithreading.

Sl.No	**Experiments**
1	Write a C++ program to find largest, smallest & second largest of three numbers using inline functions MAX & Min.
2	Write a C++ program to calculate the volume of different geometric shapes like cube, cylinder and sphere using function overloading concept.
3	Define a STUDENT class with USN, Name & Marks in 3 tests of a subject. Declare an array of 10 STUDENT objects. Using appropriate functions, find the average of the two better marks for each student. Print the USN, Name & the average marks of all the students.
4	Write a C++ program to create class called MATRIX using two-dimensional array of integers, by overloading the operator == which checks the compatibility of two matrices to be added and subtracted. Perform the addition and subtraction by overloading + and – operators respectively. Display the results by overloading the operator <<. If (m1 == m2) then m3 = m1 + m2 and m4 = m1 – m2 else display error
5	Demonstrate simple inheritance concept by creating a base class FATHER with data members: *First Name, Surname, DOB & bank Balance* and creating a derived class SON, which inherits: Surname & Bank Balance feature from base class but provides its own feature: First Name & DOB. Create & initialize F1 & S1 objects with appropriate constructors & display the FATHER & SON details.
6	Write a C++ program to define class name FATHER & SON that holds the income respectively. Calculate & display total income of a family using Friend function.
7	Write a C++ program to accept the student detail such as name & 3 different marks by get_data() method & display the name & average of marks using display() method. Define a friend function for calculating the average marks using the method mark_avg().
8	Write a C++ program to explain virtual function (Polymorphism) by creating a base class polygon which has virtual function areas two classes rectangle & triangle derived from polygon & they have area to calculate & return the area of rectangle & triangle respectively.
9	Design, develop and execute a program in C++ based on the following requirements: An EMPLOYEE class containing data members & members functions: i) Data members: employee number (an integer), Employee_ Name (a string of characters), Basic_ Salary (in integer), All_ Allowances (an integer), Net_Salary (an integer). (ii) Member functions: To read the data of an employee, to calculate Net_Salary & to print the values of all the data members. (All_Allowances = 123% of Basic, Income Tax (IT) =30% of gross salary (=basic_ Salary_All_Allowances_IT).
10	Write a C++ program with different class related through multiple inheritance & demonstrate the use of different access specified by means of members variables & members functions.
11	Write a C++ program to create three objects for a class named count object with data members

	such as roll_no & Name. Create a members function set_data ( ) for setting the data values & display ( ) member function to display which object has invoked it using „this" pointer.
12	Write a C++ program to implement exception handling with minimum 5 exceptions classes including two built in exceptions.

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

1. Write C++ program to solve simple and complex problems
2. Apply and implement major object-oriented concepts like message passing, function overloading, operator overloading and inheritance to solve real-world problems.
3. Use major C++ features such as Templates for data type independent designs and File I/O to deal with large data set.
4. Analyze, design and develop solutions to real-world problems applying OOP concepts of C++

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 35% (18 Marks out of 50) in the semester-end examination (SEE).

Continuous Internal Evaluation (CIE):

CIE marks for the practical course is **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment to be evaluated for conduction with observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled downed to 30 marks (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8th week of the semester and the second test shall be conducted after the 14th week of the semester.
- In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability. Rubrics suggested in Annexure-II of Regulation book
- The average of 02 tests is scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and average marks of two tests is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

SEE marks for the practical course is 50 Marks.

SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University

All laboratory experiments are to be included for practical examination.

(Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.

Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.

Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and

result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)
Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.
The duration of SEE is 03 hours

Rubrics suggested in Annexure-II of Regulation book

Suggested Learning Resources:

1. Object oriented programming in TURBO C++, Robert Lafore, Galgotia Publications, 2002
2. The Complete Reference C++, Herbert Schildt, 4th Edition, Tata McGraw Hill, 2003.
3. Object Oriented Programming with C++, E Balaguruswamy, 4th Edition, Tata McGraw Hill, 2006.

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IV Semester

Octave / Scilab for Signals			
Course Code	**21EC483**	CIE Marks	50
Teaching Hours/Week (L: T:P: S)	0:0:2:0	SEE Marks	50
Credits	1	Exam Hours	03

Course objectives:

1. **Preparation**: To prepare students with fundamental knowledge/ overview in the field of signals and processing.
2. **Core Competence**: To equip students with a basic foundation in electronic engineering and mathematics fundamentals required for comprehending the operation and application of signal processing.
3. **Professionalism & Learning Environment**: To inculcate in students an ethical and professional attitude by providing an academic environment inclusive of effective communication, teamwork, ability to relate engineering issues to a broader social context, and life-long learning needed for a successful professional career.

Sl.No	**Experiments**
1	Verify the Sampling theorem.
2	Determine linear convolution, Circular convolution and Correlation of two given sequences. Verify the result using theoretical computations.
3	Determine the linear convolution of two given point sequences using FFT algorithm. Verify the result using theoretical computations.
4	Determine the correlation using FFT algorithm. Verify the result using theoretical computations.
5	Determine the spectrum of the given sequence using FFT. Verify the result using theoretical computations.
6	Design and test FIR filter using Windowing method (Hamming, Hanning and Rectangular window) for the given order and cut-off frequency.
7	Design and test IIR Butterworth 1^{st} and 2^{nd} order low & high pass filter.
8	Design and test IIR Chebyshev 1^{st} and 2^{nd} order low & high pass filter.
9	Generation of an AM – Suppressed Carrier Wave & visualization of the time domain and frequency domain plots.
10	Generation and visualization of standard test signals (both continuous and discrete time).
11	Generation and visualization of audio signal (pre-recorded) and generation of echo.
12	Generation and visualization of the STFT of a chirp (and other related) signal.

Course outcomes (Course Skill Set):
At the end of the course the student will be able to:

- Demonstrate the DSP concepts on signal generation and sampling using Scilab/Octave
- Design and verify the computation of discrete signals using Scilab/Octave.
- Demonstrate and verify the application of FFT/DFT algorithm for a given signal using Scilab/Octave.
- Design and demonstrate programs to evaluate different types of low and high pass FIR filters using Scilab/Octave.
- Design, demonstrate and visualize different real world signals using Scilab/Octave programs.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 35% (18 Marks out of 50) in the semester-end examination (SEE).

Continuous Internal Evaluation (CIE):

CIE marks for the practical course is **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

Each experiment to be evaluated for conduction with observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.

Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.

Total marks scored by the students are scaled downed to 30 marks (60% of maximum marks).

Weightage to be given for neatness and submission of record/write-up on time.

Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8th week of the semester and the second test shall be conducted after the 14th week of the semester.

In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.

The suitable rubrics can be designed to evaluate each student's performance and learning ability. Rubrics suggested in Annexure-II of Regulation book

The average of 02 tests is scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and average marks of two tests is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

SEE marks for the practical course is 50 Marks.

SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University

All laboratory experiments are to be included for practical examination.

(Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.

Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.

Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)

Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.

The duration of SEE is 03 hours

Rubrics suggested in Annexure-II of Regulation book

Suggested Learning Resources:

Digital Signal Processing Using MATLAB, John G Proakis and Vinay K Ingle, Cengage Learning, 2011

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IV Semester

DAQ using LabVIEW			
Course Code	21EC484	CIE Marks	50
Teaching Hours/Week (L: T:P: S)	0:0:2:0	SEE Marks	50
Credits	1	Exam Hours	03

Course objectives:

- Process the knowledge of loop constructs.
- Fundamentals of graphical programming and use LabVIEW modules
- Implement 'Timing' functions.
- Input algebraic formulas via 'Formula Nodes' and 'Expression Nodes'.

Sl.No	**Experiments**
1	Data acquisition using LabVIEW for temperature measurement with thermocouple.
2	Data acquisition using LabVIEW for temperature measurement with AD590.
3	Data acquisition using LabVIEW for temperature measurement with RTD.
4	Data acquisition using LabVIEW for temperature measurement with Thermistor.
5	Creation of a CRO using LabVIEW and measurement of frequency and amplitude from external source.
6	Create function generator using LabVIEW and display the amplitude and frequency on CRO (externally connected)
7	Demonstrate amplitude modulation considering modulating and carrier wave from external source.
8	Interface LEDs to DAQ output and implement counter.
9	Data acquisition using LabVIEW for load / strain measurement using suitable transducers.
10	Demonstrate binary to grey code converter (& vice versa) using DAQ card.
11	Data acquisition using LabVIEW for distance/humidity measurement using suitable transducers.
12	Reading audio input with Microphones and output using DAQ card.

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

1. Build temperature indicating instruments using LabVIEW (NI DAQ)
2. Interface peripheral devices/instruments to LabVIEW
3. Build LabVIEW modules to sense and process audio inputs
4. Apply programming structures, data types, and the analysis and signal processing algorithms in LabVIEW
5. Debug and troubleshoot applications

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course.

The student has to secure not less than 35% (18 Marks out of 50) in the semester-end examination (SEE).

Continuous Internal Evaluation (CIE):

CIE marks for the practical course is **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment to be evaluated for conduction with observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled downed to 30 marks (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8th week of the semester and the second test shall be conducted after the 14th week of the semester.
- In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability. Rubrics suggested in Annexure-II of Regulation book
- The average of 02 tests is scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and average marks of two tests is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

SEE marks for the practical course is 50 Marks.

SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University

All laboratory experiments are to be included for practical examination.

(Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.

Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.

Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)

Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.

The duration of SEE is 03 hours

Rubrics suggested in Annexure-II of Regulation book

Suggested Learning Resources:

1. Virtual Instrumentation using LABVIEW, Jovitha Jerome, PHI, 2011
2. Virtual Instrumentation using LABVIEW, Sanjay Gupta, Joseph John, TMH, McGraw Hill, Second Edition, 2011.

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V Semester

Digital Communication			
Course Code	**21EC51**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	3:0:0:1	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course objectives:

- Understand the concept of signal processing of digital data and signal conversion to symbols at the transmitter and receiver.
- Compute performance metrics and parameters for symbol processing and recovery in ideal and corrupted channel conditions.
- Understand the principles of spread spectrum communications.
- Understand the basic principles of information theory and various source coding techniques.
- Build a comprehensive knowledge about various Source and Channel Coding techniques.
- Discuss the different types of errors and error detection and controlling codes used in the communication channel.
- Understand the concepts of convolution codes and analyze the code words using time domain and transform domain approach.

Teaching-Learning Process (General Instructions)

The sample strategies, which the teacher can use to accelerate the attainment of the various course outcomes are listed in the following:

1. Lecture method (L) does not mean only the traditional lecture method, but a different type of teaching method may be adopted to develop the outcomes.
2. Arrange visits to nearby PSUs such as BHEL, BEL, ISRO, etc., and small-scale communication industries.
3. Show Video/animation films to explain the functioning of various modulation techniques, Channel, and source coding.
4. Encourage collaborative (Group) Learning in the class
5. Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking
6. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize & analyze information rather than simply recall it.
7. Topics will be introduced in multiple representations.
8. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
9. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Digital Modulation Techniques: Phase shift Keying techniques using coherent detection: generation, detection and error probabilities of BPSK and QPSK, M–ary PSK, M–ary QAM. Frequency shift keying techniques using Coherent detection: BFSK generation, detection and error probability. Non coherent orthogonal modulation techniques: BFSK, DPSK Symbol representation, Block diagrams treatment of Transmitter and Receiver, Probability of error (without derivation of probability of error equation).

Teaching-Learning Process	Chalk and talk method, Simulation of modulation techniques, Power Point Presentation, YouTube videos Animation of BPSK, QPSK, BFSK and DPSK. Problems on Generation and detection of DPSK, QPSK. **Self-study topic**: Minimum shift keying and Non-coherent BFSK **RBT Level:** L1, L2, L3

Module-2	
Signalling Communication through Band Limited AWGN Channels: **Signalling over AWGN Channels**- Introduction, Geometric representation of signals, Gram- Schmidt Orthogonalization procedure, Conversion of the continuous AWGN channel into a vector channel (without statistical characterization), Optimum receivers using coherent detection: ML Decoding, Correlation receiver, matched filter receiver. **Signal design for Band limited Channels**: Design of band limited signals for zero lSI-The Nyquist Criterion (statement only), Design of band limited signals with controlled lSI-Partial Response signals, Probability of error for detection of Digital PAM: Symbol-by-Symbol detection of data with controlled lSI.	
Teaching-Learning Process	Chalk & talk method, PowerPoint Presentation, YouTube videos **Self-study topics**: Maximum Likelihood detection, Channel equalization **RBT Level:** L1, L2, L3
Module-3	
Principles of Spread Spectrum: Spread Spectrum Communication Systems: Model of a Spread Spectrum Digital Communication System, Direct Sequence Spread Spectrum Systems, Effect of De-spreading on a narrowband Interference, Probability of error (statement only), Some applications of DS Spread Spectrum Signals, Generation of PN Sequences, Frequency Hopped Spread Spectrum, CDMA based on IS-95.	
Teaching-Learning Process	Chalk & talk method, Seminar about security issues in communication systems **RBT Level:** L1, L2, L3
Module-4	
Introduction to Information Theory: Measure of information, Average information content of symbols in long independent sequences. **Source Coding:** Encoding of the Source Output, Shannon's Encoding Algorithm, Shannon-Fano Encoding Algorithm, Huffman coding. **Error Control Coding:** Introduction, Examples of Error control coding, methods of Controlling Errors, Types of Errors, types of Codes.	
Teaching-Learning Process	Chalk and talk method, Problems on source coding, error control codes **RBT Level:** L1, L2, L3
Module-5	
Linear Block Codes: Matrix description of Linear Block Codes, Error Detection & Correction capabilities of Linear Block Codes, Single error correction Hamming code, Table lookup Decoding using Standard Array. **Convolution codes:** Convolution Encoder, Time domain approach, Transform domain approach, Code Tree, Trellis and State Diagram.	
Teaching-Learning Process	Chalk and talk method, Animation of convolution encoders **RBT Level:** L1, L2, L3
Course outcomes (Course Skill Set) At the end of the course the student will be able to: 1. Analyze different digital modulation techniques and choose the appropriate modulation technique for the given specifications. 2. Test and validate symbol processing and performance parameters at the receiver under ideal and corrupted bandlimited channels. 3. Differentiate various spread spectrum schemes and compute the performance parameters of communication system. 4. Apply the fundamentals of information theory and perform source coding for given message 5. Apply different encoding and decoding techniques with error Detection and Correction.	
Assessment Details (both CIE and SEE)	

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module. Marks scored out of 100 shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Text Books:

1. Simon Haykin, "Digital Communication Systems", John Wiley & sons, First Edition, 2014, ISBN 978-0-471-64735-5.
2. John G Proakis and Masoud Salehi, "Fundamentals of Communication Systems", 2014 Edition, Pearson Education, ISBN 978-8-131-70573-5.
3. K Sam Shanmugam, "Digital and analog communication systems", John Wiley India Pvt. Ltd, 1996.
4. Hari Bhat, Ganesh Rao, "Information Theory and Coding", Cengage, 2017.
5. Todd K Moon, "Error Correction Coding", Wiley Std. Edition, 2006.

Reference Books:

1. Bernard Sklar, "Digital Communications – Fundamentals and Applications", Second Edition, Pearson Education, 2016, ISBN: 9780134724058.
2. K Sam Shanmugam, "Digital and analog communication systems", John Wiley India Pvt. Ltd, 1996.

Web links and Video Lectures (e-Resources)

- https://nptel.ac.in/courses/108102096

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V Semester

Object Oriented Programming with Java & Data Structures			
Course Code	**21EC52**	CIE Marks	50
Teaching Hours/Week (L: T: P: S)	(3:0:2:0)	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 13 Lab slots	Total Marks	100
Credits	04	Exam Hours	03

Course objectives:

The goal of the course 'Object Oriented Programming with Java & Data Structures' is

1. To make students learn fundamentals features of object oriented language and JAVA
2. To set up a Java JDK environment to create, debug and run simple Java programs.
3. To Illustrate linear representation of data structures: Stack, Queues, Lists.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. In addition to the traditional lecture method, different types of innovative teaching methods may be adopted so that the delivered lessons shall develop student's theoretical and programming skills.
2. State the need for learning Programming with real-life examples.
3. Support and guide the students for self–study.
4. You will also be responsible for assigning homework, grading assignments and quizzes, and documenting students' progress.
5. Encourage the students for group learning to improve their creative and analytical skills.
6. Show short related video lectures in the following ways:
   - As an introduction to new topics (pre-lecture activity).
   - As a revision of topics (post-lecture activity).
   - As additional examples (post-lecture activity).
   - As an additional material of challenging topics (pre-and post-lecture activity).
   - As a model solution of some exercises (post-lecture activity).

Module-1: Introduction to JAVA

An Overview of Java: Object-Oriented Programming, A First Simple program,

Data types, Variables and arrays: Primitive types, Booleans, A Closer Look at Literals, Variables, Type conversion and casting, Arrays,

Introducing Classes: Class fundamentals, Declaring objects, Assigning Object Reference Variables, Introducing Methods, Constructors, The this keyword, Garbage collection, The finalize() method, A stack class.

TextBook 1: Ch: 2, Ch: 3, Ch: 6

Teaching-Learning Process	Chalk and Talk, PowerPoint Presentation **RBT Level:** L1, L2, L3

Module-2: OOP in JAVA

A Closer Look at Methods and classes: Overloading methods, Using objects as parameters, Returning objects, Access control, static members, final members, Command LIne Arguments, String Class.
Inheritance Basics: Member access and Inheritance, A Superclass Variable can reference a subclass object, Using Super, Creating a Multilevel Hierarchy, When Constructors are called.

Text Book 1: Ch: 7

Teaching-Learning	Chalk and Talk, PowerPoint Presentation

Process	**RBT Level:** L1, L2, L3
Module-3: Inheritance and Exception Handling	
Java Collection Framework: Inheritance Hierarchy, Collection interface, The HashSet Class, Generic Collections, Generic methods, Generic Wildcards. Iterators, TreeSet class, LinkedHashset Class, EnumSet Class, List Interface, ArrayList and Vector classes, Linked class, ListIterator interface. Text Book 2: Ch: 4	
Teaching-Learning Process	Chalk and Talk, PowerPoint Presentation **RBT Level:** L1, L2, L3
Module-4: Stack, Queues, Linked data structures	
Stacks: Stack operations, JCF Stack class, A stack interface, An indexed implementation, A linked implementation, Abstracting the common code, Queues: Queue operations, JCF Queue Interface, A simple queue interface, An indexed implementation, Application: A Client-Server system. Text Book 2: Ch: 5, Ch: 6	
Teaching-Learning Process	Chalk and Talk, PowerPoint Presentation **RBT Level:** L1, L2, L3
Module-5: Lists, Trees, Binary Tree	
Lists: JCF list interface, Range-view operation sublist( ), List iterators, Other List types. Tree: Tree definitions, Decision trees, Ordered trees, Traversal algorithms Binary Tree: Definitions, Full binary trees, Complete Binary trees, Binary tree traversal algorithms, Expression tree. Text Book 2: Ch: 7, Ch: 10, Ch: 11	
Teaching-Learning Process	Chalk and Talk, PowerPoint Presentation **RBT Level:** L1, L2, L3

PRACTICAL COMPONENT OF IPCC	
Sl.No	**Experiments**
1	Use Eclipse or NetBeans IDE and acquaint with the various menus. Create a test project, add a test class, and run it. Try debug step by step with a small program of about 10 to 15 lines which contains at least one if else condition and a for loop. To include suitable Small Java programs.
2	Design a class to represent a Student (details include the Student ID, Name of the Student, Branch, year, location and college). Assign initial values using constructor. Design a sub-class with methods to accept the marks & attendance and hence calculate average of marks of 6 subjects and attendance percentage.
3	Write a recursive and non recursive Java program to implement i) Linear search ii) Binary search
4	Write a Java program to implement i) Bubble sort ii) Selection sort iii) quick sort iv) insertion sort
5	Write a Java program to generate 'N' Fibonacci numbers using recursive and non-recursive methods.
6	Write a menu-driven Java program to implement the following data structures using an array: a)Stack ADT (b) Queue ADT
7	Write a menu-driven Java program to implement the following operations on Singly Linked List (SLL): a) Create a SLL of integers. b) Insert a given integer from SLL. c) Delete a given integer into SLL. d) Display the contents of SLL.
8	Write a Java program to perform the following operations:

	a) Insert an element into a Binary Search Tree (BST). b) Delete an element from a BST. c) Search for a key element in a BST d) Traverse the BST in pre-order, in-order & post-order.
9	Write a java program to demonstrate method overloading and constructors overloading.
10	Write a Java programs to implement the following using a singly linked list and perform the given operations. a) Stack ADT i) push an element into stack ii) pop an element from the stack iii) display the contents of the stack
11	Write a Java programs to implement the following using a singly linked list and perform the given operations. b) Queue ADT i) insert an element into queue ii) delete an element from the queue iii) display the contents of the queue
12	Write a java program that works as a simple calculator. Use a Grid Layout to arrange Buttons for digits and for the + - * % operations. Add a text field to display the result. Handle any possible exceptions like divide by zero.

Course Outcomes

At the end of the course the student will be able to:

1. Use OOP concepts effectively to build simple application programs.
2. Set up a Java JDK environment to create, debug and run simple java programs
3. Explain and implement the object oriented core-concepts such as class, object, inheritance and exception handling using JAVA.
4. Implement the data structures such as Arrays, Lists, Stack, Queue and Trees using Java
5. Make a decision on choosing a suitable data structure for a specific application program.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

CIE for the theory component of IPCC

Two Tests each of **20 Marks (duration 01 hour**)

- First test at the end of 5th week of the semester
- Second test at the end of the 10th week of the semester

Two assignments each of **10 Marks**

- First assignment at the end of 4th week of the semester
- Second assignment at the end of 9th week of the semester

Scaled-down marks of two tests and two assignments added will be CIE marks for the theory component of IPCC for **30 marks**.

CIE for the practical component of IPCC

- On completion of every experiment/program in the laboratory, the students shall be evaluated and marks shall be awarded on the same day. The **15 marks** are for conducting the experiment and preparation of the laboratory record, the other **05 marks shall be for the test** conducted at the end of the semester.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks.

Marks of all experiments' write-ups are added and scaled down to 15 marks.

- The laboratory test **(duration 03 hours)** at the end of the 15th week of the semester /after completion of all the experiments (whichever is early) shall be conducted for 50 marks and scaled down to 05 marks**.**

Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **20 marks**.

SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (duration 03 hours)

- The question paper will have ten questions. Each question is set for 20 marks.
- There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
- The students have to answer 5 full questions, selecting one full question from each module.

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper shall include questions from the practical component.

- The minimum marks to be secured in CIE to appear for SEE shall be the 12 (40% of maximum marks-30) in the theory component and 08 (40% of maximum marks -20) in the practical component. The laboratory component of the IPCC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be included**.** The maximum of 04/05 questions to be set from the practical component of IPCC, the total marks of all questions should not be more than the 20 marks.

SEE will be conducted for 100 marks and students shall secure 35% of the maximum marks to qualify in the SEE. Marks secured will be scaled down to 50.

Suggested Learning Resources:

Text Books

1. "JAVA The Complete Reference", Herbert Schildt, 7th Edition, Tata McGraw Hill, 2007.
2. "Data Structures with Java", John R Hubbard, 2nd edition, Schaum's Outlines.

Reference Books

1. "Fundamentals of OOP and Data Structures in Java", Richard Wiener, Lewis J Pinson, Cambridge University Press, 2000.
2. "Object Oriented Programming and Java", Danny Poo, Derek Kion, Swarnalatha Ashok, Springer, 2nd edition, 2007.
3. "Java Fundamentals", Herbert Schildt, Dale Skrien, McGraw Hill Education, 2017.
4. "Data Structures and Algorithms Made Easy in JAVA: Data Structure and Algorithmic Puzzles", Narasimha Karumanchi, CareerMonk Publications, Second edition, 2011.
5. "Data Structures & Algorithms in Java", Goodrich, Tamassia, Goldwasser, Universities Press; Second edition, 2005.

Web links and Video Lectures (e-Resources):

- VTU e-Shikshana Program
- VTU EDUSAT Program
- https://www.youtube.com/watch?v=CFD9EFcNZTQ
- https://www.youtube.com/watch?v=grEKMHGYyns

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

Quizzes, Assignments, Seminars

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(Effective from the academic year 2021 – 22)

V Semester

Computer Communication Networks			
Course Code	**21EC53**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	3:0:0:1	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course objectives: This course will enable students to:

1. Understand the layering architecture of OSI reference model and TCP/IP protocol suite.
2. Understand the protocols associated with each layer.
3. Learn the different networking architectures and their representations.
4. Learn the functions and services associated with each layer.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecture method (L): the traditional lecture method, or a different type of teaching method may be adopted to develop the outcomes.
2. Show Video/animation films to explain the functioning of various concepts in networking.
3. Encourage collaborative (Group) Learning in the class.
4. Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking .
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
6. Demonstrate implementation of various protocols to help better understand the functioning of various concepts in networking.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Introduction: Data communication: Components, Data representation, Data flow, Networks: Network criteria, Physical Structures, Network types: LAN, WAN, Switching, The Internet. (1.1,1.2, 1.3 (1.3.1to 1.3.4 of Text).

Network Models: TCP/IP Protocol Suite: Layered Architecture, Layers in TCP/IP suite, Description of layers, Encapsulation and Decapsulation, Addressing, Multiplexing and Demultiplexing, The OSI Model: OSI Versus TCP/IP. (2.2, 2.3 of Text)

Data-Link Layer: Introduction: Nodes and Links, Services, Two Categories' of link, Sublayers, Link Layer addressing: Types of addresses, ARP (9.1, 9.2 (9.2.1, 9.2.2))

Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, YouTube videos, Animation of OSI and TCP-IP protocol suites, Example of ARP and RARP. **Self-Study**: Internet standards and administration, **RBT Level:** L1, L2, L3

Module-2

Data Link Control (DLC) services: Framing, Flow and Error Control. (11.1 of Text)

Media Access Control: Random Access: ALOHA, CSMA, CSMA/CD, CSMA/CA. (12.1 of Text).

Connecting Devices: Hubs, Switches, Virtual LANs: Membership, Configuration, Communication between Switches, Advantages. (17.1,17.2 of text)

Wired and Wireless LANs: Ethernet Protocol, Standard Ethernet. (13.1, 13.2 (13.2.1 to 13.2.5 of Text)

Introduction to wireless LAN: Architectural Comparison, Characteristics, Access Control. (15.1 of Text)	
Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, YouTube videos, Animations showing Framing, CSMA, Connecting devices, Problems on ALOHA, CSMA, Framing and Standard ethernet. **Self-Study**: Fast Ethernet, Gigabit ethernet & IEEE802.11 wireless LANs **RBT Level:** L1, L2, L3

Module-3

Network Layer: Introduction, Network Layer services: Packetizing, Routing and Forwarding, Other services, Packet Switching: Datagram Approach, Virtual Circuit Approach, IPV4 Addresses: Address Space, Classful Addressing, Classless Addressing, DHCP, Network Address Resolution (18.1(excluding 18.1.3), 18.2, 18.4 of Text)
Network Layer Protocols: Internet Protocol (IP): Datagram Format, Fragmentation, Options, Security of IPv4 Datagrams. (19.1of Text), IPv6 addressing and Protocol (22.1 and 22.2).
Unicast Routing: Introduction, Routing Algorithms: Distance Vector Routing, Link State Routing, Path vector routing. (20.1, 20.2 of Text)

Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, YouTube videos, Animation of DHCP, routing protocols, Numericals on Addressing, **Self-Study**: Network Layer performance, RIP, OSPF **RBT Level:** L1, L2, L3

Module-4

Transport Layer: Introduction: Transport Layer Services, Connectionless and Connection oriented Protocols, Transport Layer Protocols: Simple protocol, Stop and wait protocol, Go-BackN Protocol, Selective repeat protocol, Piggybacking (23.1, 23.2.1, 23.2.2, 23.2.3, 23.2.4, 23.2.5 of Text)

Transport-Layer Protocols in the Internet: User Datagram Protocol: User Datagram, UDP Services, UDP Applications, Transmission Control L1, L2, L3 Protocol: TCP Services, TCP Features, Segment, Connection, State Transition diagram, Windows in TCP, Error control, TCP congestion control. (24.2, 24.3.1, 24.3.2, 24.3.3, 24.3.4, 24.3.6, 24.3.8, 24.3.9 of Text)

***Note: Exclude FSMs for CIE and SEE**

Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, YouTube videos, Animation/Implementation of Flow control protocols and TCP using simulators, **Self-Study**: Flow Control in TCP **RBT Level:** L1, L2, L3

Module-5

Application Layer: Introduction: providing services, Application- layer paradigms, Standard Client – Server Protocols: Hyper Text Transfer Protocol, FTP: Two connections, Control Connection, Data Connection, Electronic Mail: Architecture, Domain Name system: Name space, DNS in internet, Resolution, DNS Messages, Registrars, DDNS, security of DNS. (25.1, 26.1.2, 26.2, 26.3, 26.6 of Text)
Quality of Service (30.1, 30.2.) Network Security (31.1)

Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, YouTube videos, Animation/Implementation of HTTP, FTP, DNS using network simulators, **Self Study**: WWW , TELNET **RBT Level:** L1, L2, L3

Course outcomes (Course Skill Set)

At the end of the course the student will be able to:

1. Understand the concepts of networking thoroughly.
2. Identify the protocols and services of different layers.
3. Distinguish the basic network configurations and standards associated with each network.
4. Discuss and analyse the various applications that can be implemented on networks.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end

examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module. Marks scored out of 100 shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Text Books:

Forouzan, "Data Communications and Networking", 5th Edition, McGraw Hill, 2013, ISBN: 1-25-906475-3.

Reference Books:

1. James J Kurose, Keith W Ross, "Computer Networks", Pearson Education.
2. Wayne Tomasi, "Introduction to Data Communication and Networking", Pearson India, 1st edition.
3. Andrew Tannenbaum, "Computer Networks", Prentice Hall.
4. William Stallings, "Data and Computer Communications", Prentice Hall.

Web links and Video Lectures (e-Resources)

- https://nptel.ac.in/courses/106105183.
- TCP/IP Tutorial and Technical Overview, (IBM Redbook) - Download From http://www.redbooks.ibm.com/abstracts/gg243376.html
- TCP/IP Guide, Charles M Kozierok, Available Online - http://www.tcpipguide.com/
- Request for Comments (RFC) - IETF - http://www.ietf.org/rfc.html
- https://cosmolearning.org/courses/computer-networks-524/video-lectures/
- https://www.eecis.udel.edu/~bohacek/videoLectures/ComputerNetworking/ComputerNetworking_v2.html

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Implementation of simple networks and various networking protocols and algorithms using simulators like NCTUns / CISCO packet tracer and measurement of various parameters using WireShark
- Implementation of simple networks and various networking protocols and algorithms in C/C++/Python

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V Semester

Microwave Theory and Antennas			
Course Code	**21EC54**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	3:0:0:1	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course objectives: This course will enable students to :

- Describe the microwave properties and its transmission media.
- Describe the microwave devices for several applications.
- Understand the basic concepts of antenna theory.
- Identify antenna types for specific applications.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Using videos for demonstration of the fundamental principles to students for better understanding of concepts.
2. Demonstration of microwave devices and Antennas in the lab environment where students can study them in real time.

Module-1

Microwave Sources: Introduction, Gunn Diode (Text 2: 7.1,7.1.1,7.1.2)

Microwave transmission lines: Microwave frequencies, Microwave devices, Microwave systems. Transmission line equations and solutions, Reflection Coefficient and Transmission Coefficient. Standing wave and standing wave ratio. Smith chart, Single stub matching.

Text 2: 0.1, 0.2, 0.3, 3.1, 3.2, 3.3, 3.5, 3.6 (except double stub matching)

Teaching-Learning Process	Chalk and Talk would be helpful for the quantitative analysis. Videos of the Basic principles of the devices would help students to grasp better. **RBT Level:** L1, L2, L3

Module-2

Microwave Network Theory: Introduction, S matrix representation of multi-port networks (Text 1: 6.1, 6.3, 6.3.1, 6.3.2)

Microwave passive devices: Coaxial connectors and Adapters, Attenuators, Phase shifters, waveguide Tees, Magic Tee, Circulator, Isolator. (Text 1: 6.4.2, 6.4.14, 6.4.15, 6.4.16, 6.4.17 A, B)

Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2, L3

Module-3

Strip Lines: Introduction, Microstrip lines, Parallel Strip lines (Text 2: 11.1,11.2)

Antenna Basics: Introduction, Basic Antenna Parameters, Patterns, Beam Area, Radiation Intensity, Beam efficiency, Directivity and Gain, Antenna Aperture Effective height, Bandwidth, Radio communication Link, Antenna Field Zones (Text 3: 2.1-2.7, 2.9-2.11, 2.13).

Teaching-Learning Process	Chalk and talk method, Power point presentation and videos. **RBT Level:** L1, L2, L3

Module-4	
Point sources and arrays: Introduction, Point Sources, Power patterns, Power theorem, Radiation Intensity, Arrays of 2 isotropic point sources, Pattern multiplication, Linear arrays of n Isotropic sources of equal amplitude and Spacing. (Text 3: 5.1-5.6, 5.9, 5.13) **Electric Dipole**: Introduction, Short Electric dipole, Fields of a short dipole. Radiation resistance of a short dipole. Thin linear antenna (field analysis). (Text 3: 6.1-6.5)	
Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2, L3
Module-5	
Loop and Horn antenna: Introduction: Small loop, Comparison of far fields of small loop and Short dipole. Radiation resistance of small loop, Horn Antennas, Rectangular antennas. (Text 3: 7.1,7.2, 7.4, 7.6, 7.7, 7.8, 7.19, 7.20) **Antenna Types**: The Helix geometry, Helix modes, Practical design consideration for mono-filar axial mode Helical Antenna, Yagi Uda array, Parabolic Reflector (Text 3: 8.3, 8.4, 8.5, 8.8, 9.5)	
Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2, L3

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

1. Describe the use and advantages of microwave transmission
2. Analyze various parameters related to transmission lines.
3. Identify microwave devices for several applications.
4. Analyze various antenna parameters and their significance in building the RF system.
5. Identify various antenna configurations for suitable applications.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per

the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module. Marks scored out of 100 shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Text Books:

1. Microwave Engineering -Annapurna Das, Sisir K Das, TMH Publication, 2nd Edition, 2010.
2. Microwave Devices and Circuits – Samuel Y Liao, Pearson Education.
3. Antennas and Wave Propagation -John D Krauss, Ronald J Marhefka, Ahmad S Khan, 4th Edition, McGraw Hill Education, 2013.

Reference Books:

1. Microwave Engineering -David M Pozar, John Wiley India Pvt Ltd., Pvt Ltd., 3rd edition, 2008.
2. Microwave Engineering-Sushrut Das, Oxford Higher Education, 2nd Edn, 2015.
3. Antennas and Wave Propagation- Harish and Sachidananda, Oxford University Press, 2007.

Web links and Video Lectures (e-Resources)

- Nptel Videos and Lectures
- https://www.tutorialspoint.com/antenna_theory/antenna_theory_horn.html
- http://www.antenna-theory.com/antennas/smallLoop.php

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Lab based demos for the devices can be done in the form of experiments.
- Mini Projects can be given to students involving design of microwave devices and Antennas.

03.10.2022

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V Semester

Communication Lab II			
Course Code	**21ECL55**	CIE Marks	50
Teaching Hours/Week (L: T: P: S)	0:0:2:0	SEE Marks	50
Credits	1	Exam Hours	3

Course objectives:

This laboratory course enables students to

- Design and demonstrate communication circuits for different digital modulation techniques.
- To simulate Source coding Algorithms using C/C++/ MATLAB code.
- To simulate Error correcting and detecting codes using C/C++/ MATLAB code.
- Simulate the networking concepts and protocols using C/C++/ Network simulation tool.
- Understand entropies and mutual information of different communication channels.

Sl.No.	**Experiments**
	Implement the following using discrete components
1	FSK generation and detection
2	PSK generation and detection
3	DPSK Transmitter and receiver
4	QPSK Transmitter and Receiver
	Implement the following in C/C++/MATLAB/Scilab/Python or any other Suitable software
5	Write a program to encode binary data using Huffman code and decode it.
6	Write a program to encode binary data using a (7,4) Hamming code and decode it.
7	Write a program to encode binary data using a ((3,1,2)/suitably designed) Convolution code and decode it.
8	For a given data, use CRC-CCITT polynomial to obtain the CRC code. Verify the program for the cases a) Without error b) With error
	Implement the following algorithms in C/C++/MATLAB/Network simulator
9	Write a program for congestion control using leaky bucket algorithm.
10	Write a program for distance vector algorithm to find suitable path for transmission.
11	Write a program for flow control using sliding window protocols.
12	Configure a simple network (Bus/star) topology using simulation software **OR** Configure a simple network (Ring/Mesh) topology using simulation software.
	Demonstration Experiments (For CIE)
13	Configure and simulate simple Wireless Local Area network.
14	Simulate the BER performance of (2, 1, 3) binary convolutional code with generator sequences g(1) =(1 0 1 1) and g(2) =(1 1 1 1) on AWGN channel. Use QPSK modulation scheme. Channel decoding is to be performed through Viterbi decoding. Plot the bit error rate versus SNR (dB), i.e. $P_{e,b}$ versus E_b/N_0. Consider binary input vector of size 3 lakh bits. Also find the coding gain.
15	Simulate the BER performance of (7, 4) Hamming code on AWGN channel. Use QPSK modulation

	scheme. Channel decoding is to be performed through maximum-likelihood decoding. Plot the bit error rate versus SNR (dB), i.e. $P_{e,b}$ versus E_b/N_0. Consider binary input vector of size 5 lakh bits. Use the following parity check matrix for the (7, 4) Hamming code. Also find the coding gain. $$H = \begin{bmatrix} 1 & 0 & 0 & 1 & 1 & 1 & 0 \\ 0 & 1 & 0 & 0 & 1 & 1 & 1 \\ 0 & 0 & 1 & 1 & 1 & 0 & 1 \end{bmatrix}$$
16	Simulate the BER performance of rate 1/3 Turbo code. Turbo encoder uses two recursive systematic encoders with $G(D) = \left[1, \frac{1+D^4}{1+D+D^2+D^3+D^4}\right]$ and pseudo-random interleaver. Use QPSK modulation scheme. Channel decoding is to be performed through maximum a-posteriori (MAP) decoding algorithm. Plot the bit error rate versus SNR (dB), i.e. $P_{e,b}$ versus E_b/N_0. Consider binary input vector of size of around 3 lakh bits and the block length as 10384 bits. Also find the coding gain.

Course outcomes (Course Skill Set):

On the completion of this laboratory course, the students will be able to:

1. Design and test the digital modulation circuits and display the waveforms.
2. To Implement the source coding algorithm using C/C++/ MATLAB code.
3. To Implement the Error Control coding algorithms using C/C++/ MATLAB code.
4. Illustrate the operations of networking concepts and protocols using C programming and network simulators.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 35% (18 Marks out of 50) in the semester-end examination (SEE).

Continuous Internal Evaluation (CIE):

CIE marks for the practical course is **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment to be evaluated for conduction with observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled downed to 30 marks (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8th week of the semester and the second test shall be conducted after the 14th week of the semester.
- In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability. Rubrics suggested in Annexure-II of Regulation book
- The average of 02 tests is scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and average marks of two tests is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

SEE marks for the practical course is 50 Marks.

SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by

the University

All laboratory experiments are to be included for practical examination.

(Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.

Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.

Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners).

Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.

The duration of SEE is 03 hours.

Rubrics suggested in Annexure-II of Regulation book

Suggested Learning Resources:

1. Simon Haykin, "Digital Communication Systems", John Wiley & sons, First Edition, 2014, ISBN 978-0-471-64735-5.
2. K Sam Shanmugam, "Digital and analog communication systems", John Wiley India Pvt. Ltd, 1996.
3. Forouzan, "Data Communications and Networking", 5th Edition, McGraw Hill, 2013, ISBN: 1-25-906475-3.

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V Semester

IoT (Internet of Things) Lab			
Course Code	21EC581	CIE Marks	50
Teaching Hours/Week (L: T:P: S)	0:0:2:0	SEE Marks	50
Credits	1	Exam Hours	03

Course objectives:

- To impart necessary and practical knowledge of components of Internet of Things
- To develop skills required to build real-life IoT based projects.

Sl.No	**Experiments**
1	i) To interface LED/Buzzer with Arduino/Raspberry Pi and write a program to 'turn ON' LED for 1 sec after every 2 seconds. ii) To interface Push button/Digital sensor (IR/LDR) with Arduino/Raspberry Pi and write a program to 'turn ON' LED when push button is pressed or at sensor detection.
2	i) To interface DHT11 sensor with Arduino/Raspberry Pi and write a program to print temperature and humidity readings. ii) To interface OLED with Arduino/Raspberry Pi and write a program to print temperature and humidity readings on it.
3	To interface motor using relay with Arduino/Raspberry Pi and write a program to 'turn ON' motor when push button is pressed.
4	To interface Bluetooth with Arduino/Raspberry Pi and write a program to send sensor data to smartphone using Bluetooth.
5	To interface Bluetooth with Arduino/Raspberry Pi and write a program to turn LED ON/OFF when '1'/'0' is received from smartphone using Bluetooth.
6	Write a program on Arduino/Raspberry Pi to upload temperature and humidity data to thingspeak cloud.
7	Write a program on Arduino/Raspberry Pi to retrieve temperature and humidity data from thingspeak cloud.
8	To install MySQL database on Raspberry Pi and perform basic SQL queries.
9	Write a program on Arduino/Raspberry Pi to publish temperature data to MQTT broker.
10	Write a program to create UDP server on Arduino/Raspberry Pi and respond with humidity data to UDP client when requested.
11	Write a program to create TCP server on Arduino/Raspberry Pi and respond with humidity data to TCP client when requested.
12	Write a program on Arduino/Raspberry Pi to subscribe to MQTT broker for temperature data and print it.

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

1. Understand internet of Things and its hardware and software components
2. Interface I/O devices, sensors & communication modules
3. Remotely monitor data and control devices
4. Develop real life IoT based projects

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 35% (18 Marks out of 50) in the semester-end examination (SEE).

Continuous Internal Evaluation (CIE):

CIE marks for the practical course is **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment to be evaluated for conduction with observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled downed to 30 marks (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8th week of the semester and the second test shall be conducted after the 14th week of the semester.
- In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability. Rubrics suggested in Annexure-II of Regulation book
- The average of 02 tests is scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and average marks of two tests is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

SEE marks for the practical course is 50 Marks.

SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University

All laboratory experiments are to be included for practical examination.

(Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.

Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.

Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)

Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.

The duration of SEE is 03 hours

Rubrics suggested in Annexure-II of Regulation book

Suggested Learning Resources:

1. Vijay Madisetti, Arshdeep Bahga, Internet of Things. "A Hands on Approach", University Press
2. Dr. SRN Reddy, Rachit Thukral and Manasi Mishra, "Introduction to Internet of Things: A practical Approach", ETI Labs
3. Pethuru Raj and Anupama C Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press
4. Jeeva Jose, "Internet of Things", Khanna Publishing House, Delhi
5. Adrian McEwen, "Designing the Internet of Things", Wiley
6. Raj Kamal, "Internet of Things: Architecture and Design", McGraw Hill

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V Semester

Communication Simulink Toolbox			
Course Code	**21EC582**	CIE Marks	50
Teaching Hours/Week (L: T:P: S)	0:0:2:0	SEE Marks	50
Credits	1	Exam Hours	03

Course objectives:

- To impart knowledge of simulation software in digital communications
- To develop skills required to build and analyze the performance of various simulated communication systems under different conditions

Sl. No.	Experiments
1	Modulation & demodulation of a random binary data stream using 16 – QAM.
2	Bit error rate (BER) improvement using Pulse Shaping on 16 – QAM signal. (Use forward error correction (FEC) coding.)
3	Perform OFDM modulation and obtain time domain and frequency domain plots to show a low-rate signal, a high-rate signal, and a frequency selective multipath channel response.
4	(a) Simulate basic OFDM with no cyclic prefix. (b) Perform Equalization, Convolution, and Cyclic Prefix Addition on basic OFDM.
5	OFDM with FFT Based Oversampling - Modify an OFDM+ Cyclic Prefix signal to efficiently output an oversampled waveform from the OFDM modulator.
6	Simulate a basic communication system in which the signal is first QPSK modulated and then subjected to Orthogonal Frequency Division Multiplexing (OFDM).
7	Obtain the scatter plots & eye diagrams of a QPSK signal to visualize the signal behaviour in presence of AWGN.
8	(a) Generate a multiband signal using the Communications Toolbox. (b) Random noise generation using Simulink & display histogram plots of Gaussian, Rayleigh, Rician, and Uniform noise.
9	QPSK Transmitter and Receiver in Simulink.
10	Multipath Fading Channel in Simulink – For example: Simulate QPSK transmission over a • multipath Rayleigh fading channel and • a multipath Rician fading channel.
11	Adjacent and Co-Channel Interference using Simulink. • Use PSK-modulated signals to show the effects of adjacent and co-channel interference on a transmitted signal.
12	Modulation Classification with Deep Learning • Predict Modulation Type Using CNN

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

1. Perform sampling, aliasing, filtering, and quadrature modulation through simulation.
2. Plot signal space representation of digital modulation techniques.
3. Design and implement a pulse shape and matched filter to avoid inter-symbol interference and maximize receiver SNR.
4. Demonstrate advanced wireless communication techniques like Multipath fading, CCI etc. and model the same using MATLAB / Simulink.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course.

The student has to secure not less than 35% (18 Marks out of 50) in the semester-end examination (SEE).

Continuous Internal Evaluation (CIE):

CIE marks for the practical course is **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment to be evaluated for conduction with observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled downed to 30 marks (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8th week of the semester and the second test shall be conducted after the 14th week of the semester.
- In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability. Rubrics suggested in Annexure-II of Regulation book
- The average of 02 tests is scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and average marks of two tests is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

SEE marks for the practical course is 50 Marks.

SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University

All laboratory experiments are to be included for practical examination.

(Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.

Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.

Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)

Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.

The duration of SEE is 03 hours

Rubrics suggested in Annexure-II of Regulation book

Suggested Learning Resources:

1. Communication Toolbox – Examples (https://in.mathworks.com/)
2. "Digital Communication Laboratory" Courseware by Professor Lee C Potter, Dr. Yang Yang, Electrical and Computer Engineering, The Ohio State University.

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V Semester

Antenna Design & Testing			
Course Code	**21EC583**	CIE Marks	50
Teaching Hours/Week (L: T:P: S)	0:0: 2 :0	SEE Marks	50
Credits	1	Exam Hours	03

Course objectives:

- To understand the various antenna parameters.
- Conduct experiments to study the Radiation pattern of Antennas.
- Design different types of antenna arrays and study the pattern characteristics (MATLAB)
- Design of MMIC antennas like Patch Antenna and study the characteristics.

Sl.No	**Experiments**
1	To obtain the radiation pattern of a Yagi-Uda Antenna array and calculate its directivity.
2	To obtain the radiation pattern of a Dipole Antenna array and calculate its directivity.
3	To calculate the aperture of a Dipole Antenna.
4	To obtain the near and far fields of a given antenna and compare the fields.
5	To obtain the Radiation pattern of a microstrip antenna.
6	To obtain the resonant frequency of a Yagi-Uda /Dipole antenna.
7	To obtain the bandwidth of a given Antenna.
8	Plot 2-D and 3-D radiation pattern of omnidirectional antenna using MATLAB.
9	Design and implementation of a broadside array using MATLAB.
10	Design and implementation of an endfire array using MATLAB.
Demonstration Experiments (For CIE)	
11	Design of a Patch Antenna using HFSS Software.
12	Design of a dipole Antenna using HFSS Software.

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

1. Analyze the radiation pattern and characteristics of antenna
2. Ability to design various antenna
3. Ability to use different software tools to study antenna characteristics
4. Analyze radiation pattern of linear array antennas

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 35% (18 Marks out of 50) in the semester-end examination (SEE).

Continuous Internal Evaluation (CIE):

CIE marks for the practical course is **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment to be evaluated for conduction with observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning

of the practical session.

- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled downed to 30 marks (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8th week of the semester and the second test shall be conducted after the 14th week of the semester.
- In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability. Rubrics suggested in Annexure-II of Regulation book
- The average of 02 tests is scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and average marks of two tests is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

SEE marks for the practical course is 50 Marks.

SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University

All laboratory experiments are to be included for practical examination.

(Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.

Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.

Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)

Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.

The duration of SEE is 03 hours

Rubrics suggested in Annexure-II of Regulation book

Suggested Learning Resources:

1. Antennas and Wave Propagation -John D Krauss, Ronald J Marhefka, Ahmad S Khan, 4th Edition, McGraw Hill Education, 2013.
2. https://www.mathworks.com/help/antenna/
3. Help and demo files of the HFSS and MATLAB software

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V Semester

Microwaves Toolbox			
Course Code	**21EC584**	CIE Marks	50
Teaching Hours/Week (L: T:P: S)	0:0:2:0	SEE Marks	50
Credits	1	Exam Hours	03

Course objectives:

- Identification of microwave components/devices.
- Study basic principles of operation of microwave devices/ components

Sl.No	**Experiments**
1	V- I Characteristics of Gunn-diode.
2	Study of characteristics of Magic Tee.
3	Coupling and Isolation characteristics of microstrip directional coupler.
4	Determination of power division of microstrip power divider.
5	Determination of resonance characteristics of microstrip ring resonator and computation of dielectric constant of the substrate.
6	Measurement of frequency, guide wavelength, power and attenuation in a microwave Test bench.
7	Study of characteristics of E plane Tee / H plane Tee.
8	To measure unknown impedance using Smith chart through test bench setup.
9	Measurement of VSWR and reflection coefficient and attenuation in a microwave test bench setup.
10	Study propagation of wave using rectangular waveguide using MATLAB.
11	Study of impedance matching using MATLAB.
12	To calculate phase and group velocity using MATLAB.

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

1. Demonstrate the characteristics of microwave sources.
2. Demonstrate the characteristics of directional coupler
3. Study of microwave measurement procedure.
4. Apply MATLAB toolbox for study of microwaves phenomena.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 35% (18 Marks out of 50) in the semester-end examination (SEE).

Continuous Internal Evaluation (CIE):

CIE marks for the practical course is **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment to be evaluated for conduction with observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.

- Total marks scored by the students are scaled downed to 30 marks (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8th week of the semester and the second test shall be conducted after the 14th week of the semester.
- In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability. Rubrics suggested in Annexure-II of Regulation book
- The average of 02 tests is scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and average marks of two tests is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

SEE marks for the practical course is 50 Marks.

SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University

All laboratory experiments are to be included for practical examination.

(Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.

Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.

Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)

Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.

The duration of SEE is 03 hours

Rubrics suggested in Annexure-II of Regulation book

Suggested Learning Resources:

MATLAB

1. Microwave Engineering -Annapurna Das, Sisir K Das, TMH Publication, 2nd Edition, 2010.
2. Antennas and Wave Propagation -John D Krauss, Ronald J Marhefka, Ahmad S Khan, 4th Edition, McGraw Hill Education, 2013.
3. https://www.mathworks.com/help/antenna
4. https://www.mathworks.com/help/antenna/ref/waveguide.html

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VI Semester

Computer Organization & ARM Microcontrollers			
Course Code	**21EC62**	CIE Marks	50
Teaching Hours/Week (L: T: P: S)	(3:0:2:0)	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 12 Lab slots	Total Marks	100
Credits	04	Exam Hours	03

Course objectives: This course will enable students to:

1. Explain the basic organization of a computer system.
2. Demonstrate functioning of different sub systems, such as processor, Input/output, and memory.
3. Describe the architectural features and instructions of 32-bit microcontroller ARM Cortex M3.
4. Apply the knowledge gained for Programming ARM Cortex M3 for different applications.
5. Understand the basic hardware components and their selection method based on the characteristics and attributes of an embedded system.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

- Lecture method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
- Encourage collaborative (Group) Learning in the class.
- Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking.
- Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
- Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
- Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.
- Give Programming Assignments.

Module-1

Basic Structure of Computers: Basic Operational Concepts, Bus Structures, Performance – Processor Clock, Basic Performance Equation, Clock Rate, Performance Measurement.
Text Book 1: Chapter 1 – 1.3, 1.4, 1.6 (1.6.1-1.6.4, 1.6.7), Chapter 2 – 2.2 to 2.10
Input/Output Organization: Accessing I/O Devices, Interrupts – Interrupt Hardware, Direct Memory Access, Buses, Interface Circuits, Standard I/O Interfaces – PCI Bus, SCSI Bus, USB.
Text Book 1: Chapter 4 – 4.1, 4.2, 4.4, 4.5, 4.6, 4.7

Teaching-Learning Process	Chalk and Talk, YouTube videos **RBT Level:** L1, L2, L3

Module-2

Memory System: Basic Concepts, Semiconductor RAM Memories, Read Only Memories, Speed, Size, and Cost, Cache Memories – Mapping Functions, Replacement Algorithms, Performance Considerations.
Text book 1: Chapter 5 – 5.1 to 5.4, 5.5 (5.5.1, 5.5.2), 5.6

Basic Processing Unit: Some Fundamental Concepts, Execution of a Complete Instruction, Multiple Bus Organization, Hard-wired Control, Micro programmed Control. Basic concepts of pipelining,

Text book 1: Chapter7, Chapter 8 – 8.1

Teaching-Learning Process	Chalk and Talk, YouTube videos **RBT Level:** L1, L2, L3

Module-3
ARM Embedded Systems: Introduction, RISC design philosophy, ARM design philosophy, Embedded system hardware – AMBA bus protocol, ARM bus technology, Memory, Peripherals, Embedded system software – Initialization (BOOT) code, Operating System, Applications. ARM Processor Fundamentals, ARM core dataflow model, registers, current program status register, Pipeline, Exceptions, Interrupts and Vector Table, Core extensions. Text book 2: Chapter 1, 2

Teaching-Learning Process	Chalk and Talk, YouTube videos **RBT Level:** L1, L2, L3

Module-4
Introduction to the ARM Instruction set: Introduction, Data processing instructions, Load - Store instruction, Software interrupt instructions, Program status register instructions, Loading constants, ARMv5E extensions, Conditional Execution. Text book 2: Chapter 3

Teaching-Learning Process	Chalk and Talk, Power point presentations, Programming assignments **RBT Level:** L1, L2, L3

Module-5
Introduction to the THUMB instruction set: Introduction, THUMB register usage, ARM – THUMB interworking, Other branch instructions, Data processing instructions, Stack instructions, Software interrupt instructions. **Efficient C Programming**: Overview of C Compilers and optimization, Basic C Data types, C looping structures. Text book 2: Chapter 4, 5

Teaching-Learning Process	Chalk and Talk, Power point presentations, Programming assignments **RBT Level:** L1, L2, L3

PRACTICAL COMPONENT OF IPCC

Conduct the following experiments by writing Assembly Language Program (ALP) using ARM Cortex M3 Registers using an evaluation board/simulator and the required software tool.

Sl.No	Experiments
1	Write an ALP to i) multiply two 16-bit binary numbers. ii) add two 64-bit numbers.
2	Write an ALP to find the sum of first 10 integer numbers.
3	Write an ALP to find factorial of a number.
4	Write an ALP to add an array of 16-bit numbers and store the 32-bit result in internal RAM.
5	Write an ALP to find the square of a number (1 to 10) using look-up table.
6	Write an ALP to find the largest/smallest number in an array of 32 numbers.
7	Write an ALP to arrange a series of 32-bit numbers in ascending/descending order.
8	i) Write an ALP to count the number of ones and zeros in two consecutive memory locations. ii)Write an ALP to Scan a series of 32-bit numbers to find how many are negative.

Demonstration Experiments (For CIE only not for SEE)	
Conduct the following experiments on an ARM CORTEX M3 evaluation board using evaluation version of Embedded 'C' & Keil µvision-4 tool/compiler.	
9	Interface a Stepper motor and rotate it in clockwise and anti-clockwise direction.
10	Interface a DAC and generate Triangular and Square waveforms.
11	Display the Hex digits 0 to F on a 7-segment LED interface, with a suitable delay in between.
12	Interface a simple Switch and display its status through Relay, Buzzer and LED.

Course Outcomes

At the end of the course the student will be able to:

1. Explain the basic organization of a computer system.
2. Demonstrate functioning of different sub systems, such as processor, Input/output, and memory.
3. Describe the architectural features and instructions of 32-bit microcontroller ARM Cortex M3.
4. Apply the knowledge gained for Programming ARM Cortex M3 for different applications.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

CIE for the theory component of IPCC

Two Tests each of **20 Marks (duration 01 hour**)

- First test at the end of 5th week of the semester
- Second test at the end of the 10th week of the semester

Two assignments each of **10 Marks**

- First assignment at the end of 4th week of the semester
- Second assignment at the end of 9th week of the semester

Scaled-down marks of two tests and two assignments added will be CIE marks for the theory component of IPCC for **30 marks**.

CIE for the practical component of IPCC

- On completion of every experiment/program in the laboratory, the students shall be evaluated and marks shall be awarded on the same day. The **15 marks** are for conducting the experiment and preparation of the laboratory record, the other **05 marks shall be for the test** conducted at the end of the semester.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to 15 marks.
- The laboratory test **(duration 03 hours)** at the end of the 15th week of the semester /after completion of all the experiments (whichever is early) shall be conducted for 50 marks and scaled down to 05 marks**.**

Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **20 marks**.

SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (duration 03 hours)

- The question paper will have ten questions. Each question is set for 20 marks.
- There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
- The students have to answer 5 full questions, selecting one full question from each module.

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper shall include questions from the practical component.

- The minimum marks to be secured in CIE to appear for SEE shall be the 12 (40% of maximum marks-30) in the theory component and 08 (40% of maximum marks -20) in the practical component. The laboratory component of the IPCC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be included**.** The maximum of 04/05 questions to be set from the practical component of IPCC, the total marks of all questions should not be more than the 20 marks.

SEE will be conducted for 100 marks and students shall secure 35% of the maximum marks to qualify in the SEE. Marks secured will be scaled down to 50.

Suggested Learning Resources:

Textbooks

1. Carl Hamacher, Zvonko Vranesic, Safwat Zaky, Computer Organization, 5th Edition, Tata McGraw Hill, 2002. (Listed topics only from Chapters 1, 2, 4, 5, 8).
2. Andrew N Sloss, Dominic System and Chris Wright, “ARM System Developers Guide”, Elsevier, Morgan Kaufman publisher, 1st Edition, 2008.

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

Programming Assignments / Mini Projects can be given to improve programming skills

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VI Semester

VLSI Design and Testing			
Course Code	**21EC63**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	3:0:0:1	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course objectives:

- Impart knowledge of MOS transistor theory and CMOS technology
- Learn the operation principles and analysis of inverter circuits.
- Infer the operation of Semiconductor memory circuits.
- Demonstrate the concept of CMOS testing.

Teaching-Learning Process (General Instructions)

The sample strategies, which the teacher can use to accelerate the attainment of the various course outcomes are listed in the following:

1. Lecture method (L) does not mean only the traditional lecture method, but a different type of teaching method may be adopted to develop the outcomes.
2. Arrange visits to nearby PSUs and industries.
3. Show Video/animation films to explain the functioning of various fabrication & testing techniques.
4. Encourage collaborative (Group) Learning in the class
5. Topics will be introduced in multiple representations.
6. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Introduction: A Brief History, MOS Transistors, CMOS Logic (1.1 to 1.4 of TEXT1)

MOS Transistor Theory: Introduction, Long-channel I-V Characteristics, Non-ideal I-V Effects, DC Transfer Characteristics (2.1, 2.2, 2.4 and 2.5 of TEXT1).

Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, YouTube videos, Videos on transistor working **Self-study topics**: MOSFET Scaling and Small-Geometry Effects **RBT Level:** L1, L2, L3

Module-2

Fabrication: CMOS Fabrication and Layout, Introduction, CMOS Technologies, Layout Design Rules, (1.5 and 3.1 to 3.3 of TEXT1).

Delay: Introduction, Transient Response, RC Delay Model, Linear Delay Model, Logical Efforts of Paths (4.1 to 4.5 of TEXT1, except sub-sections 4.3.7, 4.4.5, 4.4.6, 4.5.5 and 4.5.6).

Teaching-Learning Process	Chalk and talk method, Power point presentation, YouTube videos, Videos on fabrication **Self-study topics**: Layouts of complex design using Euler's method **RBT Level:** L1, L2, L3

Module-3

Semiconductor Memories: Introduction, Dynamic Random Access Memory (DRAM) and Static Random Access Memory (SRAM), Nonvolatile Memory, Flash Memory, Ferroelectric Random Access Memory (FRAM) (10.1 to 10.6 of TEXT2)

Teaching-Learning	Chalk and talk method, PowerPoint Presentation, YouTube videos on Standard

Process	cell memory Design **Self-study topics**: Memory array design **RBT Level:** L1, L2, L3
Module-4	
Faults in digital circuits: Failures and faults, Modelling of faults, Temporary faults **Test generation for combinational logic circuits**: Fault diagnosis of digital circuits, test generation techniques for combinational circuits, Detection of multiple faults in combinational logic circuits. (1.1 to 1.3, 2.1 to 2.3 of TEXT3)	
Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, YouTube videos, videos on testing algorithms for test generation **Self-study topics**: Testable combinational logic circuits **RBT Level:** L1, L2, L3
Module-5	
Test generation for sequential circuits: Testing of sequential circuits as iterative combinational circuits, state table verification, test generation based on circuits structure, functional fault models, test generation based on functional fault models. **Design of testable sequential circuits**: Controllability and Observability, Adhoc design rules, design of diagnosable sequential circuits, The scan path technique, LSSD, Random Access scan technique, partial scan. (4.1 to 4.5, 5.1 to 5.7 of TEXT3)	
Teaching-Learning Process	Chalk and talk method/Power point presentation, YouTube videos **Self-study topics**: Memory testing techniques **RBT Level:** L1, L2, L3

Course outcomes (Course Skill Set)

At the end of the course the student will be able to:

1. Demonstrate understanding of MOS transistor theory, CMOS fabrication flow and technology scaling.
2. Draw the basic gates using the stick and layout diagram with the knowledge of physical design aspects.
3. Interpret memory elements along with timing considerations.
4. Interpret testing and testability issues in combinational logic design.
5. Interpret testing and testability issues in combinational logic design.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20**

Marks (duration 01 hours)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module. Marks scored out of 100 shall be reduced proportionally to 50 marks

Suggested Learning Resources:

Text Books:

1. "CMOS VLSI Design- A Circuits and Systems Perspective", Neil H E Weste, and David Money Harris 4th Edition, Pearson Education.
2. "CMOS Digital Integrated Circuits: Analysis and Design", Sung Mo Kang & Yosuf Leblebici, Third Edition, Tata McGraw-Hill.
3. "Digital Circuit Testing and Testability", Lala Parag K, New York, Academic Press, 1997.

Reference Books:

1. "Basic VLSI Design", Douglas A Pucknell, Kamran Eshraghian, 3rd Edition, Prentice Hall of India publication, 2005.
2. "Essential of Electronic Testing for Digital, Memory and Mixed Signal Circuits", Vishwani D Agarwal, Springer, 2002.

Web links and Video Lectures (e-Resources)

- https://www.youtube.com/watch?v=oL8SKNxEaHs&list=PLLy_2iUCG87Bdulp9brz9AcvW_TnFCUmM
- https://www.youtube.com/watch?v=lRpt1fCHd8Y&list=PLCmoXVuSEVHlEJi3SwdyJ4EICffuyqpjk
- https://www.youtube.com/watch?v=yLqLD8Y4-Qc

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Model displayed for clear understanding of fabrication process of MOS transistor
- Practise session can be held to understand the significance of various layers in MOS process, with the help of coloured layouts

03.10.2022

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VI Semester

VLSI Laboratory			
Course Code	**21ECL66**	CIE Marks	50
Teaching Hours/Week (L: T: P: S)	0:0:2:0	SEE Marks	50
Credits	1	Exam Hours	3

Course objectives:

This laboratory course enables students to

- Design, model, simulate and verify digital circuits.
- Design layouts and perform physical verification of CMOS digital circuits.
- Perform ASIC design flow and understand the process of synthesis, synthesis constraints and evaluating the synthesis reports to obtain optimum gate level netlist.
- Perform RTL-GDSII flow and understand the stages in ASIC.

Sl.No.	**Experiments**
	ASIC Digital Design
1	4-Bit Adder • Write Verilog Code • Verify the Functionality using Test-bench • Synthesize the design by setting proper constraints and obtain the netlist. From the report generated identify Critical path, Maximum delay, Total number of cells, Power requirement and Total area required
2	4-Bit Booth Multiplier • Write Verilog Code • Verify the Functionality using Test-bench • Synthesize the design by setting proper constraints and obtain the netlist. From the report generated identify Critical path, Maximum delay, Total number of cells, Power requirement and Total area required
3	32-Bit ALU Supporting 4-Logical and 4-Arithmetic operations, using case and if statement for ALU Behavioral Modeling • Write Verilog Code • Verify functionality using Test-bench • Synthesize the design targeting suitable library and by setting area and timing constraints • Tabulate the Area, Power and Delay for the Synthesized netlist • Identify Critical path
4	Latch and Flip-Flop • Synthesize the design and compare the synthesis report (D, SR, JK)
	ASIC Analog Design
5	a) Capture the schematic of CMOS inverter with load capacitance of 0.1pF and set the widths of Inverter with Wn = Wp, Wn = 2Wp, Wn = Wp/2 and length at selected technology. Carry out the following:

	i. Set the input signal to a pulse with rise time, fall time of 1ns and pulse width of 10ns and the time period of 20ns and plot the input voltage and output voltage of designed inverter? ii. From the simulation result compute tpHL, tpLH and td for all three geometrical settings of width? iii. Tabulate the results of delay and find the best geometry for minimum delay for CMOS inverter? b) Draw layout of inverter with Wp/Wn = 40/20, use optimum layout methods. Verify for DRC and LVS, extract parasitic and perform post layout simulations, compare the results with pre-layout simulations. Record the observations.
6	a) Capture the schematic of 2-input CMOS NAND gate having similar delay as that of CMOS inverter computed in experiment above. Verify the functionality of NAND gate and also find out the delay td for all four possible combinations of input vectors. Table the results. Increase the drive strength to 2X and 4X and tabulate the results. b) Draw the layout of NAND with Wp/Wn = 40/20, use optimum layout methods. Verify for DRC and LVS, extract parasitic and perform post layout simulations, compare the results with pre-layout simulations. Record the observations.
7	a) Capture schematic of Common Source Amplifier with PMOS Current Mirror Load and find its transient response and AC response? Measure the Unit Gain Bandwidth (UGB), amplification factor by varying transistor geometries, study the impact of variation in width to UGB. b) Draw Layout of common source amplifier, use optimum layout methods. Verify for DRC & LVS, extract parasitic and perform post layout simulations, compare the results with pre-layout simulations. Record the observations.
8	a) Capture schematics of two-stage operational amplifier and measure the following: i. UGB ii. dB Bandwidth iii. Gain Margin and phase margin with and without coupling capacitance iv. Use the op-amp in the inverting and non-inverting configuration and verify its functionality. v. Study the UGB, 3dB bandwidth, gain and power requirement in op-amp by varying the stage wise transistor geometries and record the observations. b) Draw layout of two-stage operational amplifier with minimum transistor width set to 300 (in 180/90/45 nm technology), choose appropriate transistor geometries as per the results obtained in part a. Use optimum layout methods. Verify for DRC and LVS, extract parasitic and perform post layout simulations, compare the results with pre-layout simulations. Record the observations.
	Demonstration Experiments (For CIE)
9	UART • Write Verilog Code • Verify the Functionality using Test-bench • Synthesize the design targeting suitable library and by setting area and timing constraints • Tabulate the Area, Power and Delay for the Synthesized netlist, Identify Critical path
10	For synthesized netlist carry out the following: • Floor planning • Placement and Routing • Record the parameters such as no. of metal layers used for routing, flip method for placement of standard cells • Physical Verification and record the DRC and LVS reports • Generate GDSII

11	Design and characterize 6T binary SRAM cell and measure the following: • Read Time, Write Time, SNM, Power • Draw Layout of 6T SRAM, use optimum layout methods. Verify for DRC & LVS, extract parasitic and perform post layout simulations, compare the results with pre-layout simulations. Record the observations.

Course outcomes (Course Skill Set):

On the completion of this laboratory course, the students will be able to:

1. Design and simulate combinational and sequential digital circuits using Verilog HDL.
2. Understand the synthesis process of digital circuits using EDA tool.
3. Perform ASIC design flow and understand the process of synthesis, synthesis constraints and evaluating the synthesis reports to obtain optimum gate level netlist.
4. Design and simulate basic CMOS circuits like inverter, common source amplifier, differential amplifier, SRAM.
5. Perform RTL_GDSII flow and understand the stages in ASIC design.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 35% (18 Marks out of 50) in the semester-end examination (SEE).

Continuous Internal Evaluation (CIE):

CIE marks for the practical course is **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment to be evaluated for conduction with observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled downed to 30 marks (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8th week of the semester and the second test shall be conducted after the 14th week of the semester.
- In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability. Rubrics suggested in Annexure-II of Regulation book
- The average of 02 tests is scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and average marks of two tests is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

SEE marks for the practical course is 50 Marks.

SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University

All laboratory experiments are to be included for practical examination.
(Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be

decided jointly by examiners.
Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.
Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.
General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners).
Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.
The duration of SEE is 03 hours.
Rubrics suggested in Annexure-II of Regulation book

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VI Semester

Communication Engineering			
Course Code	**21EC651**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	3:0:0: 1	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course objectives:

This course will enable students to:

- Describe essential elements of an electronic communication system.
- Understand Amplitude, Frequency & Phase modulations, and Amplitude demodulation.
- Define the sampling theorem and methods to generate pulse modulations.
- Learn the various methods of digital modulation techniques and compare the different schemes.
- Introduce the basic concepts of information theory and coding.
- Understand the basic concepts of wireless and cellular communications.

Teaching-Learning Process (General Instructions)

The sample strategies, which the teacher can use to accelerate the attainment of the various course outcomes are listed in the following:

1. Lecture method (L) does not mean only the traditional lecture method, but a different type of teaching method may be adopted to develop the outcomes.
2. Show Video/animation films to explain the evolution of communication technologies.
3. Encourage collaborative (Group) Learning in the class
4. Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
6. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
7. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Introduction to Electronic Communications: Historical perspective, Electromagnetic frequency spectrum, Signal and its representation, Elements of electronic communications system, primary communication resources, signal transmission concepts, Analog and digital transmission, Modulation, Concept of frequency translation, Signal radiation and propagation (Text 1: 1.1 to 1.10)

Teaching-Learning Process	Chalk and talk method, Power Point Presentation **Self-study topics:** Classification of Signals and systems **RBT Level:** L1, L2, L3

Module-2

Amplitude Modulation Techniques: Types of analog modulation, Principle of amplitude modulation, AM power distribution, Limitations of AM, (TEXT 1: 4.1, 4.2, 4.4, 4.6)

Angle Modulation Techniques: Principles of Angle modulation, Theory of FM-basic Concepts, Theory of phase modulation (TEXT1: 5.1, 5.2, 5.5)

Teaching-Learning Process	Chalk and talk method/Power point presentation **Self-study topics:** DSBSC, SSB and VSB modulation techniques and comparison. **RBT Level:** L1, L2, L3

Module-3	
Sampling Theorem and Pulse Modulation Techniques: Digital Versus Analog Transmissions, Sampling Theorem, Classification of pulse modulation techniques, PAM, PWM, PPM, PCM, Quantization of signals (TEXT 1: 7.2 to 7.8)	
Teaching-Learning Process	Chalk and talk method **Self-study topics:** Differential PCM and Delta Modulation **RBT Level:** L1, L2, L3
Module-4	
Digital Modulation Techniques: Types of digital Modulation, ASK, FSK, PSK, QPSK. (TEXT 1: 9.1 to 9.5) **Information Theory, Source and Channel Coding:** Information, Entropy and its properties, Shannon,-Hartley Theorem, Objectives of source coding, Source coding technique, Shannon source coding theorem, Channel coding theorem, Error Control and Coding. [Text1: 10.1,10.2, 10.11.2, 11.1 to 11.3, 11.8, 11.9, 11.12]	
Teaching-Learning Process	Chalk and talk method, Power Point Presentation. **Self-study topics:** Quadrature Amplitude Modulation, Comparison of Digital Modulation techniques. **RBT Level:** L1, L2, L3
Module-5	
Evolution of wireless communication systems: Brief History of wireless communications, Advantages of wireless communication, disadvantages of wireless communications, wireless network generations, Comparison of wireless systems, Evolution of next generation networks, Applications of wireless communication (TEXT 2: 1.1 to 1.7) **Principles of Cellular Communications:** Cellular terminology, Cell structure and Cluster, Frequency reuse concept, Cluster size and system capacity, Method of locating cochannel cells, Frequency reuse distance (TEXT 2: 4.1 to 4.7)	
Teaching-Learning Process	Chalk and talk method/Power point presentation **Self-study topics:** Basic propagation mechanisms, Multipath fading. **RBT Level:** L1, L2, L3

Course outcomes (Course Skill Set)

At the end of the course the student will be able to:

1. Describe the scheme and concepts of radiation and propagation of communication signals through air.
2. Understand the AM and FM modulation techniques and represent the signal in time and frequency domain relations.
3. Understand the process of sampling and quantization of signals and describe different methods to generate digital signals.
4. Describe the basic digital modulation techniques, channel capacity, source coding technique and the channel coding.
5. Compare the different wireless communication systems and describe the structure of cellular communication.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module. Marks scored out of 100 shall be reduced proportionally to 50 marks

Suggested Learning Resources:

Books:

1. T L Singal, Analog and Digital Communications, McGraw Hill Education (India) Private Limited, 2012, 0-07-107269-1
2. T L Singal, Wireless Communications, McGraw Hill Education (India) Private Limited, 2016, ISBN:0-07-068178-3.

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VI Semester

Microcontrollers			
Course Code	**21EC652**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	3:0:0:1	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course objectives:

This course will enable students to:

- Understand the difference between a Microprocessor and a Microcontroller and embedded microcontrollers.
- Familiarize the basic architecture of 8051 microcontroller.
- Program 8051microprocessor using Assembly Level Language and C.
- Understand the interrupt system of 8051 and the use of interrupts.
- Understand the operation and use of inbuilt Timers/Counters and Serial port of 8051.
- Interface 8051 to external memory and I/O devices using its I/O ports.

Teaching-Learning Process (General Instructions)

The sample strategies, which the teacher can use to accelerate the attainment of the various course outcomes are listed in the following:

1. Lecture method (L) does not mean only the traditional lecture method, but a different type of teaching method may be adopted to develop the outcomes.
2. Show Video/animation films to explain the functioning of various techniques.
3. Encourage collaborative (Group) Learning in the class
4. Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
6. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
7. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.
8. Give Programming Assignments.

Module-1

8051 Microcontroller: Microprocessor Vs Microcontroller, Embedded Systems, Embedded Microcontrollers, 8051 Architecture- Registers, Pin diagram, I/O ports functions, Internal Memory organization. External Memory (ROM & RAM) interfacing.
Text2 : Chapter 1 section 1.1 to 1.3, chapter 3 sections 3.1 to 3.3

Teaching-Learning Process	Chalk and talk method, Simulation of modulation techniques **RBT Level:** L1, L2, L3

Module-2

8051 Instruction Set: Addressing Modes, Data Transfer instructions, Arithmetic instructions, Logical instructions, Bit manipulation instructions. Simple Assembly language program examples (without loops) to use these instructions.
Text2 : Chapter 5 , chapter 6, chapter 7, chapter 8

Teaching-Learning Process	Chalk and talk method/Power point presentation **RBT Level:** L1, L2, L3

Module-3	
8051 Jump and Call instructions & Embedded C Jump and Call Instructions, Calls & Subroutine instructions. Assembly language program examples on subroutine and involving loops. Text2 : chapter 8 section 8.1 to 8.4 **8051 Programming in C**: Data Types and Time delay in 8051 C, I/O programming in 8051 C, Logical Operations in C. Text1 : chapter 7 section 7.1 to 7.3	
Teaching-Learning Process	Chalk and talk method **RBT Level:** L1, L2, L3
Module-4	
8051 Timers and Serial Port **8051 Timers and Counters** – Operation and Assembly language programming to generate a pulse using Mode-1 and a square wave using Mode- 2 on a port pin. **8051 Serial Communication**- Basics of Serial Data Communication, RS- 232 standard, 9 pin RS232 signals, Simple Serial Port programming in Assembly and C to transmit a message and to receive data serially. Text1 : Chapter 9 section 9.1 Chapter 10 section 10.1 to 10.5	
Teaching-Learning Process	Chalk and talk method **RBT Level:** L1, L2, L3
Module-5	
8051 Interrupts and Interfacing Applications 8051 Interrupts. 8051 Assembly language programming to generate an external interrupt using a switch, 8051 C programming to generate a square waveform on a port pin using a Timer interrupt. **Interfacing** 8051 to ADC-0804, DAC, LCD and Stepper motor and their 8051 Assembly and C language interfacing programming. Text 1: Chapter 11 section 11.1 and 11.2 Chapter 13 section 13.1 to 13.2, chapter 12 section 12.1, chapter 17 section 17.2	
Teaching-Learning Process	Chalk and talk method/Power point presentation **RBT Level:** L1, L2, L3

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

1. Explain the difference between Microprocessors & Microcontrollers, Architecture of 8051 Microcontroller, Interfacing of 8051 to external memory and Instruction set of 8051.
2. Develop 8051 Assembly level programs using 8051 instruction set.
3. Develop 8051 Assembly / C language program to generate timings and waveforms using 8051 timers, to send & receive serial data using 8051 serial port.
4. Develop 8051 Assembly / C language programs to generate square wave on 8051 I/O port pin using interrupt and C Programme to send & receive serial data using 8051 serial port.
5. Interface various peripheral devices to 8051 using I/O ports.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester

3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module. Marks scored out of 100 shall be reduced proportionally to 50 marks

Suggested Learning Resources:

Text Books:

1. "The 8051 Microcontroller and Embedded Systems – using assembly and C", Muhammad Ali Mazidi, Janice Gillespie Mazidi and Rollin D McKinlay; PHI, 2006 / Pearson, 2006.
2. "The 8051 Microcontroller", Kenneth J Ayala, 3rd Edition, Thomson/Cengage Learning.

Reference Books:

1. "The 8051 Microcontroller Based Embedded Systems", Manish K Patel, McGraw Hill, 2014, ISBN: 978-93-329-0125-4.
2. "Microcontrollers: Architecture, Programming, Interfacing and System Design", Raj Kamal, Pearson Education, 2005.

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(Effective from the academic year 2021 – 22)

VI Semester

Basic VLSI Design			
Course Code	**21EC653**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	3:0:0:1	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course objectives:

- Impart knowledge of MOS transistor theory and CMOS technologies
- Impart knowledge on architectural choices and performance trade-offs involved in designing and realizing the circuits in CMOS technology
- Cultivate the concepts of subsystem design processes
- Demonstrate the concepts of CMOS testing

Teaching-Learning Process (General Instructions)

The sample strategies, which the teacher can use to accelerate the attainment of the various course outcomes are listed in the following:

1. Lecture method (L) does not mean only the traditional lecture method, but a different type of teaching method may be adopted to develop the outcomes.
2. Show Video/animation films to explain the functioning of various techniques.
3. Encourage collaborative (Group) Learning in the class
4. Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
6. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
7. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.
8. Incorporate programming examples given under Activity based learning.

Module-1

Introduction: A Brief History, MOS Transistors, MOS Transistor Theory, Ideal I-V Characteristics, Non-ideal I-V Effects, DC Transfer Characteristics (1.1, 1.3, 2.1, 2.2, 2.4, 2.5 of TEXT2).
Fabrication: nMOS Fabrication, CMOS Fabrication [P-well process, N-well process, Twin tub process], BiCMOS Technology (1.7, 1.8, 1.10 of TEXT1).

Teaching-Learning Process	Chalk and talk method, YouTube videos, Power point presentation **RBT Level:** L1, L2

Module-2

MOS and BiCMOS Circuit Design Processes: MOS Layers, Stick Diagrams, Design Rules and Layout.
Basic Circuit Concepts: Sheet Resistance, Area Capacitances of Layers, Standard Unit of Capacitance, Some Area Capacitance Calculations, Delay Unit, Inverter Delays, Driving Large Capacitive Loads (3.1 to 3.3, 4.1, 4.3 to 4.8 of TEXT1).

Teaching-Learning Process	Chalk and talk method/Power point presentation **RBT Level:** L1, L2, L3

Module-3	
Scaling of MOS Circuits: Scaling Models & Scaling Factors for Device Parameters **Subsystem Design Processes**: Some General considerations, An illustration of Design Processes, **Illustration of the Design Processes**: Regularity, Design of an ALU Subsystem, The Manchester Carry-chain and Adder Enhancement Techniques (5.1, 5.2, 7.1, 7.2, 8.2, 8.3, 8.4.1, 8.4.2 of TEXT1).	
Teaching-Learning Process	Chalk and talk method, YouTube videos, Power point presentation **RBT Level:** L1, L2, L3
Module-4	
Subsystem Design: Some Architectural Issues, Switch Logic, Gate (restoring) Logic, Parity Generators, Multiplexers, The Programmable Logic Array (PLA) (6.1 to 6.3, 6.4.1, 6.4.3, 6.4.6 of TEXT1). **FPGA Based Systems**: Introduction, Basic concepts, Digital design and FPGAs, FPGA based System design, FPGA architecture, Physical design for FPGAs (1.1 to 1.4, 3.2, 4.8 of TEXT3).	
Teaching-Learning Process	Chalk and talk method, YouTube videos, Power point presentation **RBT Level:** L1, L2, L3
Module-5	
Memory, Registers and Aspects of system Timing: System Timing Considerations, Some commonly used Storage/Memory elements (9.1, 9.2 of TEXT1). **Testing and Verification**: Introduction, Logic Verification, Logic Verification Principles, Manufacturing Test Principles, Design for testability (12.1, 12.1.1, 12.3, 12.5, 12.6 of TEXT 2).	
Teaching-Learning Process	Chalk and talk method/Power point presentation **RBT Level:** L1, L2, L3

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

1. Demonstrate understanding of MOS transistor theory, CMOS fabrication flow and technology scaling.
2. Draw the basic gates using the stick and layout diagrams with the knowledge of physical design aspects.
3. Interpret Memory elements along with timing considerations
4. Demonstrate knowledge of FPGA based system design
5. Interpret testing and testability issues in VLSI Design
6. Analyze CMOS subsystems and architectural issues with the design constraints.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module. Marks scored out of 100 shall be reduced proportionally to 50 marks

Suggested Learning Resources:

Text Books:

1. "Basic VLSI Design"- Douglas A Pucknell & Kamran Eshraghian, PHI, 3rd Edition.
2. "CMOS VLSI Design- A Circuits and Systems Perspective", Neil H E Weste, David Harris, Ayan Banerjee, 3rd Edition, Pearson Education.
3. "FPGA Based System Design", Wayne Wolf, Pearson Education, 2004, Technology and Engineering.

Web links and Video Lectures (e-Resources)

- https://nptel.ac.in/courses/117101058
- https://nptel.ac.in/courses/117106093
- https://youtu.be/9SnR3M3CIm4
- https://nptel.ac.in/courses/108/107/108107129/

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

Wherever necessary **Cadence/Synopsis/Menta Graphics tools** must be used.

1.Write Verilog Code for the following circuits and their Test Bench for verification, observe the waveform and synthesize the code with technological library with given Constraints*. Do the initial timing verification with gate level simulation.

i. An inverter
ii. A Buffer
iii. Transmission Gate
iv. Basic/universal gates
v. Flip flop -RS, D, JK, MS, T
vi. Serial & Parallel adder
vii. 4-bit counter [Synchronous and Asynchronous counter]

2. Design an op-amp with given specification* using given differential amplifier Common source and Common Drain amplifier in library** and completing the design flow mentioned below:

a. Draw the schematic and verify the following
i) DC Analysis
ii) AC Analysis
iii) Transient Analysis
b. Draw the Layout and verify the DRC, ERC
c. Check for LVS
d. Extract RC and back annotate the same and verify the Design.

03.10.2022

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VI Semester

Electronic Circuits with Verilog			
Course Code	**21EC654**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	2:0:2:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course objectives:

- To understand the basic Verilog HDL design flow.
- To understand the basic Verilog programming concepts.
- To describe the simple logic circuits using dataflow, gate-level, and behavioural level modelling.
- To model digital systems using advanced concepts of Verilog HDL.

Teaching-Learning Process (General Instructions)

The sample strategies, which the teacher can use to accelerate the attainment of the various course outcomes are listed in the following:

1. Lecture method (L) does not mean only the traditional lecture method, but a different type of teaching method may be adopted to develop the outcomes.
2. Show Video/animation films to explain the functioning of various techniques.
3. Encourage collaborative (Group) Learning in the class
4. Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
6. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
7. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.
8. Give programming assignments.

Module-1

Overview of Digital Design with Verilog HDL: Evolution of CAD, emergence of HDLs, typical HDL-flow, why Verilog HDL?, trends in HDLs. (Text 1)
Hierarchical Modeling Concepts: Top-down and bottom-up design methodology, differences between modules and module instances, parts of a simulation, design block, stimulus block. (Text 1)

Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2, L3

Module-2

Basic Concepts: Lexical conventions, datatypes, system tasks, compiler directives. (Text 1)
Modules and Ports: Module definition, port declaration, connecting ports, hierarchical name referencing. (Text 1)

Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2, L3

Module-3

Gate-Level Modeling: Modeling using basic Verilog gate primitives, description of and/or and buf/not type gates, rise, fall and turn-off delays, min, max, and typical delays. (Text1)
Dataflow Modeling: Continuous assignments, delay specification, expressions, operators, operands, operator types. (Text 1)

Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2, L3

Module-4

Behavioral Description: Behavioral Description Highlights, Structure of the HDL Behavioral Description, Sequential Statements, IF Statement, The case Statement , Verilog casex and casez The wait-for Statement. The Loop Statement, For-Loop, While-Loop, Verilog repeat, Verilog forever (content with respect to Verilog only) (Text 2)

Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2, L3

Module-5

Structural Description: Highlights of Structural Description, Organization of Structural Description Binding (4.1, 4.2, 4.3 till example 4.9) (Text 2)
Tasks and Functions: Differences between tasks and functions, declaration, invocation, automatic tasks and functions. (Text 1)

Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2, L3

Course outcomes (Course Skill Set)
At the end of the course the student will be able to:

1. Under the Verilog HDL design flow.
2. Describe the basic concepts of Verilog HDL programming.
3. Design of digital electronics circuits using dataflow, behavioural, gate-level, and structural modelling.
4. Design complex digital circuits using advanced Verilog concepts.

Assessment Details (both CIE and SEE)
The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:
Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**
(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).
CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.
Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module. Marks scored out of 100 shall be reduced proportionally to 50 marks

Suggested Learning Resources:

Text Books:

1. "Verilog HDL: A Guide to Digital Design and Synthesis", Samir Palnitkar, Pearson education, Second edition.
2. "HDL programming (VHDL and Verilog)", Nazeih M Botros, John Wiley India Pvt. Ltd., 2008.

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VI Semester

Sensors & Actuators			
Course Code	**21EC655**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course objectives:

- To provide the fundamental knowledge about sensors and measurement system.
- To impart the knowledge of static and dynamic characteristics of instruments and understand the factors in selection of instruments for measurement.
- To discuss the principle, design and working of transducers for the measurement of physical time varying quantities.
- Understand the working of various actuators suitable in industrial process control systems.
- Understand the principle and application of smart sensors.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Explain the fundamental concepts required for the module in the introduction phase for the module.
2. Conducting quiz after completion of every module in class and evaluate.
3. Asking questions about completed previous topic, will aid to assess the student understanding.
4. Evaluate the internals answer booklet by correcting the mistakes if any.
5. Modules revision at the end as well use practical lab sessions and demonstrate the concepts if applicable and feasible.

Module-1

Sensors and measurement system: Sensors and transducers, Classifications of transducers-primary & secondary, active & passive, analog and digital transducers. Smart sensors.

Measurement: Definition, significance of measurement, instruments and measurement systems. mechanical, electrical and electronic instruments. Elements of generalized measurement system with example. Input-output configuration of measuring instruments and measurement systems, methods of correction for interfering and modifying inputs.

Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, More examples relating to applications **RBT Level:** L1, L2, L3

Module-2

Static and Dynamic Characteristics: Static calibration and error calibration curve, accuracy and precision, indications of precision, static error, scale range and scale span, reproducibility and drift, repeatability, signal to noise ratio, sensitivity, linearity, hysteresis, threshold, dead zone and dead time, resolution, signal to noise ratio, factors influencing the choice of transducers/instruments.

Dynamic response – Dynamic characteristics, Transfer function of generalized first order system, time constant. Transfer function of generalized second order system, natural frequency and Damping ratio.

Teaching-Learning Process	Chalk and talk method, Power point presentation, VI Lab to demonstrate the characteristics of sensors, More examples relating to applications **RBT Level:** L1, L2, L3

Module-3	
Measurement of Temperature: RTD, Thermistor, Thermocouple, laws of thermocouple, Thermopile, AD590. **Measurement of Displacement**: Introduction, Principles of Transduction, Variable resistance devices, variable Inductance Transducer, Variable Capacitance Transducer, Hall Effect Devices, Proximity Devices, Digital Transducer.	
Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, Virtual instrumentation Lab to demonstrate the characteristics of sensors **RBT Level:** L1, L2, L3
Module-4	
Measurement of Strain: Introduction, Types of Strain Gauges, Theory of operation of resistance strain gauges, Types of Electrical Strain Gauges –Wire gauges, unbounded strain gauges, foil gauges, semiconductor strain gauges (principle, types & list of characteristics only), Strain gauge Circuits – Wheatstone bride circuit, Applications. **Measurement of Force & Torque:** Introduction, Force measuring sensor –Load cells – column types devices, proving rings, cantilever beam, pressductor. Hydraulic load cell, electronic weighing system. Torque measurement: Absorption type, transmission type, stress type & deflection type.	
Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, More examples relating to applications **RBT Level:** L1, L2, L3
Module-5	
Actuators and process control system: Introduction. Block diagram and description of process control system with an example. Introduction, Block diagram of Final control operation, Signal conversions analog, digital, pneumatic signal. Actuators, Control elements. **Electrical actuating systems:** Solid-state switches, Solenoids, Electric Motors- Principle of operation and its application: D.C motors, AC motors, Synchronous Motor, Stepper motors. **Pneumatic Actuators**: Principle and working of pneumatic actuators. (Numerical problems on the topic). **Hydraulic Actuators:** Principle and working of Hydraulic actuators. (Numerical problems on the topic).	
Teaching-Learning Process	Chalk and talk method, Power point presentation More examples relating to applications **RBT Level:** L1, L2, L3

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

1. Discuss the fundamental concepts related to sensors and measurement, functional elements of measurement system, I/O Characteristics of measurement system.
2. Interpret and analyse the static and dynamic characteristics of instruments.
3. Elucidate the working principle and usage of different transducers for temperature, displacement and level measurement.
4. Discuss the principle and working of different types of actuators used in industrial application.
5. Discuss the principle and working of strain, force and torque measurement.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module. Marks scored out of 100 shall be reduced proportionally to 50 marks

Suggested Learning Resources:

Text Books:

1. Electrical and Electronic Measurements and Instrumentation, A K Sawhney, 17th Edition, (Reprint 2004), Dhanpat Rai & Co. Pvt. Ltd., 2004.
2. Instrumentation: Devices and Systems, C S Rangan, G R Sarma, V S V Mani, 2nd Edition (32 Reprint), McGraw Hill Education (India), 2014.
3. Process Control Instrumentation Technology by C D Johnson, 7th Edition, Pearson Education Private Limited, New Delhi 2002.

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VI Semester

Artificial Neural Networks			
Course Code	**21EC641**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	2:2:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course objectives:

- Preparation: To prepare students with fundamental knowledge and comprehensive understanding of artificial neural networks.
- Core Competence: To equip students to develop and configure ANNs with different types of learning algorithms for real world problems.
- Professionalism & Learning Environment: To inculcate an engineering student an ethical and professional attitude by providing an academic environment inclusive of effective communication, teamwork, ability to relate engineering issues to a broader social context, and life-long learning needed for a successful professional career.

Teaching-Learning Process (General Instructions)

The sample strategies, which the teacher can use to accelerate the attainment of the various course outcomes are listed in the following:

1. Lecture method (L) does not mean only the traditional lecture method, but a different type of teaching method may be adopted to develop the outcomes.
2. Show Video/animation films to explain the functioning of various learning algorithms.
3. Encourage collaborative (Group) Learning in the class.
4. Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking.
5. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
6. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1	
Introduction: Neural Networks, Application Scope of Neural Networks. **Artificial Neural Network: An Introduction**. - Fundamental Concept, Evolution of Neural Networks, Basic models of Artificial Neural Networks (ANN), Important Technologies of ANNs, McCulloch-Pitts Neuron, Linear Separability. **Text 1**: 1,1.1,1.2,2.1,2.2,2.3,2.4,2.5,2.6.	
Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, YouTube videos, Animation of basic model of a neuron in comparison of biological neuron. **RBT Level:** L1, L2, L3

Module-2	
Hebb Network and simple problems **Supervised Learning Network – Introduction** –Perceptron Networks-Theory, Perceptron learning rule, architecture, flowchart for training Process, Perceptron training algorithm for single output classes, Perceptron training algorithm for Multiple output classes, Perceptron Network Testing Algorithm, Adaptive Linear Neuron- Theory, Delta rule, Architecture, flowchart, Training, Testing algorithm (Adaline), Multiple Adaptive Linear Neurons -Theory, Architecture, Flowchart, Training algorithm.	
Teaching-	Chalk and talk method, PowerPoint Presentation, YouTube videos, Animation of

Learning Process	supervised learning algorithms. Problems on Hebb network **RBT Level:** L1, L2, L3

Module-3

Back–Propagation Network - Theory, Architecture, Flowchart for training process, Training Algorithm, Learning Factors of Back-Propagation Network, Testing Algorithm of Back-Propagation Network. Radial Basis Function Network, Time Delay Neural Network, Functional Link Networks.
Text 1: 3.5,3.6,3.7,3.8.

Teaching-Learning Process	Chalk and talk method, Power Point Presentation, YouTube videos Self-study topics: Architecture, Flowchart, Training and Testing algorithm. **RBT Level:** L1, L2, L3

Module-4

Associative Memory Network – Introduction, Training algorithm for Pattern association- Hebb Rule. Associative Memory Network - Theory, Architecture, Flowchart, Training algorithm, Testing Algorithm, Heteroassociative Memory Network- Theory, architecture, Testing algorithm, Hopfield Networks – Discrete Hopfield Network – architecture, Training algorithm, Testing algorithm of Discrete Hopfield Network.
Text 1: 4.1,4.2,4.3,4.4,4.6.

Teaching-Learning Process	Chalk and talk method, Power Point Presentation, YouTube videos Self-study topics: Architecture, Flowchart, Training and Testing algorithm. **RBT Level:** L1, L2, L3

Module-5

Unsupervised Learning Networks – Introduction, Fixed weight competitive nets – Maxnets, Architecture, Testing/application algorithm of Maxnet. Mexican Hat Net- Architecture, Flowchart, algorithm, Kohonen Self organizing Feature Maps – Theory, architecture. Learning Vector quantization – Theory, Architecture.
Text 1: 5.1,5.2-5.2.1,5.2.2,5.3- 5.3.1,5.3.2,5.4- 5.4.1,5.4.2.

Teaching-Learning Process	Chalk and talk method, Power Point Presentation, YouTube videos Self-study topics: Architecture, Flowchart, Training and Testing algorithm. **RBT Level:** L1, L2, L3

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

1. Compare and contrast the biological neural network and ANN.
2. Discuss the ANN for pattern classification.
3. Develop and configure ANN's with different types of functions and learning algorithms.
4. Apply ANN for real world problems.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester

5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module. Marks scored out of 100 shall be reduced proportionally to 50 marks

Suggested Learning Resources:

Text Book:

S N Sivanandam and S N Deepa, "Principles of Soft Computing", 2nd Edition, Wiley India Pvt. Ltd., 2014.

Reference Book:

Simon Haykin, "Neural Networks: A comprehensive foundation", 2nd Edition, PHI, 1998.

VI Semester

Cryptography			
Course Code	**21EC642**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	2:2:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course objectives:

This course will enable students to:

- Preparation: To prepare students with fundamental knowledge/ overview in the field of Information Security with knowledge of mathematical concepts required for cryptography.
- Core Competence: To equip students with a basic foundation of Cryptography by delivering the basics of symmetric key and public key cryptography and design of pseudo random sequence generation technique

Teaching-Learning Process (General Instructions)

The sample strategies, which the teacher can use to accelerate the attainment of the various course outcomes are listed in the following:

1. Lecture method (L) does not mean only the traditional lecture method, but a different type of teaching method may be adopted to develop the outcomes.
2. Show Video/animation films to explain the different Cryptographic Techniques / Algorithms
3. Encourage collaborative (Group) Learning in the class
4. Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
6. Topics will be introduced in a multiple representation.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.
9. Adopt Flipped class technique by sharing the materials / Sample Videos prior to the class and have discussions on the that topic in the succeeding classes
10. Give Programming Assignments

Module-1

Basic Concepts of Number Theory and Finite Fields: Divisibility and The Division Algorithm Euclidean algorithm, Modular arithmetic, Groups, Rings and Fields, Finite fields of the form GF(p), Polynomial Arithmetic, Finite Fields of the Form GF(2^m) (Text 1: Chapter 3)

Teaching-Learning Process	Chalk and Talk, YouTube videos, Flipped Class Technique Programming on implementation of Euclidean algorithm, multiplicative inverse, Finite fields of the form GF(p), construction of finite field over GF(2^m). **RBT Level:** L1, L2, L3

Module-2

Introduction: Computer Security Concepts, A Model for Network Security (Text 1: Chapter 1)
Classical Encryption Techniques: Symmetric cipher model, Substitution techniques, Transposition techniques (Text 1: Chapter 1)

Teaching-Learning Process	Chalk and Talk, YouTube videos, Flipped Class Technique and PPTs. Programming on Substitution and Transposition techniques. Self-study topics: Security Mechanisms, Services and Attacks. **RBT Level:** L1, L2, L3

Module-3

Block Ciphers: Traditional Block Cipher structure, Data encryption standard (DES) (Text 1: Chapter 2: Section1, 2) The AES Cipher. (Text 1: Chapter 4: Section 2, 3, 4) **More on Number Theory**: Prime Numbers, Fermat's and Euler's theorem, discrete logarithm. (Text 1: Chapter 7: Section 1, 2, 5)	
Teaching-Learning Process	Chalk and Talk, YouTube videos, Flipped Class Technique and PPTs. Implementation of SDES using programming languages like C++/Python/Java/Scilab. Self-study topics: DES S-Box- Linear and differential attacks **RBT Level:** L1, L2, L3
Module-4	
ASYMMETRIC CIPHERS: Principles of Public-Key Cryptosystems, The RSA algorithm, Diffie - Hellman Key Exchange, Elliptic Curve Arithmetic, Elliptic Curve Cryptography (Text 1: Chapter 8, Chapter 9: Section 1, 3, 4)	
Teaching-Learning Process	Chalk and Talk, YouTube videos, Flipped Class Technique and PPTs. Implementation of Asymmetric key algorithms using programming languages like C++/Python/Java/Scilab Numerical examples on Elliptic Curve Cryptography **RBT Level:** L1, L2, L3
Module-5	
Pseudo-Random-Sequence Generators and Stream Ciphers: Linear Congruential Generators, Linear Feedback Shift Registers, Design and analysis of stream ciphers, Stream ciphers using LFSRs, A5, Hughes XPD/KPD, Nanoteq, Rambutan, Additive generators, Gifford, Algorithm M, PKZIP (Text 2: Chapter 16)	
Teaching-Learning Process	Chalk and Talk, YouTube videos, Flipped Class Technique and PPTs. Implementation of simple stream ciphers using programming languages like C++/Python/Java/Scilab. **RBT Level:** L1, L2, L3

Course outcomes (Course Skill Set)

At the end of the course the student will be able to:

1. Explain traditional cryptographic algorithms of encryption and decryption process.
2. Use symmetric and asymmetric cryptography algorithms to encrypt and decrypt the data.
3. Apply concepts of modern algebra in cryptography algorithms.
4. Design pseudo random sequence generation algorithms for stream cipher systems.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module. Marks scored out of 100 shall be reduced proportionally to 50 marks

Suggested Learning Resources:

Text Books:

1. William Stallings , "Cryptography and Network Security Principles and Practice", Pearson Education Inc., 6th Edition, 2014, ISBN: 978-93-325-1877-3
2. Bruce Schneier, "Applied Cryptography Protocols, Algorithms, and Source code in C", Wiley Publications, 2nd Edition, ISBN: 9971-51-348-X.

Reference Books:

1. Cryptography and Network Security, Behrouz A Forouzan, TMH, 2007.
2. Cryptography and Network Security, Atul Kahate, TMH, 2003.

Web links and Video Lectures (e-Resources)

- https://nptel.ac.in/courses/106105031

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Programming Assignments / Mini Projects can be given to improve programming skills

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VI Semester

Python Programming			
Course Code	**21EC643**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	2:0:2:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course objectives:

- To learn programming using Python
- Develop application using Python

Teaching-Learning Process (General Instructions)

The sample strategies, which the teacher can use to accelerate the attainment of the various course outcomes are listed in the following:

1. In addition to the traditional lecture method, different types of innovative teaching methods may be adopted so that the delivered lessons shall develop student's theoretical and programming skills.
2. State the need for learning Programming with real-life examples.
3. Support and guide the students for self–study.
4. You will also be responsible for assigning homework, grading assignments and quizzes, and documenting students' progress
5. Encourage the students for group learning to improve their creative and analytical skills.
6. Show short, related video lectures in the following ways:
   - As an introduction to new topics (pre-lecture activity).
   - As a revision of topics (post-lecture activity).
   - As additional examples (post-lecture activity).
   - As an additional material of challenging topics (pre-and post-lecture activity).
   - As a model solution of some exercises (post-lecture activity).

Module-1

Python Basics, Python language features, History , Entering Expressions into the Interactive Shell, The Integer, Floating-Point, and String Data Types, String Concatenation and Replication, Storing Values in Variables, Your First Program, Dissecting Your Program, Flow control, Boolean Values, Comparison Operators, Boolean Operators, Mixing Boolean and Comparison Operators, Elements of Flow Control, Program Execution, Flow Control Statements, Importing Modules, Ending a Program Early with sys.exit(), Functions, def Statements with Parameters, Return Values and return Statements, The None Value, Keyword Arguments and print(), Local and Global Scope, The global Statement, Exception Handling, A Short Program: Guess the Number
Textbook 1: Chapters 1 – 3

Teaching-Learning Process	Chalk and talk method, Simulation of modulation techniques **RBT Level:** L1, L2, L3

Module-2

Data Structures: Lists: The List Data Type, Working with Lists Strings: Manipulating Strings, Working with Strings, Useful String Methods Tuples and Dictionaries, basics Using Data Structures to Model Real-World Things, Manipulating Strings.
Textbook 1: Chapters 4 – 6

Teaching-Learning Process	Chalk and talk method/Power point presentation **RBT Level:** L1, L2, L3

Module-3	
Pattern Matching with Regular Expressions, Finding Patterns of Text Without Regular Expressions, Finding Patterns of Text with Regular Expressions, More Pattern Matching with Regular Expressions,, The findall() Method, Character Classes, Making Your Own Character Classes, The Caret and Dollar Sign Characters, The Wildcard Character, Review of Regex Symbols. Reading and Writing Files, Files and File Paths, The os.path Module, The File Reading/Writing Process, Saving Variables with the shelve Module, Saving Variables with the pprint. pformat() Function Textbook 1: Chapters 7, 8	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation **RBT Level:** L1, L2, L3
Module-4	
Classes and objects: Programmer-defined types, Attributes, Rectangles, Instances as return values, Objects are mutable, Copying, Classes and functions: Time, Pure functions, Modifiers, Prototyping versus planning, Classes and methods: Object-oriented features, Printing objects, Another example, The init method, The__str__ method, Operator overloading, Type-based dispatch, Polymorphism. Textbook 2: Textbook 2: Chapters 15 – 18	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation **RBT Level:** L1, L2, L3
Module-5	
HTTP, The World's simplest Web Browser, Retrieving an image over HTTP, Retrieving web pages with urllib, Parsing html and scraping the web, Parsing HTML using RE, BeautifulSoup, Reading binary files using urllib, XML, Parsing XML, Looping through nodes, JSON, Parsing JSON, API, geocoding Web Service, Security & API usage, What is database?, Database Concepts, Database Browser, Creating a database table, SQL, Spidering Twitter, Basic data modeling, Programming with multiple tables, Three kinds of Keys, JOIN Text book : Chapter 2, 13, 15	
Teaching-Learning Process	Chalk and talk method/Power point presentation **RBT Level:** L1, L2, L3

Course outcomes (Course Skill Set)

At the end of the course the student will be able to:

1. To acquire programming skills in Python
2. To demonstrate data structure representation using Python
3. To develop the skill of pattern matching and files in Python
4. To acquire Object Oriented Skills in Python
5. To develop the ability to write database applications in Python

Assessment Details (both CIE and SEE)

The weightage of Continuous 5 End Examination) taken together.

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module. Marks scored out of 100 shall be reduced proportionally to 50 marks

Suggested Learning Resources:

Text Books:

1. Al Sweigart, "Automate the Boring Stuff with Python",1st Edition, No Starch Press, 2015. (Available under CC-BY-NC-SA license at https://automatetheboringstuff.com/) (Chapters 1 to 8)
2. Allen B Downey, "Think Python: How to Think Like a Computer Scientist", 2nd Edition, Green Tea Press, 2015. (Available under CC-BY-NC license at http://greenteapress.com/thinkpython2/thinkpython2.pdf) (Chapters 15 - 18) (Download pdf/html files from the above links)
3. Charles R. Severance, "Python for Everybody: Exploring Data Using Python 3", 1st, Create Space Independent Publishing Platform, 2016

Web links and Video Lectures (e-Resources)

- https://www.youtube.com/watch?v=_xQNeOTRyig
- https://www.youtube.com/watch?v=kqtD5dpn9C8

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Write a program to generate Fibonacci series
- Write a program to find factorial of a number using function.
- Write a menu driven program to implement stack using Lists
- Create a DB using dictionaries containing key as USN and related fields containing Name, gender, Marks1, Marks2 & Marks3 of students. Implement the following functions to perform i) Update Name/gender/marks ii) search for usn and display the relevant fields iii) delete based on search for name iv)generate the report with avg marks more than 70%
- Write a program to implement search and replace multiple occurrences of a given substring in the main string in a list.
- Write a function called most_frequent that takes a string and prints the letters in decreasing order of frequency.
- Write a program that reads a file, display the contents, builds a histogram of the words in the file and print most common words in the file.
- Write a program that searches a directory and all of its subdirectories, recursively, and returns a list of complete paths for all files with a given suffix.

03.10.2022

- Write python code to extract From: and To: Email Addresses from the given text file using regular expressions. https://www.py4e.com/code3/mbox.txt.
- Consider the sentence *"From rjlowe@iupui.edu Fri Jan 4 14:50:18 2008",* Write python code to extract email address and time of the day from the given sentence
- Write a program to read, display and count number of sentences of the given file.
- Write a program that gets the current date and prints the day of the week.
- Write a function called print_time that takes two Time objects and prints total time it in the form hour:minute:second.
- Write a program that takes a birthday as input and prints the user's age and the number of days, hours, minutes and seconds until their next birthday.

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VI Semester

Micro Electro Mechanical Systems			
Course Code	**21EC644**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	3: 0 :0 : 1	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course objectives:

- **Preparation**: To prepare students with fundamental knowledge/ overview in the field of Micro Electro Mechanical Systems.
- **Core Competence**: To equip students with a basic foundation in electronic engineering, mechanical engineering, electrical engineering, chemistry, physics and mathematics fundamentals required for comprehending the operation and application of MEMS circuits, design.
- **Professionalism & Learning Environment:** To inculcate in students an ethical and professional attitude by providing an academic environment inclusive of effective communication, teamwork, ability to relate engineering issues to a broader social context, and life-long learning needed for a successful professional career.

Teaching-Learning Process (General Instructions)
These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecture method (L) does not mean only the traditional lecture method, but a different type of teaching method may be adopted to develop the outcomes
2. Show Video/animation films to explain the functioning of various
3. Encourage collaborative (Group) Learning in the class to promote critical thinking
4. Topics for seminars on several MEMS related topics and their applications
5. Encourage the students to take up mini projects and main projects
6. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Overview of MEMS and Microsystems: MEMS and Microsystem, Typical MEMS and Microsystems Products, Evolution of Microfabrication, Microsystems and Microelectronics, Multidisciplinary Nature of Microsystems, Miniaturization. Applications and Markets.
Text1: **1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9**

Teaching-Learning Process	Chalk and talk method, Animation of MEMS products and applications **RBT Level:** L1, L2, L3

Module-2

Working Principles of Microsystems: Introduction, Microsensors, Micro actuation, MEMS with Micro actuators, Micro accelerometers, Microfluidics. **Text1: 2.1,2.2, 2.3, 2.4, 2.5, 2.6**
Engineering Science for Microsystems Design and Fabrication: Introduction, Atomic Structure of Matter, Ions and Ionization Molecular Theory of Matter and Intermolecular Forces, Plasma Physics, Electrochemistry. **Text1: 3.1, 3.2, 3.3, 3.4, 3.7, 3.8**

Teaching-Learning Process	PowerPoint Presentation, YouTube videos, Animations of MEMS Micro sensors, Micro actuators, Micro accelerometers and Microfluidics, molecules, Ions and matter **RBT Level:** L1, L2, L3

Module-3	
Engineering Mechanics for Microsystems Design: Introduction, Static Bending of Thin Plates, Mechanical Vibration, Thermo mechanics, Fracture Mechanics, Thin Film Mechanics, Overview on Finite Element Stress Analysis. **Text1: 4.1,4.2,4.3,4.4,4.5,4.6,4.7**	
Teaching-Learning Process	Chalk and talk method, Power Point Presentations and supporting YouTube Videos Solve numericals related to Thin Plates, and Vibration. Self study topics: solve numericals related to other topics **RBT Level:** L1, L2, L3
Module-4	
Scaling Laws in Miniaturization: Introduction, Scaling in Geometry, Scaling in Rigid-Body Dynamics, Scaling in Electrostatic Forces, Scaling in Electromagnetic Forces, Scaling in Electricity, Scaling in Fluid Mechanics, Scaling in Heat Transfer. **Text1: 6.1, 6.2,6.3,6.4,6.5,6.6,6.7,6.8**	
Teaching-Learning Process	Chalk and Talk Method, You Tube Videos, Solve numericals related to scaling in Geometry Self study topics: solve numericals of other topics **RBT Level:** L1, L2, L3
Module-5	
Overview of Micromanufacturing: Introduction, Bulk Micromanufacturing, Surface Micromachining, The LIGA Process, Summary on Micromanufacturing. **Text1: 9.1,9.2,9.3,9.4,9.5** **Microsystem Packaging**: Introduction, Overview of Mechanical Packaging of Microelectronics, Microsystem Packaging. **Text1: 11.1,11.2, 11.3**	
Teaching-Learning Process	Power Point Presentation, YouTube videos, Animation of MEMS micromanufacturing Supporting animation videos on packaging **RBT Level:** L1, L2, L3

Course outcomes (Course Skill Set)

At the end of the course the student will be able to:

1. Appreciate the technologies related to Micro Electro Mechanical Systems.
2. Understand design and fabrication processes involved with MEMS devices.
3. Analyse the MEMS devices and develop suitable mathematical models
4. Know various application areas for MEMS device.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module. Marks scored out of 100 shall be reduced proportionally to 50 marks

Suggested Learning Resources:

Text Book:

Tai-Ran Hsu, MEMS and Micro systems: Design and Manufacture, 1st Ed, Tata Mc Graw Hill.

Reference Books:

1. **Hans H Gatzen, Volker Saile, JurgLeuthold**, Micro and Nano Fabrication: Tools and Processes, Springer, 2015.
2. **Dilip Kumar Bhattacharya, Brajesh Kumar Kaushik**, Microelectromechanical Systems (MEMS), Cengage Learning.
3. **Chang Liu**, Foundations of MEMS, Pearson Ed.

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Develop mini projects and Final year projects using MEMS components to address the real world problems

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VII Semester

Advanced VLSI			
Course Code	**21EC71**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	3:0:0:1	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course objectives:

- Learn overview of VLSI design flow
- Emphasise on Back end VLSI design flow
- Learn basics of verification with reference to System Verilog

Teaching-Learning Process (General Instructions)

The sample strategies, which the teacher can use to accelerate the attainment of the various course outcomes are listed in the following:

1. Lecture method (L) does not mean only the traditional lecture method, but a different type of teaching method may be adopted to develop the outcomes.
2. Show Video/animation films to explain the functioning of various techniques.
3. Encourage collaborative (Group) Learning in the class
4. Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
6. Topics will be introduced in multiple representations.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Introduction to ASICs: Full custom, Semi-custom and Programmable ASICs, ASIC Design flow, ASIC cell libraries. CMOS Logic: Data path Logic Cells: Data Path Elements, Adders: Carry skip, Carry bypass, Carry save, Carry select, Conditional sum, Multiplier (Booth encoding), Data path Operators, I/O cells, Cell Compilers. Text Book 1

Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2, L3

Module-2

Floor planning and placement: Goals and objectives, Measurement of delay in Floor planning, Floor planning tools, Channel definition, I/O and Power planning and Clock planning. Placement: Goals and Objectives, Min-cut Placement algorithm, Iterative Placement Improvement, Time driven placement methods, Physical Design Flow.
Routing: Global Routing: Goals and objectives, Global Routing Methods, Global routing between blocks, Back annotation. Text Book 1

Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2, L3

Module-3	
Verification Guidelines: The verification process, basic test bench functionality, directed testing, methodology basics, constrained random stimulus, randomization, functional coverage, test bench components, layered testbench. **Data Types**: Built in Data types, fixed and dynamic arrays, Queues, associative arrays, linked lists, array methods, choosing a type, creating new types with type def, creating user defined structures, type conversion, Enumerated types, constants and strings, Expression width. Text Book 2	
Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2, L3
Module-4	
Procedural Statements and Routines: Procedural statements, Tasks, Functions and void functions, Task and function overview, Routine arguments, returning from a routine, Local data storage, time values. **Connecting the test bench and design**: Separating the test bench and design, The interface construct, Stimulus timing, Interface driving and sampling, System Verilog assertions. Text Book 2	
Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2, L3
Module-5	
Randomization: Introduction, What to randomize? , Randomization in System Verilog, Random number functions, Common randomization problems, Random Number Generators. **Functional Coverage**: Coverage types, Coverage strategies, Simple coverage example, Anatomy of Cover group and Triggering a Cover group, Data sampling, Cross coverage, Generic Cover groups, Coverage options, Analyzing coverage data, measuring coverage statistics during simulation. Text Book 2	
Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2, L3

Course outcomes (Course Skill Set)

At the end of the course the student will be able to:

1. Understand VLSI design flow
2. Describe the concepts of ASIC design methodology
3. Create floor plan including partition and routing with the use of CAD algorithms
4. Will have better insights into VLSI back-end design flow
5. Learn verification basics and System Verilog

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module. Marks scored out of 100 shall be reduced proportionally to 50 marks

Suggested Learning Resources:

Text Books:

1. Michael John Sebastian Smith, Application - Specific Integrated Circuits, Addison-Wesley Professional, 2005.
2. Chris Spear, System Verilog for Verification – A guide to learning the Test bench language features, Springer Publications, Second Edition, 2010.

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Use EDA tool to design basic Analog blocks like amplifiers and 4-bit RAM
- Prepare a white paper on ASIC design flow referring to literatures of Cadence and Synopsys EDA tools
- Mini project using System Verilog

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VII Semester

Optical & Wireless Communication			
Course Code	**21EC72**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	2:0:0:1	SEE Marks	50
Total Hours of Pedagogy	30	Total Marks	100
Credits	2	Exam Hours	3

Non-MCQ pattern of CIE and SEE

Course objectives:

This course will enable students to:

- Learn the basic principle of optical fiber communication with different modes of light propagation.
- Understand the transmission characteristics and losses in optical fiber.
- Study of optical components and its applications in optical communication networks.
- Understand the concepts of propagation over wireless channels from a physics standpoint
- Understand the multiple access techniques used in cellular communications standards.
- Application of Communication theory both Physical and networking to understand GSM systems that handle mobile telephony.

Teaching-Learning Process (General Instructions)

The sample strategies, which the teacher can use to accelerate the attainment of the various course outcomes are listed in the following:

1. Lecture method (L) does not mean only the traditional lecture method, but a different type of teaching method may be adopted to develop the outcomes.
2. Show Video/animation films to explain the functioning of various techniques.
3. Encourage collaborative (Group) Learning in the class
4. Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
6. Topics will be introduced in multiple representations.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Optical Fiber Structures: Optical Fiber Modes and Configurations, Mode theory for circular waveguides, Single mode fibers, Fiber materials.

Attenuation and Dispersion: Attenuation, Absorption, Scattering Losses, Bending loss, Signal Dispersion: Modal delay, Group delay, Material dispersion.

[Text1 : 3.1, 3.2, 2.3[2.3.1 to 2.3.4], 2.4[2.4.1, 2.4.2],2.5, 2.7].

Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2, L3

Module-2

Optical Sources and detectors: Light Emitting Diode: LED Structures, Light source materials, Quantum efficiency and LED power, Laser Diodes: Modes and threshold conditions, Rate equations, External quantum efficiency, Resonant frequencies, Photodetectors: The pin Photodetector, Avalanche Photodiodes.

WDM Concepts: Overview of WDM, Isolators and Circulators, Fiber grating filters, Dielectric thin-film filters, Diffraction Gratings. [Text1: 4.2 ,4.3, 6.1, 10.1, 10.3, 10.4, 10.5, 10.7]	
Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2, L3
Module-3	
Mobile Communication Engineering: Wireless Network generations, Basic propagation Mechanisms, Mobile radio Channel. **Principles of Cellular Communications:** Cellular terminology, Cell structure and Cluster, Frequency reuse concept, Cluster size and system capacity, Frequency Reuse Distance, Cochannel Interference and signal quality. [Text2: 1.4, 2.4, 2.5, 4.1 to 4.4, 4.6, 4.7]	
Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2, L3
Module-4	
Multiple Access Techniques: FDMA, TDMA, CDMA, SDMA, Hybrid Multiple Access Techniques, Multicarrier Multiple Access Schemes. **A Basic Cellular System:** A basic cellular system connected to PSTN, Parts of basic cellular system, Operation of a cellular system. [Text2: 8.2, 8.3, 8.4.5, 8.5, 8.6, 8.10, 9.2.2, 9.2.3, 9.3]	
Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2, L3
Module-5	
Global System for Mobile (GSM): GSM Network Architecture, GSM signalling protocol architecture, Identifiers used in GSM system, GSM Channels, Frame structure for GSM, GSM Call procedures, GSM hand-off Procedures, GSM Services and features. [Text2: 11.1, 11.2,11.3,11.4, 11.5, 11.8, 11.9. 11.10]	
Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2, L3

Course outcomes (Course Skill Set)

At the end of the course the student will be able to:

1. Classification and characterization of optical fibers with different modes of signal propagation.
2. Describe the constructional features and the characteristics of optical fiber and optical devices used for signal transmission and reception.
3. Understand the essential concepts and principles of mobile radio channel and cellular communication.
4. Describe various multiple access techniques used in wireless communication systems.
5. Describe the GSM architecture and procedures to establish call set up, call progress handling and call tear down in a GSM cellular network.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation (CIE):

CIE will be the same as other core theory courses.

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.
Semester End Examination (SEE):

For non-MCQ pattern of CIE and SEE

Continuous Internal Evaluation (CIE):

At the beginning of the semester, the instructor/faculty teaching the course has to announce the methods of CIE for the course.

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module. Marks scored out of 100 shall be reduced proportionally to 50 marks

Suggested Learning Resources:

Text Books

1. Gerd Keiser, Optical Fiber Communication, 5th Edition, McGraw Hill Education (India) Private Limited, 2016. ISBN:1-25-900687-5.
2. T L Singal, Wireless Communications, McGraw Hill Education (India) Private Limited, 2016, ISBN:0-07-068178-3.

Reference Books

1. John M Senior, Optical Fiber Communications, Principles and Practice, 3rd Edition, Pearson Education, 2010, ISBN:978-81-317-3266-3
2. Theodore Rappaport, Wireless Communications: Principles and Practice, 2nd Edition, Prentice Hall Communications Engineering and Emerging Technologies Series, 2002, ISBN 0-13-042232-0.
3. Gary Mullet, Introduction to Wireless Telecommunications Systems and Networks, First Edition, Cengage Learning India Pvt Ltd., 2006, ISBN - 13: 978-81-315-0559-5.

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VII Semester

Optical & Satellite Communication			
Course Code	**21EC741**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	3:0:0:1	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course objectives: This course will enable students to:

- Learn the basic principle of optical fiber communication with different modes of light propagation.
- Understand the transmission characteristics and losses in optical fiber.
- Study of optical components and its applications in optical communication networks.
- Understand the basic principle of satellite orbits and trajectories.
- Study of electronic systems associated with a satellite and the earth station.
- Study satellite applications focusing various domains services such as remote sensing, weather forecasting and navigation.

Teaching-Learning Process (General Instructions)

The sample strategies, which the teacher can use to accelerate the attainment of the various course outcomes are listed in the following:

1. Lecture method (L) does not mean only the traditional lecture method, but a different type of teaching method may be adopted to develop the outcomes.
2. Show Video/animation films to explain the functioning of various techniques.
3. Encourage collaborative (Group) Learning in the class
4. Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
6. Topics will be introduced in multiple representations.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Optical Fiber Structures: Optical Fiber Modes and Configurations, Mode theory for circular waveguides, Single mode fibers, Fiber materials, Photonic Crystal Fibers, Fiber Optic Cables.
Attenuation and Dispersion: Attenuation: Absorption, Scattering Losses, Bending loss, Signal Dispersion: Modal delay, Group delay, Material dispersion.
[Text1 : 2.3[2.3.1 to 2.3.4], 2.4[2.4.1, 2.4.2],2.5, 2.7,2.8, 2.11, 3.1, 3.2].

Teaching-Learning Process	Chalk and talk method, Power Point Presentation. Self-study topics: Optical Spectral bands, Basic optical laws and definitions. **RBT Level:** L1, L2, L3

Module-2

Optical Sources and detectors: Light Emitting Diode: LED Structures, Light source materials, Quantum efficiency and LED power, Laser Diodes: Modes and threshold conditions, Rate equations, External quantum efficiency, Resonant frequencies, Photodetectors: The pin Photodetector, Avalanche Photodiodes.
WDM Concepts: Overview of WDM, Isolators and Circulators, Fiber grating filters, Dielectric thin-film filters, Diffraction Gratings.

Optical Amplifiers: Basic Applications and types, Erbium doped fiber amplifiers. [Text1: 4.2 ,4.3, 6.1, 10.1, 10.3, 10.4, 10.5, 10.7, 11.1, 11.3.1,11.3.2]	
Teaching-Learning Process	Chalk and talk method, Power point presentation Self-study topics: Raman Amplifiers. **RBT Level:** L1, L2, L3
Module-3	
Satellite Orbit and Trajectories: Definition, Basic Principles, Orbital parameters, Injection velocity and satellite trajectory, Types of Satellite orbits. [Text2: 2.1, 2.2, 2.3,2.4,2.5] **Satellite In-orbit Operations:** Orbital perturbations, Satellite stabilization, Orbital effects on satellite's performance, Eclipses, Look angles: Azimuth angle, Elevation angle. [Text2: 3.3, 3.4, 3.5, 3.6, 3.7]	
Teaching-Learning Process	Chalk and talk method, Power Point Presentation. Self-study topics: Satellite launch sequence. **RBT Level:** L1, L2, L3
Module-4	
Satellite Hardware: Satellite Subsystems, Power supply subsystem, Attitude and Orbit control, Tracking, Telemetry and command subsystem, Payload. [Text2: 4.1, 4.5, 4.6, 4.7,4.8] **Earth Station:** Types of earth station, Architecture, Design considerations, Testing, Earth station Hardware, Satellite tracking. [Text2: 8.1, 8.2, 8.3,8.4,8.5,8.6]	
Teaching-Learning Process	Chalk and talk method, Power Point Presentation. Self-study topics: Mechanical structure and propulsion subsystem **RBT Level:** L1, L2, L3
Module-5	
Communication Satellites: Introduction, Related Applications, Frequency Bands, Payloads, Satellite Vs. Terrestrial Networks, Satellite Television, Satellite Data Communication Services. **Applications:** Remote Sensing Satellites: Classification, Orbits, payloads. Weather Forecasting Satellites: Overview, Fundamentals, orbits and payload. Global Positioning Satellite System.	
Teaching-Learning Process	Chalk and talk method, Power point presentation Self-study topics: Regional, National and International Satellite systems **RBT Level:** L1, L2, L3

Course outcomes (Course Skill Set)

At the end of the course the student will be able to:

1. Classification and characterization of optical fibers and devices used for optical communication.
2. Understand the principle of operation of optical devices used for multiplexing and amplification of light.
3. Describe the satellite orbits and its trajectories with the definitions of parameters associated with it.
4. Describe the electronic hardware systems associated with the satellite subsystem and earth station.
5. Understand the functioning of satellites for communication, remote sensing, and weather and navigation applications.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester

2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module. Marks scored out of 100 shall be reduced proportionally to 50 marks

Suggested Learning Resources:

Text Books:

1. Gerd Keiser, Optical Fiber Communication, 5th Edition, McGraw Hill Education (India) Private Limited, 2016. ISBN:1-25-900687-5.
2. Anil K Maini, Varsha Agrawal, Satellite Communication, Wiley India Pvt. Ltd., 2015, ISBN: 978-81-265-2071-8.

Reference Books:

1. John M Senior, Optical Fiber Communications, Principles and Practice, 3rd Edition, Pearson Education, 2010, ISBN:978-81-317-3266-3
2. Timothy Pratt, Charles Bostian, Jeremy Allnutt, Satellite Communications, 2nd Edition, Wiley India Pvt. Ltd , 2017, ISBN: 978-81-265-0833-4
3. Dennis Roddy, Satellite Communications, 4th Edition, McGraw- Hill International edition, 2006.

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VII Semester

ARM Embedded Systems			
Course Code	**21EC742**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	3:0:0:1	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course objectives:

This course will enable students to:

- Explain the architectural features and instructions of 32 bit ARM microcontroller
- Develop Programs using the various instructions of ARM for different Applications.
- Understand the basic hardware components and their selection method based on the characteristics and
- Attributes of an embedded system.
- Develop the hardware software co-design and firmware design approaches.
- Explain the need of real time operating system for embedded system applications.

Teaching-Learning Process (General Instructions)

The sample strategies, which the teacher can use to accelerate the attainment of the various course outcomes are listed in the following:

1. Lecture method (L) does not mean only the traditional lecture method, but a different type of teaching method may be adopted to develop the outcomes.
2. Show Video/animation films to explain the functioning of various techniques.
3. Encourage collaborative (Group) Learning in the class
4. Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
6. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
7. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.
8. Give programming assignments.

Module-1

ARM Embedded System: RISC Design Philosophy, ARM design Philosophy, Embedded System hardware and Embedded System software.
ARM Processor Fundamentals: Registers, Current Program Status Registers, Pipeline, Exceptions, Interrupts and the Vector table, Core Extensions, Architecture Revisions, ARM processor families
(Text1 : Chapter 1 and Chapter 2)

Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2, L3

Module-2

ARM Instructions: Introduction, Data Processing Instructions, Branch Instructions, Load – Store Instructions Software Instructions, Program Status Register Instructions, Conditional Execution.
Thumb Instructions: Thumb register usage, ARM – Thumb Interworking, Other branch Instructions, Data Processing instructions, Single and Multiple Register Load Store Instructions, Stack Instructions, Software Interrupt Instructions.
(Text1: Chapter 3 and chapter 4,)

Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2, L3

Module-3

Embedded System Components: Embedded Vs General computing system, Classification of Embedded systems, Major applications and purpose of ES. Elements of an Embedded System (Block diagram and explanation), Differences between RISC and CISC, Harvard and Princeton, Big and Little Endian formats, Memory (ROM and RAM types), Sensors, Actuators, Optocoupler, Communication Interfaces (I2C, SPI, IrDA, Bluetooth, Wi-Fi, Zigbee only)

(Text 2: All the Topics from Ch-1 and Ch-2 (Fig and explanation before 2.1) 2.1.1.6 to 2.1.1.8, 2.2 to 2.2.2.3, 2.3 to 2.3.2, 2.3.3.3, selected topics of 2.4.1 and 2.4.2 only).

Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2, L3

Module-4

Embedded System Design Concepts: Characteristics and Quality Attributes of Embedded Systems, Operational and non-operational quality attributes, Embedded Systems-Application and Domain specific, Hardware Software Co-Design and Program Modeling (excluding UML), Embedded firmware design and development (excluding C language).
Text 2: Ch-3, Ch-4 (4.1, 4.2.1 and 4.2.2 only), Ch-7 (Sections 7.1, 7.2 only), Ch-9 (Sections 9.1, 9.2, 9.3.1, 9.3.2 only)

Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2, L3

Module-5

RTOS and IDE for Embedded System Design: Operating System basics, Types of operating systems, Task, process and threads (Only POSIX Threads with an example program), Thread preemption, Preemptive Task scheduling techniques, Task Communication, Task synchronization issues – Racing and Deadlock, Concept of Binary and counting semaphores (Mutex example without any program), How to choose an RTOS, Integration and testing of Embedded hardware and firmware, Embedded system Development Environment – Block diagram (excluding Keil), Disassembler/decompiler, simulator, emulator and debugging techniques
(Text 2: Ch-10 (Sections 10.1, 10.2, 10.3, 10.5.2 , 10.7, 10.8.1.1, 10.8.1.2, 10.8.2.2, 10.10 only), Ch-12, Ch-13 (a block diagram before 13.1, 13.3, 13.4, 13.5, 13.6 only)

Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2, L3

Course outcomes (Course Skill Set)

At the end of the course the student will be able to:

1. Describe the architectural features and instructions of 32 bit microcontroller ARM Cortex M3.
2. Apply the knowledge gained for Programming ARM Cortex M3 for different applications.
3. Understand the basic hardware components and their selection method based on the characteristics and attributes of an embedded system.
4. Develop the hardware software co-design and firmware design approaches.
5. Explain the need of real time operating system for embedded system applications.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module. Marks scored out of 100 shall be reduced proportionally to 50 marks

Suggested Learning Resources:

Text Books:

1. Andrew N Sloss, "ARM System Developer's guide", Elsevier Publications, 2016
2. Shibu K V, "Introduction to Embedded Systems", Tata McGraw Hill Education Private Limited, 2nd Edition.

Reference Books:

1. James K Peckol, "Embedded systems- A contemporary design tool", John Wiley, 2008.
2. Yifeng Zhu, "Embedded Systems with Arm Cortex-M Microcontrollers in Assembly Language and C", 2nd Ed., Man Press LLC ©, 2015.
3. K V K K Prasad, "Embedded real time systems", Dreamtech publications, 2003.
4. Rajkamal, "Embedded Systems",2nd Edition, McGraw hill Publications, 2010.

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VII Semester

Basic Digital Image Processing			
Course Code	**21EC743**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	2:0:2:1	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course objectives:

- Understand the fundamentals of digital image processing
- Understand the image enhancement techniques in spatial domain used in digital image processing
- Understand the frequency domain enhancement techniques in digital image processing
- Understand the Color Image Processing in digital image processing
- Understand the image restoration techniques and methods used in digital image processing

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Show Video/animation films to explain the functioning of various image processing concepts.
2. Encourage cooperative (Group) Learning through puzzles, diagrams, coding etc., in the class.
3. Encourage students to ask questions and investigate their own ideas helps improve their problem-solving skills as well as gain a deeper understanding of academic concepts.
4. Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking
5. Students are encouraged to do coding based projects to gain knowledge in image processing.
6. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
7. Topics will be introduced in multiple representations.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.
9. Arrange visits to nearby PSUs such as CAIR(DRDO), NAL, BEL, ISRO, etc., and small-scale software industries to give industry exposure.

Module-1

Digital Image Fundamentals: What is Digital Image Processing?, Origins of Digital Image Processing, Examples of fields that use DIP, Fundamental Steps in Digital Image Processing, Components of an Image Processing System, Elements of Visual Perception, Image Sensing and Acquisition, Image Sampling and Quantization, Some Basic Relationships Between Pixels.
[Text 1: Chapter 1, Chapter 2: Sections 2.1 to 2.5]

Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, YouTube videos, Videos on Image processing applications Self-study topics: Arithmetic and Logical operations Practical topics: Problems on Basic Relationships Between Pixels. **RBT Level:** L1, L2, L3

Module-2

Spatial Domain: Some Basic Intensity Transformation Functions, Histogram Processing, Fundamentals of Spatial Filtering, Smoothing Spatial Filters, Sharpening Spatial Filters
[Text 1: Chapter 3: Sections 3.2 to 3.6]

Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, YouTube videos and animations of Intensity Transformation Functions, Histogram Processing, Spatial domain filters. Self-study topics: Point, line and edge detection. Practical topics: Problems on Intensity Transformation Functions, Histogram, Spatial domain filters **RBT Level:** L1, L2, L3

Module-3

Frequency Domain: Basics of Filtering in the Frequency Domain, Image Smoothing and Image Sharpening Using Frequency Domain Filters.

[Text 1: Chapter 4: Sections 4.7 to 4.9]

Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, YouTube videos on frequency domain filtering, Color image processing. Self-study topics: Basic concept of segmentation. Practical topics: Problems on Image smoothing and sharpening **RBT Level:** L1, L2, L3

Module-4

Color Image Processing: Color Fundamentals, Color Models, Pseudo-color Image Processing.

[Text 1: Chapter 6: Sections 6.1 to 6.3]

Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, YouTube videos on Color image processing. Practical topics: Problems on Pseudo-color Image Processing **RBT Level:** L1, L2, L3

Module-5

Restoration: A model of the Image Degradation/Restoration Process, Noise models, Restoration in the Presence of Noise Only using Spatial Filtering and Frequency Domain Filtering, Inverse Filtering, Minimum Mean Square Error (Wiener) Filtering.

[Text 1: Chapter 5: Sections 5.1, to 5.4.3, 5.7, 5.8]

Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, YouTube videos on Noise models, filters and its applications. Self-study topics: Linear position invariant degradation, Estimation of degradation function. **RBT Level:** L1, L2, L3

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

1. Understand image formation and the role of human visual system plays in perception of gray and color image data.
2. Apply image processing techniques in spatial domains.
3. Apply image processing techniques in frequency (Fourier) domains.
4. Conduct independent study and analysis of Image Enhancement techniques.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester

3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module. Marks scored out of 100 shall be reduced proportionally to 50 marks

Suggested Learning Resources:

Text Book:

Digital Image Processing- Rafael C Gonzalez and Richard E Woods, PHI, 3rd Edition, 2010.

Reference Books:

1. Digital Image Processing- S Jayaraman, S Esakkirajan, T Veerakumar, Tata McGraw Hill, 2014.
2. Fundamentals of Digital Image Processing- A K Jain, PHI Learning Private Limited 2014.

Web links and Video Lectures (e-Resources)

- Image databases, https://imageprocessingplace.com/root_files_V3/image_databases.htm
- Student support materials, https://imageprocessingplace.com/root_files_V3/students/students.htm
- NPTEL Course, Introduction to Digital Image Processing, https://nptel.ac.in/courses/117105079
- Computer Vision and Image Processing, https://nptel.ac.in/courses/108103174
- Image Processing and Computer Vision – Matlab and Simulink,
- https://in.mathworks.com/solutions/image-video-processing.html

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Simulink models for Image processing

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B.E: Electronics & Communication Engineering / B.E: Electronics & Telecommunication Engineering
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VII Semester

Basic Digital Signal Processing			
Course Code	**21EC744**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	3:0:0:1	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course objectives:

This course will enable students to:

- **Preparation**: To prepare students with fundamental knowledge/ overview in the field of Signal Processing
- **Core Competence**: To equip students with a basic foundation of Signal Processing by delivering the mathematical description of discrete time signals and systems, classifying signals into different categories based on their properties, analyzing Linear Time Invariant (LTI)systems in time and transform domains, basics of FIR & IIR Filter Design

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecture method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
2. Show Video/animation films to explain the different concepts Digital Signal Processing.
3. Encourage collaborative (Group) Learning in the class.
4. Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
6. Topics will be introduced in a multiple representation.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.
9. Adopt Flipped class technique by sharing the materials / Sample Videos prior to the class and have discussions on the that topic in the succeeding classes
10. Give Programming Assignments.

Module-1	
Signal Definition, Signal Classification, System definition, System classification, for both continuous time and discrete time, Definition of LTI systems (Chapter1)	
Teaching-Learning Process	Chalk and talk method, YouTube videos, Flipped Class Technique, Programming assignments **RBT Level:** L1, L2, L3

Module-2	
Introduction to Fourier Transform, Fourier Series, Relating the Laplace Transform to Fourier Transform, Frequency response of continuous time systems (Chapter3)	
Teaching-Learning Process	Chalk and talk method, YouTube videos, Flipped Class Technique, Programming assignments **RBT Level:** L1, L2, L3

Module-3	
Frequency response of ideal analog filters, Salient features of Butterworth filters Design and implementation of Analog Butterworth filters to meet given specifications (Chapter8)	
Teaching-Learning Process	Chalk and talk method, YouTube videos, Flipped Class Technique, Programming assignments **RBT Level:** L1, L2, L3
Module-4	
Sampling Theorem- Statement and proof, converting the analog signal to a digital signal, Practical sampling, The Discrete Fourier Transform, Properties of DFT, Comparing the frequency response of analog and digital systems (FFT not included) (Chapter 3,4)	
Teaching-Learning Process	Chalk and talk method, YouTube videos, Flipped Class Technique, Programming assignments **RBT Level:** L1, L2, L3
Module-5	
Definition of FIR and IIR filters, Frequency response of ideal digital filters. Transforming the Analog Butterworth filter to the Digital IIR Filter using BLT to meet given specifications. Design of Low pass / High pass FIR Filters using the Window technique, to meet given specifications, Comparing the designed filter with the desired filter frequency response (Chapter8)	
Teaching-Learning Process	Chalk and talk method, Power point presentation, YouTube videos, Flipped Class Technique, Programming assignments **RBT Level:** L1, L2, L3

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

1. Understand the continuous time and discrete time signals and systems, in time and frequency domain
2. Apply the concepts of signals and systems to obtain the desired parameter/representation
3. Design analog/digital filters to meet given specifications
4. Design and implement the analog filter using components/suitable simulation tools
5. Design and implement the digital filter (FIR/IIR) using suitable simulation tools, and record the input and output of the filter for the given audio signal

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module. Marks scored out of 100 shall be reduced proportionally to 50 marks

Suggested Learning Resources:

Text Books:

1. 'Signals and Systems', Simon Haykin and Barry Van Veen, Wiley.
2. "Fundamentals of Digital Signal Processing", Lonnie C Ludeman, John Wiley and Sons, 1986.

Reference Books:

3. 'Theory and Application of Digital Signal Processing', Rabiner and Gold
4. 'Signals and Systems', Schaum's Outline series
5. 'Digital Signal Processing', Schaum's Outline series

Web links and Video Lectures (e-Resources)

By Prof. S C Dutta Roy, IIT Delhi
https://nptel.ac.in/courses/117102060

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Programming Assignments / Mini Projects can be given to improve programming skills

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VII Semester

E-waste Management			
Course Code	**21EC745**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	3:0:0:1	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course objectives:

- **Current Status:** According to a report on e-waste presented by the United Nations (UN) in World Economic Forum on January 24, 2019, the waste stream reached 48.5 MT in 2018. With such a large quantity of e-waste being generated each year, the future of e-waste recycling in India looks pretty bright. The E-waste (Management) Rules, 2016, enacted on October 1, 2017, added over 21 products (Schedule-I) under the purview of the rule.
- **Purview:** This course covers an extensive review of e-waste management in India. With a focus on the evolution of legal frameworks in India and the world, it presents impacts and outcomes; challenges and opportunities; and management strategies and practices to deal with e-waste. It also includes a survey of pan-India initiatives and trajectories of law-driven initiatives for effective e-waste management along with responses from industries and producers.
- **Scope:** There is a considerable scope for e-waste recycling in India. It is not only a solution to help mitigate e-waste management issues, but it also helps to generate employment. With the rise in e-waste recycling plants, the demand for employees with all levels of qualification and skills also increases.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecture method (L) does not mean only the traditional lecture method, but a different type of teaching method may be adopted to develop the outcomes.
2. Show Video/animation films to explain the functioning of various techniques.
3. Encourage collaborative (Group) Learning in the class
4. Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
6. Topics will be introduced in multiple representations.
7. Discuss how every concept can be applied to the real world - and when that's possible, it helps to improve the students' understanding.
8. Arrange visits to nearby industries to give industry exposure.

Module-1

Sustainable development and e-waste management: Importance of electrical and electronic equipment in a nation's development, and e-waste as toxic companion of digital era, I: Let's understand e-waste, II: E-waste statistics: quantities, collection and recycling, E-waste categories and harmonising statistics, III: An overview on status of e-waste related legislation across the globe; IV: UN initiatives for e-waste management: creating partnerships and achieving Agenda 2030; V: Indian scenario: e-waste generation, collection and recycling.

Teaching-Learning Process	Chalk and talk method, YouTube videos. **RBT Level:** L1, L2

Module-2

Extended producer responsibility: a mainstay for e-waste management: Evolution of concept of 'extended producer responsibility', EPR applied for waste management and extended for e-waste

management, EPR: goals, implementation, and challenges for e-waste management, EPR implemented for e-waste management under the existing regulatory frameworks in different countries, Role of a PRO prescribed in regulatory framework, Considerations for successful implementation of EPR, Challenges in implementation of EPR for e-waste management, Impact of EPR, EPR and e-waste management in India. **Toxicity and impacts on environment and human health**: Toxicity, recycling, and regulations, I: Environmental concerns, II: Human health concerns.	
Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, More examples relating to applications. **RBT Level:** L1, L2, L3
Module-3	
Treating e-waste, resource efficiency, and circular economy: Safe environment, resource use, and circular economy, Circular economy: recycling, resource recovery, and resource efficiency, Potentials of urban mining in circular economy, Recycling and resource efficiency related challenges to the circular economy, Urban mining, recycling, resource use, resource efficiency, and circular economy in India. **E-waste management through legislations in India**: I: Historical backdrop of regulatory regime for e-waste in India, II: E-waste (management) Rules, 2016 and E-waste (management) Amendment Rules, 2018, III: Analysing performance of EPR and CPCB as regulatory mechanisms, IV: Legal cases and judicial directives.	
Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation **RBT Level:** L1, L2, L3
Module-4	
Strategies and initiatives for dealing with e-waste in India: I: Overview of pan-India initiatives for dealing with e-waste during 2000 and 2012, II: Law-driven e-waste management – initiatives by the government, non-government agencies, and judiciary.	
Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation. **RBT Level:** L1, L2, L3
Module-5	
Moving towards horizons: I: Legal and judicial domain, II: Economic concerns, III: Environment concerns, IV: Recycling culture/recycling society.	
Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, More examples relating to applications. **RBT Level:** L1, L2, L3

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

1. Understand the existing discourse on e-waste and its management, statistics across the world, opportunities, and challenges w.r.t. regulatory framework, SDGs, CE, and LCIA (Life Cycle Impact Assessment) and MFA (Material Flow Analysis), Indian scenario.
2. Describe EPR, a regulatory framework for achieving specified goals across different countries and impacts on environment and human health.
3. Explain themes in the context of resource use and sustainable development. Urban mining, informal sector operations and need for resource use policy, financial support for recycling infrastructure building, etc. in Indian context and also explain to what extent – different aspects of e-waste management have been incorporated in the existing regulatory framework in comparison with international legislatures.
4. Identify and infer pan-Indian initiatives dealing with e-waste management, ranging from building knowledge base through research and social action by different stakeholders to technological and legal advancements, and industrial initiatives. Analyse roadmap for the Agenda 2030.
5. Use opportunities and challenges around four domains: legal and judicial domain; economic concerns; recycling culture/society; and environment concerns.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module. Marks scored out of 100 shall be reduced proportionally to 50 marks

Suggested Learning Resources:

Text Book:

Varsha Bhagat Gangulay, 'E-Waste Management', Taylor and Francis, 2022.

Web links and Video Lectures (e-Resources)

•https://link.springer.com/book/10.1007/978-3-030-14184-4
•https://rajyasabha.nic.in/rsnew/publication_electronic/E-Waste_in_india.pdf
•https://greene.gov.in/wp-content/uploads/2018/01/E-waste-Vol-II-E-waste-Management-Manual.pdf
•https://nptel.ac.in/courses/105105169

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

• Groups can be made to conduct a survey on the present scenario of India and top 5 countries facing ewaste management challenges.
• Industry visits to give an exposure of the e waste management process and also business.
• Case studies to develop e-waste management models.
• Survey of few e-waste management companies can be carried out and submit report.

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VII Semester

Advanced Design Tools for VLSI			
Course Code	**21EC721**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	3:0:0:1	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course objectives:

- Impart knowledge of EDA tools and methodology for FPGA
- Learn principles of IP core for FPGA and embedded systems
- Infer the concept of machine learning in fabrication and physical design

Teaching-Learning Process (General Instructions)

The sample strategies, which the teacher can use to accelerate the attainment of the various course outcomes are listed in the following:

1. Lecture method (L) does not mean only the traditional lecture method, but a different type of teaching method may be adopted to develop the outcomes.
2. Arrange visits to nearby PSUs and small-scale communication industries.
3. Show Video/animation films to explain the functioning of various techniques.
4. Encourage collaborative (Group) Learning in the class
5. Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking
6. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
7. Topics will be introduced in multiple representations.
8. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
9. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Introduction: Introduction, Prologue, EDA: From Methodologies, Algorithms, Tools to Integrated Circuits and Systems, EDA from Halcyon's Days to the Blooming Paradigm of Chip Industry, Categories of the EDA Tools, Quo Vadis, EDA? The Challenges and Opportunities, Designing the System as SoC Using the Soft IP Cores, Types of IP Cores, Design Issues Pertaining to the Soft IP Cores
Text Book1: 1.1 to 1.5, 1.7 to 1.10

Development of FPGA Based Network on Chip for Circumventing Spam: Introduction, Conception of the Spam Mail, FPGA Based Network on Chip for Circumventing Spam, Tools Infrastructure and Design Flow, Introducing Hardware-Software Co-design, Hardware Software Co-design, Framework Proposed in the Present Case Study, Description of System at Higher Level, Resolving the System a Step Down, System Design, Development of Soft IP Core of Bloom Filter, Presenting System Design of Purely Software Modules, Integrating of the Hardware-Software Modules Using EDK
Text Book1: 2.1 to 2.13

Teaching-Learning Process	Chalk and talk method, , PowerPoint Presentation, YouTube videos **RBT Level:** L1, L2, L3

Module-2

Analog Front End and FPGA Based Soft IP Core for ECG Logger: Prior Art, The Very Rationale of the System, Analog Front End of the Setup, VHDL Implementation of the ECG Soft IP Core, ModelSim Simulation Results, Synthesis Results Using Mentor Graphics Tool, Monitoring the ECG Using MODEM

Based Setup, ECG Signal Reconstruction Mechanism at the Hospital End, VHDL Listing for Driving the Analog Demultiplexer and Serial DAC from Spartan-3E FPGA, Discussion Regarding the VHDL Implementation, ModelSim Simulation Results, Synthesis Results Using Mentor Graphics Tool: Leonardo Spectrum. Text Book1: 3.1 to 3.12	
Teaching-Learning Process	Chalk and talk method/Power point presentation **RBT Level:** L1, L2, L3
Module-3	
FPGA Based Multifunction Interface for Embedded Applications: Introduction, Universal FPGA Based Interface for High End Embedded Applications, Soft IP Core for the LCD Interface, Soft IP Core for the DAC Interface, Handel C Listing of the Soft IP Core for the DAC Interface, Soft IP Core for the Linear Tech LTC6912-1 Dual Amp, Soft IP Core for the ADC Interface, Soft IP Core for the VGA Interface, Soft IP Core for the Keyboard Interface, Triangular Wave Generator Using DAC Text Book1: 4.1 - 4.10	
Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2, L3
Module-4	
Machine Learning for Compact Lithographic Process Models: Introduction, The Lithographic Patterning Process, Machine Learning of Compact Process Models, Neural Network Compact Patterning Models. Text Book2: 2.1 to 2.4 **Machine Learning for Mask Synthesis**: Introduction, Machine Learning-Guided OPC, Machine Learning-Guided EPC. Text Book2: 3.1 to 3.4	
Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2, L3
Module-5	
Machine Learning in Physical Verification, Mask Synthesis, and Physical Design: Introduction, Machine Learning in Physical Verification, Machine Learning in Mask Synthesis, Machine Learning in Physical Design. Text Book2: 4.1 to 4.4	
Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2, L3

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

1. Demonstrate the EDA methodologies and Tools for FPGA based NoC
2. Interpretation of soft core for ECG logger
3. Interfacing of DAC for embedded Application
4. Interpretation of Machine Learning for fabrication
5. Interpretation of ML in physical design

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester

2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module. Marks scored out of 100 shall be reduced proportionally to 50 marks

Suggested Learning Resources:

Text Books:

1. Rajanish K Kamat, Santosh A Shinde, Pawan K Gaikwad, Hansraj Guhilot, 'Harnessing VLSI System Design with EDA Tools', Springer, 2012.
2. Ibrahim (Abe) M Elfadel, Duane S Boning, Xin Li, 'Machine Learning in VLSI Computer-Aided Design', Springer, 2011.

Web links and Video Lectures (e-Resources)

- https://www.digimat.in/nptel/courses/video/117101004/L01.html
- https://www.youtube.com/watch?v=zC5b5_7oRKk

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VII Semester

Digital Image Processing			
Course Code	**21EC722**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	3:0:0:1	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course objectives:

- Understand the fundamentals of digital image processing.
- Understand the image transform used in digital image processing.
- Understand the image enhancement techniques in spatial domain used in digital image processing.
- Understand the Color Image Processing and frequency domain enhancement techniques in digital image processing.
- Understand the image restoration techniques and methods used in digital image processing.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Show Video/animation films to explain the functioning of various image processing concepts.
2. Encourage cooperative (Group) Learning through puzzles, diagrams, coding etc., in the class.
3. Encourage students to ask questions and investigate their own ideas helps improve their problem-solving skills as well as gain a deeper understanding of academic concepts.
4. Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking
5. Students are encouraged to do coding based projects to gain knowledge in image processing.
6. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
7. Topics will be introduced in multiple representations.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding
9. Arrange visits to nearby PSUs such as CAIR (DRDO), NAL, BEL, ISRO, etc., and small-scale software industries to give industry exposure.

Module-1

Digital Image Fundamentals: What is Digital Image Processing?, Origins of Digital Image Processing, Examples of fields that use DIP, Fundamental Steps in Digital Image Processing, Components of an Image Processing System, Elements of Visual Perception, Image Sensing and Acquisition, Image Sampling and Quantization, Some Basic Relationships Between Pixels.
[Text 1: Chapter 1, Chapter 2: Sections 2.1 to 2.5]

Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, YouTube videos, Videos on Image processing applications Self-study topics: Arithmetic and Logical operations Practical topics: Problems on Basic Relationships Between Pixels. **RBT Level:** L1, L2, L3

Module-2	
Image Transforms: Introduction, Two-Dimensional Orthogonal and Unitary Transforms, Properties of Unitary Transforms, Two-Dimensional DFT, cosine Transform, Haar Transform. Text 2: Chapter 5: Sections 5.1 to 5.3, 5.5, 5.6, 5.9]	
Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, YouTube videos of various transformation techniques and related applications. Self-study topics: Sine transforms, Hadamard transforms, KL transform, Slant transform. Practical topics: Problems on DFT and DCT **RBT Level:** L1, L2, L3
Module-3	
Spatial Domain: Some Basic Intensity Transformation Functions, Histogram Processing, Fundamentals of Spatial Filtering, Smoothing Spatial Filters, Sharpening Spatial Filters [Text: Chapter 3: Sections 3.2 to 3.6]	
Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, YouTube videos and animations of Intensity Transformation Functions, Histogram Processing, Spatial domain filters. Self-study topics: Point, line and edge detection. Practical topics: Problems on Intensity Transformation Functions, Histogram, Spatial domain filters **RBT Level:** L1, L2, L3
Module-4	
Frequency Domain: Basics of Filtering in the Frequency Domain, Image Smoothing and Image Sharpening Using Frequency Domain Filters. **Color Image Processing:** Color Fundamentals, Color Models, Pseudo-color Image Processing. [Text 1: Chapter 4: Sections 4.7 to 4.9 and Chapter 6: Sections 6.1 to 6.3]	
Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, YouTube videos on frequency domain filtering, Color image processing. Self-study topics: Basic concept of segmentation. Practical topics: Problems on Pseudo-color Image Processing **RBT Level:** L1, L2, L3
Module-5	
Restoration: A model of the Image Degradation/Restoration Process, Noise models, Restoration in the Presence of Noise Only using Spatial Filtering and Frequency Domain Filtering, Inverse Filtering, Minimum Mean Square Error (Wiener) Filtering. [Text 1: Chapter 5: Sections 5.1, to 5.4.3, 5.7, 5.8]	
Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, YouTube videos on Noise models, filters and its applications. Self-study topics: Linear position invariant degradation, Estimation of degradation function. **RBT Level:** L1, L2, L3

Course outcomes (Course Skill Set)

At the end of the course the student will be able to:

1. Understand image formation and the role of human visual system plays in perception of gray and color image data.
2. Compute various transforms on digital images.
3. Conduct independent study and analysis of Image Enhancement techniques.
4. Apply image processing techniques in frequency (Fourier) domain.
5. Design image restoration techniques.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module. Marks scored out of 100 shall be reduced proportionally to 50 marks

Suggested Learning Resources:

Text Books:

1. Digital Image Processing- Rafael C Gonzalez and Richard E Woods, PHI, 3rd Edition 2010.
2. Fundamentals of Digital Image Processing- A K Jain, PHI Learning Private Limited 2014.

Reference Book:

Digital Image Processing- S Jayaraman, S Esakkirajan, T Veerakumar, Tata McGraw Hill, 2014.

Web links and Video Lectures (e-Resources)

- Image databases, https://imageprocessingplace.com/root_files_V3/image_databases.htm
- Student support materials, https://imageprocessingplace.com/root_files_V3/students/students.htm
- NPTEL Course, Introduction to Digital Image Processing, https://nptel.ac.in/courses/117105079
- Computer Vision and Image Processing, https://nptel.ac.in/courses/108103174
- Image Processing and Computer Vision – Matlab and Simulink,
- https://in.mathworks.com/solutions/image-video-processing.html

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Verilog /VHDL coding for Image manipulation.
- Simulink models for Image processing.

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VII Semester

DSP Algorithms & Architecture			
Course Code	**21EC723**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	3:0:0:1	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course objectives:

This course will enable the students to

- Understand the concepts of digital signal processing techniques.
- Understand the computational building blocks of DSP processors and its speed issues.
- Understand the various addressing modes, peripherals, interrupts and pipelining structure of the TMS320C54xx processor.
- Learn how to interface the external devices to the TMS320C54xx processor in various modes.
- Understand DSP algorithms and applications with their implementation using TMS320C54xx processor.

Teaching-Learning Process (General Instructions)

The sample strategies, which the teacher can use to accelerate the attainment of the various course outcomes are listed in the following:

1. Lecture method (L) does not mean only the traditional lecture method, but a different type of teaching method may be adopted to develop the outcomes.
2. Show Video/animation films to explain the functioning of various techniques.
3. Encourage collaborative (Group) Learning in the class
4. Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
6. Topics will be introduced in multiple representations.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Introduction to Digital Signal Processing: Introduction, A Digital Signal – Processing system, Major features of programmable Digital signal processors, The Sampling Process, Discrete Time Sequences, Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT), Linear Time-Invariant Systems, Digital Filters, Decimation and Interpolation.
Section 1.3, 2.1 to 2.8 of Text 1

Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2, L3

Module-2

Architectures for Programmable Digital Signal Processing Devices: Introduction, Basic Architectural Features, DSP Computational Building Blocks, Bus Architecture and Memory, Data Addressing Capabilities, Address Generation Unit, Programmability and Program Execution, Speed Issues, Features for External Interfacing.
Section 4.1 to 4.9 of Text 1

Teaching-Learning	Chalk and talk method, Power point presentation

Process	**RBT Level:** L1, L2, L3
Module-3	
Programmable Digital Signal Processors: Introduction, Commercial Digital Signal-processing Devices, Data Addressing Modes of TMS32OC54XX, Memory Space of TMS32OC54xx Processors, Program Control. Detail Study of TMS320C54X & 54xx Instructions and Programming, On – Chip Peripherals, Interrupts of TMS32OC54XX Processors, Pipeline Operation of TMS32OC54xx Processor. Section 5.1 to 5.10 of Text 1	
Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2, L3
Module-4	
Implementation of Basic DSP Algorithms: Introduction, The Q – notation, FIR Filters, IIR Filters, Interpolation and Decimation Filters (one example in each case). **Implementation of FFT Algorithms**: Introduction, An FFT Algorithm for DFT Computation, Overflow and Scaling, Bit – Reversed Index. Generation & Implementation on the TMS32OC54xx. Section 7.1 to 7.6 and 8.1 to 8.6 of Text 1	
Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2, L3
Module-5	
Interfacing Memory and Parallel I/O Peripherals to Programmable DSP Devices: Introduction, Memory Space Organization, External Bus Interfacing Signals. Memory Interface, Parallel I/O Interface, Programmed I/O, Interrupts and I/O Direct Memory Access (DMA). **Interfacing and Applications of DSP Processors**: Introduction, Synchronous Serial Interface, A CODEC Interface Circuit, DSP Based Bio-telemetry Receiver, A Speech Processing System, An Image Processing System. Section 9.1 to 9.8, 10.1 to 10.5 and11.1 to 11.5 of Text 1	
Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2, L3

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

1. Comprehend the knowledge & concepts of digital signal processing techniques.
2. Apply knowledge of various types of addressing modes, interrupts, peripherals and pipelining structure of TMS320C54xx processor.
3. Develop assembly language programs to implement FIR, IIR filters and FFT algorithms.
4. Build the Applications on Programmable DSP devices.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20**

Marks (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module. Marks scored out of 100 shall be reduced proportionally to 50 marks

Suggested Learning Resources:

Text Book:

"Digital Signal Processing", Avatar Singh and S Srinivasan, Thomson Learning, 2004

Reference Books:

1. "Digital Signal Processing: A practical approach", Ifeachor E C, Jervis B. W Pearson-Education, PHI, 2002.
2. "Digital Signal Processors", B Venkataramani and M Bhaskar, TMH, 2nd Ed., 2010
3. "Architectures for Digital Signal Processing", Peter Pirsch, John Wiley.

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VII Semester

Biomedical Signal Processing			
Course Code	**21EC724**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	3:0:0:1	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course objectives:

This course will enable students to:

- Possess the basic mathematical, scientific and computational skills necessary to analyse ECG and EEG signals.
- Apply classical and modern filtering and compression techniques for ECG and EEG signals.
- Develop a thorough understanding on basics of ECG and EEG feature extraction.

Teaching-Learning Process (General Instructions)

The sample strategies, which the teacher can use to accelerate the attainment of the various course outcomes are listed in the following:

1. Lecture method (L) does not mean only the traditional lecture method, but a different type of teaching method may be adopted to develop the outcomes.
2. Show Video/animation films to explain the functioning of various techniques.
3. Encourage collaborative (Group) Learning in the class
4. Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking
5. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Introduction to Biomedical Signals: The nature of Biomedical Signals, Examples of Biomedical Signals, Objectives of Biomedical Signal analysis, Difficulties in Biomedical Signal analysis.
(Text-1: 1.1, 1.2, 1.3, 1.4)

Electrocardiography: Techniques used in electrocardiography, ECG Electrodes, the cardiac equivalent generator, genesis of the ECG, the standard and augmented limb leads, 12 lead ECG, the vectorcardiogram, ECG signal characteristics.
(Text-2: 2.1, 2.1.1, 2.1.2, 2.1.3, 2.1.4, 2.1.5, 2.2.1, 2.2.2, 2.3)

Signal Conversion: Simple signal conversion systems, Conversion requirements for biomedical signals, Signal converter characteristics, D to A converters, A to D converters, Sample and Hold circuit, Analog Multiplexer, Amplifiers
(Text-2: 3.2, 3.3, 3.4.1, 3.4.2, 3.4.3, 3.4.4, 3.4.5, 3.4.6).

Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, YouTube videos **RBT Level:** L1, L2, L3

Module-2

Signal Averaging: Basics of signal averaging, Signal averaging as a digital filter, a typical averager, Software for signal averaging, Limitations of signal averaging.
(Text-2: 9.1, 9.2, 9.3, 9.4, 9.5).

Adaptive Filters: Principal noise canceller model, 60-Hz adaptive cancelling using a sine wave model, Applications: Maternal ECG in fetal ECG, Cardiogenic artifact, detection of ventricular fibrillation and tachycardia. (Text-2: 8.1, 8.2, 8.3.1, 8.3.2, 8.3.3).

Teaching-Learning	Chalk and talk method, PowerPoint Presentation, YouTube videos

Process	**RBT Level:** L1, L2, L3
Module-3	
Data Reduction Techniques: Introduction, Turning point algorithm, AZTEC algorithm, Fano algorithm, Huffman coding: Static coding, Modified coding, Adaptive coding, Residual differencing, Runlength coding. (Text-2: 10.1, 10.2, 10.3, 10.4.1, 10.4.2, 10.4.3, 10.4.4, 10.4.5). **Time and Frequency domain techniques:** The Fourier transform for a discrete nonperiodic and periodic signals, the Fast Fourier transform, Correlation in time domain and in frequency domain, Convolution in time domain and in frequency domain, Power spectrum estimation: Parseval's theorem (Text-2: 11.1.1, 11.1.2, 11.1.3, 11.2.1, 11.2.2, 11.2.3, 11.3.1, 11.3.2, 11.3.3, 11.4.1)	
Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, YouTube videos **RBT Level:** L1, L2, L3
Module-4	
ECG QRS detection: Power spectrum of the ECG, Bandpass filtering techniques, Differentiation techniques, Template matching techniques: Template cross correlation, template subtraction, automata based template matching, a QRS detection algorithm. **ECG Analysis Systems:** Interpretation of the 12 lead ECG, ST segment analyzer, Portable arrhythmia monitor: Holter recording, software and hardware design, arrhythmia analysis (Text -2)	
Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, YouTube videos **RBT Level:** L1, L2, L3
Module-5	
Neurological signal processing: The brain and its potentials, origin of brain waves, the EEG signal and its characteristics, EEG analysis, Linear prediction theory, The Autoregressive method, Recursive estimation of AR parameters, Spectral error measure. (Text-3: 4.1, 4.2, 4.3 4.4, 4.5, 4.6, 4.7, 4.8) **Event detection and waveform analysis:** EEG rhythms, waves and transients, Detection of EEG rhythms, Template matching for EEG spike and wave detection, the matched filter (Text-1: 4.2.4, 4.4.1, 4.4.2, 4.6)	
Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2, L3

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

1. Describe the origin, properties and suitable models of important biological signals such as ECG and EEG.
2. Know the basic signal processing techniques in analysing biological signals.
3. Acquire mathematical and computational skills relevant to the field of biomedical signal processing.
4. Describe the basics of ECG signal compression algorithms.
5. Know the complexity of various biological phenomena.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester

3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module. Marks scored out of 100 shall be reduced proportionally to 50 marks

Suggested Learning Resources:

Books:

1. Biomedical Signal Analysis-Rangaraj M Rangayyan, John Wiley & Sons 2002
2. Biomedical Digital Signal Processing- Willis J Tompkins, PHI2001.
3. Biomedical Signal Processing Principles and Techniques-D C Reddy, McGraw-Hill publications, 2005.

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VII Semester

Speech Signal Processing			
Course Code	**21EC725**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course objectives:

- Introduce the models for speech production
- Develop Time domain and frequency domain speech processing techniques
- Introduce a predictive technique for speech compression
- Provide fundamental knowledge required to understand and analyze speech recognition, synthesis and speaker identification systems.

Teaching-Learning Process (General Instructions)

The sample strategies, which the teacher can use to accelerate the attainment of the various course outcomes are listed in the following:

1. Lecture method (L) does not mean only the traditional lecture method, but a different type of teaching method may be adopted to develop the outcomes.
2. Show Video/animation films to explain the functioning of various techniques.
3. Encourage collaborative (Group) Learning in the class
4. Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
6. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Fundamentals of Human Speech Production: The Process of Speech Production, Short-Time Fourier representation of Speech, The Acoustic Theory of Speech production, Digital Models for Sampled Speech Signals.

Teaching-Learning Process	Chalk and talk method, Power point presentations, Animation of process of speech production **RBT Level:** L1, L2, L3

Module-2

Time-Domain Methods for Speech Processing: Introduction to Short-Time Analysis of Speech, Short-Time Energy and Short-Time Magnitude, Short-Time Zero-Crossing Rate, The Short-Time Autocorrelation Function, Speech vs Silence detection.

Teaching-Learning Process	Chalk and talk method, Power point presentation Simulation of Short Time analysis algorithm using tools like Matlab/simulink **RBT Level:** L1, L2, L3

Module-3

Frequency Domain Representations: Discrete-Time Fourier Analysis, Short-Time Fourier Analysis, Overlap Addition (OLA) and Filter Bank Summation (FBS) Method of Synthesis, Time-Decimated Filter Banks, Two-Channel Filter Banks, Modifications of the STFT.

Teaching-Learning Process	Chalk and talk method, Power point presentation Visualization of speech using spectrogram **RBT Level:** L1, L2, L3

Module-4	
The Cepstrum and Homomorphic Speech Processing: Introduction, Homomorphic Systems for Convolution, Homomorphic Analysis of the Speech Model, Computing the Short-Time Cepstrum and Complex Cepstrum of Speech, Homomorphic Filtering of Natural Speech, Cepstrum Analysis of All-Pole Models, Cepstrum Distance Measures.	
Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2, L3
Module-5	
Linear Predictive Analysis of Speech Signals: Introduction to Basic Principles of Linear Predictive Analysis, Computation of the Gain for the Model, Frequency Domain Interpretations of Linear Predictive Analysis, Solution of the LPC Equations, The Prediction Error Signal.	
Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2, L3

Course outcomes (Course Skill Set)

At the end of the course the student will be able to:

1. Model speech production system and describe the fundamentals of speech.
2. Apply time domain and frequency domain algorithms, on speech to find, enhance and modify speech parameters.
3. Choose an appropriate processing technique for a given application.
4. Analyse speech recognition, synthesis and speaker identification systems

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question

papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module. Marks scored out of 100 shall be reduced proportionally to 50 marks

Suggested Learning Resources:

Text Books

1. **Digital Processing of Speech Signals** - L R Rabiner and R W Schafer, Pearson Education Asia, 2004.
2. **Theory and Applications of Digital Speech Processing**-Rabiner and Schafer, Pearson Education 2011.

Reference Books

1. **Fundamentals of Speech Recognition**- Lawrence Rabiner and Biing-Hwang Juang, Pearson Education, 2003.
2. **Speech and Language Processing**–An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition- Daniel Jurafsky and James H Martin, Pearson Prentice Hall, 2009.

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VII Semester

IoT & Wireless Sensor Networks			
Course Code	**21EC731**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course objectives:

- To provide an exposure to the broad perspective of Internet of Things with respect to the characteristics, design, technologies and applications.
- To provide a basic understanding of the important aspects of Wireless sensor networks covering applications, sensor and transmission technology & systems, middleware, performance and traffic management.

Teaching-Learning Process (General Instructions)

The sample strategies, which the teacher can use to accelerate the attainment of the various course outcomes are listed in the following:

1. Lecture method (L) does not mean only the traditional lecture method, but a different type of teaching method may be adopted to develop the outcomes.
2. Show Video/animation films to explain the various concepts.
3. Encourage collaborative (Group) Learning in the class
4. Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
6. Topics will be introduced in multiple representations.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Internet of Things: Introduction, Physical design, Logical design, Enabling technologies, Levels & deployment templates.
Text 1: Chapter 1

Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2, L3

Module-2

Domain Specific IoTs: Home automation, cities, environment, energy, retail, logistics, agriculture, industry, health & lifestyle.
Text 1: Chapter 2

Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2, L3

Module-3

Wireless Sensor Networks: Introduction, applications of sensor networks, basic overview of the technology, basic sensor network architectural elements, present day sensor network research, challenges and hurdles, examples of Category 2 WSN applications, examples of Category 1 WSN applications

Text 2: Chapter 1 – 1.1, 1.1.2, 1.2, 1.2.1, 1.2.2 (phase 4), 1.2.3 Chapter 2: 2.4, 2.5	
Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2, L3
Module-4	
Wireless sensor technology: Introduction, sensor node technology – overview, hardware and software, sensor taxonomy, WN operating environment, WN trends. **Wireless Transmission technology and systems:** Introduction, Campus applications, MAN/WAN applications. Text 2: Chapter 3: 3.1, 3.2 – 3.2.1, 3.2.2, 3.3, 3.4, 3.5 Chapter 4: 4.1, 4.3.1, 4.3.2	
Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2, L3
Module-5	
Middleware for WSNs: Introduction, principles, architecture, data related functions **Performance and traffic management:** background, WSN Design issues, performance modelling of WSNs. Text 2: Chapter 8: 8.1, 8.2, 8.3, 8.3.1 Chapter 11: 11.2, 11.3, 11.4	
Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2, L3

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

1. Understand the characteristics, building blocks, enabling technologies of the IoT systems
2. Describe the characteristics and applications of domain specific IoTs.
3. Discuss the overview of the Wireless sensor networks characteristics and applications.
4. Present the sensor, transmission technology and systems associated with WSN.
5. Understand the concepts of middleware, performance evaluation and traffic management in WSN.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per

the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module. Marks scored out of 100 shall be reduced proportionally to 50 marks

Suggested Learning Resources:

Text Books:

1. 'Internet of Things', Arshdeep Bagha and Vijay Madisetti, Universities Press, 2015
2. 'Wireless Sensor Networks', Kazem Sohraby, Daniel Minoli and Taieb Znati, Wiley, 2015.

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VII Semester

Network Security			
Course Code	**21EC732**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	3:0:0:1	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course objectives:

- **Preparation**: To prepare students with fundamental knowledge/ overview in the field of Network Security with knowledge of security mechanisms and services.
- **Core Competence**: To equip students with a basic foundation of Network Security by delivering the basics of Transport Level Security, Secure Socket Layer, Internet Protocol security, Intruders, Intrusion detection and Malicious Software, Firewalls, Firewall characteristics, Biasing and Configuration.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecture method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
2. Show Video/animation films to explain the different Network Security Techniques / Algorithms
3. Encourage collaborative (Group) Learning in the class
4. Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
6. Topics will be introduced in a multiple representation.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.
9. Adopt Flipped class technique by sharing the materials / Sample Videos prior to the class and have discussions on the that topic in the succeeding classes
10. Give Programming Assignments

Module-1

Attacks on Computers and Computer Security: Need for Security, Security Approaches, Principles of Security Types of Attacks. **(Text2: Chapter1)**
Security Mechanisms, Services and Attacks, A model for Network security **(Text1: Chapter1: 3, 4, 5, 6)**
Network Access Control, Extensible Authentication Protocol **(Text1: Chapter 16: Section 1,2)**

Teaching-Learning Process	Chalk and talk method, YouTube videos, Flipped Class Technique **RBT Level:** L1, L2, L3

Module-2

Transport Level Security: Web Security Considerations, Secure Sockets Layer, Transport Layer Security, HTTPS, Secure Shell (SSH) **(Text1: Chapter15)**

Teaching-Learning Process	Chalk and talk method YouTube videos, Flipped Class Technique and PPTs. Self-study topics: Block cipher modes, Cryptographic Hash functions and MAC codes **RBT Level:** L1, L2, L3

Module-3	
IP Security: Overview of IP Security (IPSec), IP Security Architecture, Modes of Operation, Security Associations (SA), Authentication Header (AH), Encapsulating Security Payload (ESP), Internet Key Exchange. **(Text1: Chapter19)**	
Teaching-Learning Process	Chalk and talk method, YouTube videos, Flipped Class Technique and PPTs. Self-study topics: OSI Model **RBT Level:** L1, L2, L3
Module-4	
Intruders: Intruders, Intrusion Detection, Password Management. **(Chapter20-Text1)** **MALICIOUS SOFTWARE:** Viruses and Related Threats, Virus Countermeasures, **(Chapter21-Text1)**	
Teaching-Learning Process	Chalk and talk method, YouTube videos, Flipped Class Technique and PPTs. **RBT Level:** L1, L2, L3
Module-5	
Firewalls: The Need for firewalls, Firewall Characteristics, Types of Firewalls, Firewall Biasing, Firewall location and configuration **(Chapter 22-Text 1)**	
Teaching-Learning Process	Chalk and talk method, YouTube videos, Flipped Class Technique and PPTs. **RBT Level:** L1, L2, L3

Course outcomes (Course Skill Set)

At the end of the course the student will be able to:

1. Explain network security services and mechanisms and explain security concepts
2. Understand the concept of Transport Level Security and Secure Socket Layer.
3. Explain Security concerns in Internet Protocol security
4. Explain Intruders, Intrusion detection and Malicious Software
5. Describe Firewalls, Firewall Characteristics, Biasing and Configuration

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per

the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module. Marks scored out of 100 shall be reduced proportionally to 50 marks

Suggested Learning Resources:

Text Books:

1. William Stallings, "Cryptography and Network Security Principles and Practice", Pearson Education Inc., 5th Edition, 2014, ISBN: 978-81-317- 6166-3
2. Atul Kahate, "Cryptography and Network Security", TMH, 2003.

Reference Books:

1. Cryptography and Network Security, Behrouz A Forouzan, TMH, 2007.
2. Introduction to Computer Security, Matt Bishop, Sathyanarayana S V, Pearson Education, 2006, ISBN 81-7758-425/1.

Web links and Video Lectures (e-Resources)

https://nptel.ac.in/courses/106105031
https://nptel.ac.in/courses/128106006

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Programming Assignments / Mini Projects can be given to improve programming skills.

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VII Semester

Fabrication Technology			
Course Code	**21EC733**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	3:0:0:1	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course objectives:

- Familiarise with the concepts of different processes involved in fabrication process and also with packaging issues.
- Apply principles to identify and analyse the various steps for the fabrication of various components.
- Introduce the fundamental concepts relevant to VLSI fabrication.
- Enable the students to understand the various VLSI fabrication techniques.

Teaching-Learning Process (General Instructions)

The sample strategies, which the teacher can use to accelerate the attainment of the various course outcomes are listed in the following:

1. Lecture method (L) does not mean only the traditional lecture method, but a different type of teaching method may be adopted to develop the outcomes.
2. Show Video/animation films to explain the functioning of various techniques.
3. Encourage collaborative (Group) Learning in the class.
4. Topics will be introduced in multiple representations.
5. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Crystal Growth and Wafer Preparation: Introduction, Electronic grade Silicon, Czochralski Crystal Growing, Silicon Shaping

Epitaxy: Introduction, Vapor-Phase Epitaxy

Text Book 1.1 to 1.4, 2.1 to 2.2

Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, Videos on crystal growth process Self-study topics: Mask Preparation **RBT Level:** L1, L2, L3

Module-2

Epitaxy: Molecular beam epitaxy, Epitaxial evaluation

Oxidation: Introduction, Growth mechanism and kinetics, Thin oxides, oxidation techniques, oxide properties, redistribution of dopants, oxidation of polysilicon, oxidation-induced defects

Text Book 2.3 and 2.5, 3.1 to 3.8

Teaching-Learning Process	Chalk and talk method, Power point presentation, videos on Epitaxial process Self-study topics: Advanced oxidation techniques **RBT Level:** L1, L2, L3

Module-3

Lithography: Introduction, Optical Lithography, Electron Lithography, X-ray lithography, Ion Lithography

Text Book 4.1 to 4.5

Teaching-	Chalk and talk method, PowerPoint Presentation, Videos on Lithography

Learning Process	Self-study topics: Sputtering and edge lithography **RBT Level:** L1, L2, L3

Module-4

Diffusion: Introduction, Models of diffusion in solids, fick's 1D diffusion equation, atomic diffusion mechanism, Diffussivities, Measurement techniques, fast diffusants in silicon, diffusion in polycrystalline silicon, diffusion in SiO2

Ion Implantation: Introduction, Implantation equipment

Text Book 7.1 to 7.9, 8.1 and 8.3

Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, Videos on diffusion method Self-study topics: Effect of doping concentration in diffusion process **RBT Level:** L1, L2, L3

Module-5

Ion Implantation: Annealing, Shallow Junctions, High energy implantation

Metallization: Introduction, Metallization applications, metallization choices, Metallization problems, New role of metallization.

Text Book 8.4 to 8.6, 9.1 to 9.7 (except 9.4 and 9.5)

Teaching-Learning Process	Chalk and talk method, Power point presentation, Videos on Annealing process Self-study topics: e-beam evaporation, plasma spray deposition **RBT Level:** L1, L2, L3

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

1. Understanding the process in the field of Fabrication technology.
2. Understand the properties and growth mechanism of oxidation.
3. Relate to the competing methods of various lithographic techniques and their limitations.
4. Analyse the diffusion profiles and models in various materials.
5. Describe the Metallization choices, properties and selection of optimum deposition process.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per

the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module. Marks scored out of 100 shall be reduced proportionally to 50 marks

Suggested Learning Resources:

Text Book:

VLSI Technology, S M Sze, 2nd edition, Mc Graw Hill.

Reference Books:

1. VLSI Fabrication Principles, S K Gandhi, John Willey & Sons.
2. Micromachined transducer, G T A Kovacs, McGraw Hill.

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VII Semester

Machine Learning with Python			
Course Code	**21EC734**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	2:0: 2:1	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course objectives:

- To understand the basic theory underlying machine learning.
- To be able to formulate machine learning problems corresponding to different applications.
- To understand a range of machine learning algorithms along with their strengths and weaknesses.
- To be able to apply machine learning algorithms to solve problems of moderate complexity.
- To apply the algorithms to a real-world problem, optimize the models learned and report on the expected accuracy that can be achieved by applying the models.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. In addition to the traditional lecture method, different types of innovative teaching methods may be adopted so that the delivered lessons shall develop student's theoretical and programming skills.
2. State the need for learning Machine Learning with real-life examples.
3. Support and guide the students for self–study.
4. You will also be responsible for assigning homework, grading assignments and quizzes, and documenting students & progress
5. Encourage the students for group learning to improve their creative and analytical skills.
6. Show short, related video lectures in the following ways:
    - As an introduction to new topics (pre-lecture activity).
    - As a revision of topics (post-lecture activity).
    - As additional examples (post-lecture activity).
    - As an additional material of challenging topics (pre-and post-lecture activity).
    - As a model solution of some real world problems. (post-lecture activity).

Module-1

Introduction:

Introduction to Machine Learning, Building intelligent machines to transform data into knowledge, The three different types of machine learning, An introduction to the basic terminology and notations, A roadmap for building machine learning systems, Using Python for machine learning.

Training Machine Learning Algorithms for Classification

Artificial neurons – a brief glimpse into the early history of machine learning, Implementing a perceptron learning algorithm in Python, Adaptive linear neurons and the convergence of learning.

Textbook 1: Chapters 1, 2

Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2, L3

Module-2

A Tour of Machine Learning Classifiers Using Scikit-Learn

Choosing a classification algorithm, First steps with scikit-learn, Modeling class probabilities via logistic regression, Maximum margin classification with support vector machines, Solving nonlinear problems using a kernel SVM, Decision tree learning, K-nearest neighbors – a lazy learning algorithm

Building Good Training Sets – Data Preprocessing Dealing with missing data, Handling categorical data, Partitioning a dataset in training and test sets, Bringing features onto the same scale, Selecting meaningful features, Assessing feature importance with random forests. Textbook 1: Chapters 3 ,4	
Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2, L3
Module-3	
Compressing Data via Dimensionality Reduction Unsupervised dimensionality reduction via principal component Analysis, Supervised data compression via linear discriminant analysis, Using kernel principal component analysis for nonlinear mappings **Learning Best Practices for Model Evaluation and Hyperparameter Tuning** Streamlining workflows with pipelines, Using k-fold cross-validation to assess model performance, Debugging algorithms with learning and validation curves, Fine-tuning machine learning models via grid search, Looking at different performance evaluation metrics **Applying Machine Learning to Sentiment Analysis** Obtaining the IMDb movie review dataset, Introducing the bag-of-words model, training a logistic regression model for document classification , Working with bigger data – online algorithms and out-of-core learning Textbook 1: Chapters 5,6,8	
Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2, L3
Module-4	
Embedding a Machine Learning Model into a Web Application Serializing fitted scikit-learn estimators, Setting up a SQLite database for data storage, Developing a web application with Flask, Turning the movie classifier into a web application, Deploying the web application to a public server **Predicting Continuous Target Variables with Regression Analysis** Introducing a simple linear regression model, Exploring the Housing Dataset, Implementing an ordinary least squares linear regression model, Fitting a robust regression model using RANSAC, Evaluating the performance of linear regression models, Using regularized methods for regression- Turning a linear regression model into a curve – polynomial regression Textbook 1: Chapters 9,10	
Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2, L3
Module-5	
Working with Unlabeled Data – Clustering Analysis Grouping objects by similarity using k-means, Organizing clusters as a hierarchical tree, **Training Artificial Neural Networks for Image Recognition** Modeling complex functions with artificial neural networks, Classifying handwritten digits, Training an artificial neural network, Other neural network architectures Textbook 1: Chapters 11,12	
Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2, L3

Course outcomes (Course Skill Set)

At the end of the course the student will be able to:

1. Appreciate the importance of visualization in the data analytics solution
2. Apply structured thinking to unstructured problems
3. Understand a very broad collection of machine learning algorithms and problems
4. Learn algorithmic topics of machine learning and mathematically deep enough to introduce the required theory
5. Develop an appreciation for what is involved in learning from data.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module. Marks scored out of 100 shall be reduced proportionally to 50 marks

Suggested Learning Resources:

Text Books:

1. Python Machine Learning by Sebastian Raschka, Published by Packt Publishing Ltd.
2. Machine Learning with Python for Everyone by Mark E Fenner
3. Machine Learning using Python by Manaranjan Pradhan & U Dinesh Kumar
4. Practical Machine Learning with Python by Dipanjan Sarkar, Raghav Bali &Tushar Sharma

Web links and Video Lectures (e-Resources)
• https://www.youtube.com/watch?v=RnFGwxJwx-0 • https://www.youtube.com/watch?v=eq7KF7JTinU
Activity Based Learning (Suggested Activities in Class)/ Practical Based learning • Using IRIS data set implement Adaline rule Classification Algorithm. • Implement Logistic Regression algorithm and generate corresponding graphs for overfitting and under fitting. • Implement linear SVM algorithm with maximum margin intuition. • Implement a kernel SVM to solve nonlinear problems. • Implement KNN Algorithm. • Implement decision tree algorithm. • Implement s rbf_kernel_pca for separating half-moon shapes. • Develop web application using flask.

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI
B.E: Electronics & Communication Engineering / B.E: Electronics & Telecommunication Engineering
NEP, Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
(Effective from the academic year 2021 – 22)

VII Semester

Multimedia Communication			
Course Code	**21EC735**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	3:0:0:1	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course objectives:

This course will enable students to:

- Understand the importance of multimedia in today's online and offline information sources and repositories.
- Understand the how Text, Audio, Image and Video information can be represented digitally in a computer so that it can be processed, transmitted and stored efficiently.
- Understand the Multimedia Transport in Wireless Networks
- Understand the Real-time multimedia network applications.
- Understand the Different network layer based application.

Teaching-Learning Process (General Instructions)

The sample strategies, which the teacher can use to accelerate the attainment of the various course outcomes are listed in the following:

1. Lecture method (L) does not mean only the traditional lecture method, but a different type of teaching method may be adopted to develop the outcomes.
2. Show Video/animation films to explain the functioning of various techniques.
3. Encourage collaborative (Group) Learning in the class
4. Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking
5. Topics will be introduced in multiple representations.
6. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1	
Multimedia Communications: Introduction, Multimedia information representation, Multimedia networks, multimedia applications, Application and networking terminology. (Chapter 1 of Text 1)	
Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2
Module-2	
Information Representation: Introduction, Digitization principles, Text, Images, Audio and Video. (Chapter 2 of Text 1)	
Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2, L3
Module-3	
Text and Image Compression: Introduction, Compression principles, text compression, image Compression. (Chapter 3 of Text 1)	
Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2, L3

Module-4	
Audio and video compression: Introduction, Audio compression, video compression, video compression principles, video compression. (Chapter 4 of Text 1)	
Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2, L3
Module-5	
Multimedia Information Networks: Introduction, LANs, Ethernet, Token ring, Bridges, FDDI High-speed LANs, LAN protocol (Chap. 8 of Text 1).	
Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2

Course outcomes (Course Skill Set)

At the end of the course the student will be able to:

1. Understand basics of different multimedia networks and applications.
2. Understand different compression techniques to compress audio and video.
3. Describe multimedia Communication across Networks.
4. Analyse different media types to represent them in digital form.
5. Compress different types of text and images using different compression techniques.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module. Marks scored

out of 100 shall be reduced proportionally to 50 marks

Suggested Learning Resources:

Text Books:

Multimedia Communications- Fred Halsall, Pearson Education, 2001, ISBN -978813170994

Reference Books:

1. Multimedia: Computing, Communications and Applications- Raif Steinmetz, Klara Nahrstedt, Pearson Education, 2002, ISBN-978817758
2. Fundamentals of Multimedia – Ze-Nian Li, Mark S Drew, and Jiangchuan Liu.

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Implementation of compression algorithms using MATLAB/ any open source tools (Python, Scilab, etc.)

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI.

Scheme of Teaching and Examinations and Syllabus

Master of Computer Applications (MCA)

(Effective from Academic year 2020 - 21)

VISVESVARAYA TECHNOLOGICAL UNIVERSITY
Scheme of Teaching and Examination

Master of Computer Applications

Under Outcome Based Education (OBE) and Choice Based Credit System (CBCS) Scheme

SEMESTER-I

S.No	Course Type	Course Code	Title	Teaching Hours/ Week			Examination				Credits
				L	P	T/S DA	Duration in hours	SEE Marks	CIE Marks	Total Marks	
1	PCC	20MCA11	Data Structures with Algorithms	04	-	-	03	60	40	100	04
2	PCC	20MCA12	Operating System with Unix	04	-	-	03	60	40	100	04
3	PCC	20MCA13	Computer Networks	04	-	-	03	60	40	100	04
4	PCC	20MCA14	Mathematical Foundation for Computer Applications	03	-	02	03	60	40	100	04
5	PCC	20MCA15	Research Methodology & IPR	02	-	02	03	60	40	100	02
6	PCC	**20MCA16**	**Data Structures with Algorithms Lab**	-	04		03	60	40	100	02
7	PCC	20MCA17	Unix Programming Lab	-	04		03	60	40	100	02
8	PCC	**20MCA18**	**Computer Networks Lab**	-	04		03	60	40	100	02
9	BC	20MCA19-BC*	Basics of Programming & CO	02	-	02	03	60	40	100	-
Total				**17**	**12**	**06**	**27**	**540**	**360**	**900**	**24**

***Only for non-computer science students**

Note: PCC- Professional Core Course; PCE- Professional Elective Course

Each Course (PCC/PCE) shall have case study discussion and may be considered as a part of assignment.

Theory courses internal assessment (CIE) shall be based on internal test (50% weightage), 50% weightage may be given to other continues assessment carried out during the teaching learning processes. Course coordinator may select suitable assessment techniques/tools for continues evaluation such as weekly Multiple Choice Questions (MCQ) quiz, higher order cognitive level questions as assignment, and case study questions/

any other assignment useful for learning with a minimum cognitive level at the application level. Average marks of three internal tests have to be considered for CIE along with other continues evaluations.

Laboratory courses internal assessment shall be based on internal test (**50**% weightage), remaining 50% weightage shall be given to continues evaluation of practical execution during regular laboratory hours. During regular laboratory hours students may be asked to solve the extended versions of the laboratory program/problem, and demonstrate higher order cognitive level such as analysis and design programming assignment. During the laboratory hours after the program execution, technical quiz may be conducted. Wherever laboratory is also having project work students may be asked to solve novel problems in their projects work.

Skill development activities (SDA):

Students and course instructor/s to involve either individually or in groups to interact together to enhance the learning and application skills.

The students should interact with industry (small, medium and large), understand their problems or foresee what can be undertaken for study in the form of research/ testing / projects, and for creative and innovative methods to solve the identified problem.

The students shall

1) Gain confidence in modelling of systems and algorithms.
2) Work on different software/s (tools) to Simulate, analyse and authenticate the output to interpret and conclude. Operate the simulated system under changed parameter conditions to study the system with respect to thermal study, transient and steady state operations, etc.
3) Handle advanced instruments to enhance technical talent.
4) Involve in case studies and field visits/ field work.
5) Accustom with the use of standards/codes etc., to narrow the gap between academia and industry.

All activities should enhance student's abilities to employment and/or self-employment opportunities, management skills, Statistical analysis, fiscal expertise, etc.

Tutorial:

Tutorial sessions may be conducted using cooperative Learning techniques. Tutorial sheets maintained should indicate date, problem (statement) addressed, and cooperative learning technique employed, solution to the problem. Course coordinator shall maintain document in specific format for tutorial / SDA.

In order to promote reinforcement of TLP, course coordinator to analyze the performance of the student after the execution of particular test and conduct remedial/ tutorial classes. It is recommended to make changes in delivery methods wherever required and give appropriate assignments/ study materials to fast/slow learners.

Note:

1) Four credit courses are designed for 50 hours of teaching and learning process

2) Three credit courses are designed for 40hours Teaching – Learning process.
3) Two credit courses are designed for 30hours Teaching – Learning process.

Research/Technical Seminar:

As a part of the course Research Methodology & IPR, presenting the seminar is mandatory. The CIE marks awarded for Resaerch/Technical Seminar shall be based on the evaluation of Seminar Report, Presentation skills and performance in Question and Answer session in the ratio 50:25:25. Seminar is to be considered for **20 marks. Remaining 20 marks is for internal tests.**

Students shall do the literature survey of existing work on contemporary topics and present. Student shall highlight on the research gap and propose solution. Seminar presentation and report have to be evaluated using rubrics.

Bridge course: 20MCA19-BC

20MCA19-BC: Bridge course is a non-credit course introduced to the students who admits into MCA program from non-computer science background. Students have to secure eligibility by scoring 50% marks in aggregate (CIE and SEE).

VISVESVARAYA TECHNOLOGICAL UNIVERSITY
Scheme of Teaching and Examination

Master of Computer Applications

Under Outcome Based Education (OBE) and Choice Based Credit System (CBCS) Scheme

SEMESTER-II

S.No.	Course Type	Course Code	Title	Teaching Hours/Week			Examination				Credits
				L	P	T/SDA	Duration in hours	SEE Marks	CIE Marks	Total Marks	
1	PCC	20MCA21	Database Management System	03	-	-	03	60	40	100	03
2	PCC	20MCA22	Object Oriented Programming with Java	03	-	-	03	60	40	100	03
3	PCC	20MCA23	Web Technologies	04	-	-	03	60	40	100	04
4	PCC	20MCA24	Software Engineering	03	-	02	03	60	40	100	04
5	PEC	20MCA25X	Elective-1	03	-	-	03	60	40	100	03
6	PEC	20MCA26X	Elective-2	03	-	-	03	60	40	100	03
7	PCC	20MCA27	DBMS Lab	-	04	-	03	60	40	100	02
8	PCC	20MCA28	Java Programming Lab.	-	04	-	03	60	40	100	02
9	PCC	20MCA29	Web Technologies Lab with Mini-project	-	04	-	03	60	40	100	02
Total				**19**	**12**	**02**	**27**	**540**	**360**	**900**	**26**

Elective-I		Elective-II	
20MCA251	Cybersecurity	20MCA261	Cryptography and Network Security
20MCA252	Data Mining and Business Intelligence	20MCA262	Artificial Intelligence
20MCA253	Enterprise Resource Planning	20MCA263	Mobile Application Development
20MCA254	User Interface Design	20MCA264	Distributed operating System
20MCA255	Optimization Techniques	20MCA265	Natural Language Processing

VISVESVARAYA TECHNOLOGICAL UNIVERSITY
Scheme of Teaching and Examination

Master of Computer Applications

Under Outcome Based Education (OBE) and Choice Based Credit System (CBCS) Scheme

SEMESTER-III

S.No	Course Type	Course Code	Title	Teaching Hours/Week			Examination				Credits
				L	P	T/SDA	Duration in hours	SEE Marks	CIE Marks	Total Marks	
1	**PCC**	**20MCA31**	**Data Analytics using Python**	**04**	**-**	**-**	**03**	**60**	**40**	**100**	**04**
2	PCC	20MCA32	IoT	04	-	-	03	60	40	100	04
3	PCC	20MCA33	Advances in Java	04	-	-	03	60	40	100	04
4	PEC	20MCA34X	Elective-II	03	-	-	03	60	40	100	03
5	PEC	20MCA35X	Elective-III	03	-	-	03	60	40	100	03
6	PCC	20MCA36	Data Analytics Lab with Mini-project	-	04		03	60	40	100	02
7	PCC	20MCA37	IoT Lab with Mini Project	-	04		03	60	40	100	02
8	PCC	20MCA38	Advances in Java Lab	-	04		03	60	40	100	02
	Total			**18**	**12**	**-**	**24**	**480**	**320**	**800**	**24**

Elective-III		**Elective-IV**	
20MCA341	Block chain Technology	20MCA351	Deep Learning
20MCA342	Cloud Computing	20MCA352	Big data Analytics
20MCA343	Digital Marketing	20MCA353	Wireless Ad Hoc Networks
20MCA344	Software Testing	20MCA354	Software Project Management
20MCA345	NOSQL	20MCA355	Software Defined Networks

VISVESVARAYA TECHNOLOGICAL UNIVERSITY
Scheme of Teaching and Examination

Master of Computer Applications

Under Outcome Based Education (OBE) and Choice Based Credit System (CBCS) Scheme

SEMESTER-IV

S.No	Course Type	Course Code	Title	Teaching Hours/Week			Examination				Credits
				Lecture(L)	Tutorial(T)	Practical(P)\Seminar	Duration in hours	SEE Marks	CIE Marks	Total Marks	
1	PCC	20MCA41	Advances in Web Technologies	02	02		3	60	40	100	02
2	PCC	20MCA42	Programming using C#	02	02	-	03	60	40	100	02
3	PCC	20MCA43	Industry Internship (4 weeks in vacation of 3rd sem.)	-	-	-	-	-	100	100	02
4	PCC	20MCA44	Project work Phase 2 (During 4th Semester- min. of 4 Months)			02	03	60	40	100	20
Total				**4**	**4**	**02**	**09**	**180**	**220**	**400**	**26**

Internship:

All the students have to undergo mandatory internship of 4 weeks during the vacation of III semester. Internship shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not take-up/complete the internship shall be declared as fail in internship course and have to complete the same during the subsequent semester. After satisfying the internship requirements the degree will be awarded. However, student can carry out 4th semester project without completing the internship.

Project:

The candidate should carry out the project in any industry or R&D institution or educational institution under a guide/co-guide. The candidate has to present the work carried out before the examiners during the University examination. The work out carried out should be free from plagiarism. The

literature study may be clearly written which may be summary of existing project and highlight of what are the functionalities that are proposed to this project. Student shall indicate the different research papers, documents refereed as a part of the literature study. It is recommended to do prior art search as part of literature survey before submitting the synopsis for the projects.

This is an individual project for a duration of minimum of 4 months or duration of the semester. Rubrics have to be used for evaluation of projects which makes the evaluation transparent and valid. Paper publication in an indexed journal/conference is compulsory as part of the project work.

Project work evaluation

There shall be three project presentations each to be considered for 5 marks (5X3= 15 marks) and a final presentation for 15 marks. Presentation may be given using Power point presentation/demonstrations of the work. Synopsis submitted in a proper format is to be evaluated for 10 marks. Student has to publish a research paper in indexed journal / conference. Publications follow the Thesis. 10% weightage is given in SEE. Project report organization/contents can be similar to project report contents of 2018 scheme/syllabus .

Data Structures with Algorithms Choice Based Credit System

Semester:	I	CIE Marks:	40
Course Code:	20MCA11	SEE Marks:	60
Contact Hours (L:T:P):	4:0:0	Exam Hours:	03

Course Outcomes: At the end of the course students will be able to

1. CO1: Demonstrate different data structures, its operations using C programming.
2. CO2: Analyse the performance of Stack, Queue, Lists, Trees, Hashing, Searching and Sorting techniques.
3. CO3: Implement some applications of data structures in a high-level language such as C/C++
4. CO4: Design and apply appropriate data structures for solving computing problems.
5. CO5: Compute the efficiency of algorithms in terms of asymptotic notations for the given problem.

Module-1

Classification of Data Structures: Primitive and Non- Primitive, Linear and Nonlinear; Data structure Operations, Stack: Definition, Representation, Operations and Applications: Polish and reverse polish expressions, Infix to postfix conversion, evaluation of postfix expression, infix to prefix, postfix to infix conversion.

Module-2

Recursion - Factorial, GCD, Fibonacci Sequence, Tower of Hanoi. Queue: Definition, Representation, Queue Variants: Circular Queue, Priority Queue, Double Ended Queue; Applications of Queues. Programming Examples.

Module-3

Linked List:Limitations of array implementation, Memory Management: Static (Stack) and Dynamic (Heap) Memory Allocation, Memory management functions. Definition, Representation, Operations: getnode() and Freenode() operations, Types: Singly Linked List. Linked list as a data Structure, Inserting and removing nodes from a list, Linked implementations of stacks, Header nodes, Array implementation of lists.

Module-4

Introduction, Fundamentals of the Analysis of Algorithm Efficiency Notion of Algorithm, Fundamentals of Algorithmic Problem Solving, Important Problem Types, Analysis Framework, Asymptotic Notations and Basic efficiency classes, Mathematical analysis of Recursive and Non-recursive algorithms.

Module-5

Brute Force: Selection Sort and Bubble Sort, Sequential Search, Exhaustive search and String Matching. Divide-and-Conquer Mergesort, Quicksort, Binary Search, Binary tree Traversals and related properties. Decrease-and-Conquer Insertion Sort, Depth First and Breadth First Search, Topological sorting. Greedy Technique Prim's Algorithm, Kruskal's Algorithm, Dijkstra's Algorithm.

Question Paper Pattern:

- The Question paper will have TEN questions
- Each full question will be for 20 marks
- There will be 02 full questions (with maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting one full question from each module.

Textbooks

1. Introduction to the Design and Analysis of Algorithms. AnanyLevitin, Pearson Education, 2nd Edition.

2. Programming in ANSI C, Balaguruswamy, McGraw Hill Education .

3. Data Structures Using C and C++ by YedidyahLangsam and Moshe J. Augenstein and Aaron M Tenanbanum, 2nd Edition, Pearson Education Asia, 2002.

4. Introduction to Data Structure and Algorithms with C++ by Glenn W. Rowe.

Operating System with UNIX

Semester: I	**I**	**CIE Marks:**	**40**
Course Code:	**20MCA12**	**SEE Marks:**	**60**
Contact Periods (L:T:P):	**4-0-0**	**Exam Hours:**	**3**

Course Outcomes:

1. CO1:Analyse the basic Operating System Structure and concept of Process Management
2. CO2: Analyse the given Synchronization/ Deadlock problem to solve and arrive at valid conclusions.
3. CO3: Analyse OS management techniques and identify the possible modifications for the given problem context.
4. CO4:Demonstrate the working of basic commands of Unix environment including file processing
5. CO5: : Demonstrate the usage of different shell commands, variable and AWK filtering to the given problem

Module-1

Introduction to Operating Systems, Computer System Architecture; Operating System Operations; ; Operating System Structure: Operating System Services; System Calls; Types of System Calls; System Programs;; Virtual Machines; System boot.

Process Management Process Scheduling: Basic Concepts, Scheduling Criteria, Scheduling Algorithms, Multiple Processor Scheduling. Process Synchronization

Module-2

Deadlocks: System model; Deadlock Characterization, Methods for handling deadlocks; Deadlock Prevention; Deadlock Avoidance; Deadlock Detection and Recovery from deadlock. Memory Management: Memory Management Strategies: Background, Swapping; Contiguous Memory Allocation; Paging; Segmentation; Virtual Memory Management; Demand Paging; Page Replacement; Allocation of Frames; Thrashing.

Module-3

The File System: The File, What's in a File name? The Parent-Child Relationship, The HOME Variable: The Home Directory, pwd, cd, mkdir, rmdir, Absolute Pathnames, Relative Pathnames, The Unix File System. The vi Editor: vi Basics, Input Mode, ex Mode and Command Mode.

Basic File Attributes: ls options, File Ownership, File Permissions, chmod, Directory Permissions, Changing the File Ownership More File Attributes: File Systems and Inodes, Hard Links, Symbolic Links, The Directory, umask, Modification and Access Times, find. **The Shell:** The Shell's Interpretive Cycle, Shell Offerings, Pattern Matching-The Wild-cards, Escaping and Quoting, Redirection: The Three Standard Files, Two Special Files: /dev/null and /dev/tty, pipes, tee: Creating a Tee, Command Substitution**.**

Module-4

The Process: Process Basics, ps: Process Status, System Processes, Mechanism of Process Creation, Internal and External Commands, Running Jobs in Background, Killing Processes with Signals, Job Control, at and batch, cron.

Essential Shell Programming: Shell Variables, Environment Variables, Shell Scripts, read, Using Command Line Arguments, exit and exit status of command, The Logical Operators, The if Conditional, using test and [] to Evaluate Expression, The case Conditional, expr, while: looping, for: looping with a list, set and shift, trap, Debugging Shell Scripts with set – x.

Module-5

AWK and Advanced Shell Programming

Simple AWK Filtering, Splitting a Line into Fields, printf, the Logical and Relational Operators, Number Processing, Variables, The –f option, BEGIN and END positional Parameters, getline, Built-invariables, Arrays, Functions, Interface with the Shell, Control Flow. The sh command, export Command, Conditional Parameter Substitution, Merging Streams, Shell Functions, eval, Exec Statement and Examples

Question Paper Pattern:

- The Question paper will have TEN questions
- Each full question will be for 20 marks
- There will be 02 full questions (with maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting one full question from each module.

Text books

1. Sumitabha Das: UNIX Concepts and Applications, 4th Edition, Tata McGraw Hill, 2006.
2. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne: Operating Systems Principles, 8th Edition, Wiley – India.

References

1. UNIX: The Complete Reference: Kenneth Roson et al, Osborne/McGraw Hill, 2000.
2. Using UNIX: Steve Montsugu, 2ndEdition, Prentice Hall India, 1999.
3. UNIX and Shell Programming: M G Venkateshmurthy, Pearson Education Asia, 2005
4. Behrouz A Forouzan and Richard F Gilberg
5. 4.D M Dhamdhere: Operating Systems – A Concept Based Approach, 2nd Edition, Tata McGraw – Hill, 2002.
6. P C P Bhatt: Operating Systems, 2ndEdition, PHI, 2006.
7. 6. Harvey M Deital: Operating Systems, 3rdEdition, Addison Wesley, 1990.

Computer Networks Choice Based Credit System

Semester: I	CIE Marks:40
Course code:20MCA13	SEE Marks:60
Contact Hours (L: T:P):4-0-0	Exam Hours:03

Course Outcomes: At the end of the course, the student will be able to

1. CO1: Apply the basic concepts of networking and to analyse different parameters such as bandwidth, delay, throughput of the networks for the given problem.
2. CO2: Apply different techniques to ensure the reliable and secured communication in wired and wireless communication
3. CO3: Analyse the networking concepts of TCP/IP for wired and wireless components
4. CO4: Identify the issues of Transport layer to analyse the congestion control mechanism
5. CO5: Design network topology with different protocols and analyse the performance using NS2

Module-1

Applications, Requirements, Network Architecture, Implementing Network Software, Performance.

Module-2

Perspectives on Connecting, Encoding (NRZ, NRZI, Manchester, 4B/5B), Framing, Error Detection, Reliable Transmission, Ethernet and Multiple Access Networks (802.3), Wireless.

Module-3

Internetworking and Advanced Internetworking Switching and Bridging, Basic Internetworking (IP), Routing, The Global Internet, Routing among Mobile Devices.

Module-4

End-to-End Protocols and Congestion Control Simple Demultiplexer (UDP), Reliable Byte Stream (TCP), Queuing Disciplines, TCP Congestion Control, Congestion-Avoidance Mechanisms.

Module-5
Network Security and Applications Cryptographic Building Blocks, Key Pre-distribution, Firewalls, Traditional Applications, Infrastructure Services.
Question Paper Pattern: • The Question paper will have TEN questions • Each full question will be for 20 marks • There will be 02 full questions (with maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer FIVE full questions, selecting one full question from each module.
Text books
1. " Computer Networks A Systems Approach" by Larry L Peterson and Bruce S Davie, 5th Edition, MKP – 2012 – (1, 2 ,3.1,3.2,3.3, 3.4,4.1, 5.1,5.2 , 6.2,6.36.4, 8.1,8.2,8.5, 9.1,9.3)
References
1. James F. Kurose, Keith W. Ross, "Computer Networking – A Top-Down Approach Featuring the Internet", Fifth Edition, Pearson Education, 2009. 2. Nader. F. Mir, "Computer and Communication Networks", Pearson Prentice Hall Publishers, 2010. 3. Ying-Dar Lin, Ren-Hung Hwang, Fred Baker, "Computer Networks: An Open Source Approach", Mc Graw Hill Publisher, 2011. 4. Behrouz A. Forouzan, "Data Communication and Networking", Fourth Edition, Tata McGraw – Hill, 2011.

Mathematical Foundation for Computer Applications

Choice Based Credit System

Semester: I	CIE Marks:40
Course Code:20MCA14	SEE Marks:60
Contact Hours(L: T:P)::3-2-0	Exam Hours:03

Course Outcomes: At the end of the course student will be to

1. CO1: Apply the fundamentals of set theory and matrices for the given problem.
2. CO2: Apply the types of distribution, evaluate the mean and variance for the given case study/ problem.
3. CO3: solve the given problem by applying the Mathematical logic concepts
4. CO4: Model the given problem by applying the concepts of graph theory.
5. CO5: Design strategy using gaming theory concepts for the given problem.
6. CO6: Identify and list the different applications of discrete mathematical concepts in computer science.

Module-1
Set Theory and Matrices

Sets, Operations on sets, Cardinality of sets, inclusion-exclusion principle, pigeonhole principle, matrices, finding Eigen values and Eigen vectors.

Module-2

Mathematical Logic

Propositional Logic, Applications of Propositional Logic, Propositional Equivalences

Predicates and Quantifiers, Nested Quantifiers, Rules of Inference Introduction to Proofs

Module-3

Relations

Relations and Their Properties, n-ary Relations and Their Application, Representing Relations, Closures of Relations,Equivalence Relations, Partial Orderings

Module-4

Random variable and probability distribution

Concept of random variable, discrete probability distributions, continuous probability distributions, Mean, variance and co-variance and co-variance of random variables. Binomial and normal distribution, Exponential and normal distribution with mean and variables and problems

Module-5

Graph Theory

Graphs and Graphs models, Graph Terminology and Special Types of Graphs, Representing Graphs and Graph Isomorphism, Connectivity, Euler and Hamilton Paths, Shortest-Path Problems, Planar Graphs, Graph Coloring

Question Paper Pattern:

- The Question paper will have TEN questions
- Each full question will be for 20 marks
- There will be 02 full questions (with maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting one full question from each module.

Text book

1. Kenneth H Rosen, "Discrete Mathematics and its Applications", McGraw Hill publications, 7th edition. (Chapters 2.1,2.2,2.5, 2.6,6.2,8.5,8.6,10.1 to 10.8)
2. Wolpole Myers Ye "Probability and Statistics for engineers and Scientist" Pearson Education, 8th edition.

References

1. 1.Richard A Johnson and C.B Gupta "Probability and statistics for engineers" Pearson Education.
2. 2.J.K Sharma "Discrete Mathematics", Mac Millian Publishers India, 3rd edition,2011.

Research Methodology and IPR Choice Based Credit System

Semester: I	CIE Marks:40
Course Code:20MCA15	SEE Marks:60
Contact Hours (L: T:P):2:2:0	Exam Hours:03

Course Outcomes: At the end of the course students will be able to

1. CO1: Identify the suitable research methods and articulate the research steps in a proper sequence for the given problem.
2. CO2: Carry out literature survey, define the problem statement and suggest suitable solution for the given problem and present in the format of the research paper (IEEE).
3. CO3: Analyse the problem and conduct experimental design with the samplings.
4. CO4:Perform the data collection from various sources segregate the primary and secondary data
5. CO5: Apply some concepts/section of Copy Right Act /Patent Act /Cyber Law/ Trademark to the given case and develop –conclusions

Module-1

Research Methodology: Introduction, Meaning of Research, Objectives of Research, Motivation in Research, Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Importance of Knowing How Research is Done, Research Process, Criteria of Good Research, and Problems Encountered by Researchers in India.

Module-2

Defining the Research Problem: Research Problem, Selecting the Problem, Necessity of Defining the Problem, Technique Involved in Defining a Problem, An Illustration.

Reviewing the literature: Place of the literature review in research, Bringing clarity and focus to your research problem, Improving research methodology, Broadening knowledge base in research area, Enabling contextual findings, How to review the literature, searching the existing literature, reviewing the selected literature, Developing a theoretical framework, Developing a conceptual framework, Writing about the literature reviewed.

Module-3

Research Design: Meaning of Research Design, Need for Research Design, Features of a Good Design, Important Concepts Relating to Research Design, Different Research Designs, Basic Principles of Experimental Designs, Important Experimental Designs. Design of Sample Surveys: Introduction, Sample Design, Sampling and Non-sampling Errors, Sample Survey versus Census Survey, Types of Sampling Designs

Module-4

Data Collection: Experimental and Surveys, Collection of Primary Data, Collection of

Secondary Data, Selection of Appropriate Method for Data Collection, Case Study Method.

Interpretation and Report Writing: Meaning of Interpretation, Technique of Interpretation, Precaution in Interpretation, Significance of Report Writing, Different Steps in Writing Report, Layout. Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Precautions for Writing Research Reports.

Module-5

Intellectual Property (IP) Acts:Introduction to IP: Introduction to Intellectual Property (IP), different types of IPs and its importance in the present scenario, Patent Acts: Indian patent acts 1970.Design Act: Industrial Design act 2000. Copy right acts: Copyright Act 1957. Trade Mark Act, 1999

Question Paper Pattern:

- The Question paper will have TEN questions
- Each full question will be for 20 marks
- There will be 02 full questions (with maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting one full question from each module.

Text books

1. Research Methodology: Methods and Techniques, C.R. Kothari, Gaurav Garg New Age International 4th Edition, 2018.
2. Research Methodology a step-by- step guide for beginners. (For the topic Reviewing the literature under module 2) Ranjit Kumar SAGE Publications Ltd 3rd Edition, 2011 Study Material.
3. Intelectual property, Debirag E. Bouchoux, Cengage learning, 2013.

References

1. 1.Research Methods: the concise knowledge base Trochim, Atomic Dog Publishing, 2005.
2. 2.Conducting Research Literature Reviews: From the Internet to Paper Fink A Sage Publications, 2009.

Data Structures with Algorithms Lab

Semester: II	CIE Marks: 40
Course Code:20MCA16	SEE Marks:60
Contact Hours (L:T:P): 0:0:4	Exam Hours:03

Course Outcomes: At the end of the course, Students will be able to

1. CO1: Implement sorting / searching techniques, and validate input/output for the given problem.
2. CO2: Implement data structures (namely Stacks, Queues, Circular Queues, Linked Lists, and Trees), its operations and algorithms.
3. CO3: Implement the algorithm to find whether the given graph is connected or not and conclude on the performance of the technique implemented.
4. CO4: Design and apply appropriate data structures for solving computing problems
5. CO5: Implement the techniques for evaluating the given expression.

1. Write a C program to Implement the following searching techniques a. Linear Search b. Binary Search.
2. Write a C program to implement the following sorting algorithms using user defined functions: a. Bubble sort (Ascending order) b. Selection sort (Descending order).
3. Write a C Program implement STACK with the following operations
   a. Push an Element on to Stack b. Pop an Element from Stack
4. Implement a Program in C for converting an Infix Expression to Postfix Expression.
5. Implement a Program in C for evaluating an Postfix Expression.
6. Write a C program to simulate the working of a singly linked list providing the following operations: a. Display & Insert b. Delete from the beginning/end
   c. Delete a given element
7. Obtain the Topological ordering of vertices in a given graph with the help of a c programming.
8. Check whether a given graph is connected or not using DFS method using C programming.
9. From a given vertex in a weighted connected graph, find shortest paths to other vertices Using Dijkstra's algorithm (C programming)
10. Find Minimum Cost Spanning Tree of a given undirected graph using Kruskal's algorithm (C programming)

Unix Programming Lab

Choice Based Credit System

Semester:I	CIE Marks:40
Course Code: 20MCA17	SEE Marks:60
Contact Hours (L: T:P): 0:0:4	Exam Hours:03

Course Outcomes: At the end of the course students will be able to

1. CO1:Demonstrate the working of basic commands of Unix environment including file processing
2. CO2: Apply Regular expression to perform pattern matching using utilities like grep,sed and awk.
3. CO3: Implement unix commands/ system calls to demonstrate process management
4. CO4: Demonstrate the usage of different shell commands, variable and AWK filtering to the given problem.
5. CO5:Develop shell scripts for developing the simple applications to the given problem.

Laboratory Experiments:

(a) Explore Unix Environment.
(b) Explore vi- editor with Vim tutor. Perform the following operations using vi editor, but not limited to:

1. Insert character, delete character, replace character.
2. Save File and continue working.
3. Save File and exit editor.
4. Quit the editor.
5. Quit without saving the file.
6. Rename a file.
7. Insert lines, delete line.
8. Setline numbers.
9. Search for a pattern.
10. 10. Move forward and backward.

1a. Write a shell script that takes a valid directory name as a argument recursively descend all the sub-directors, find the maximum length of any file in that hierarchy and writ the maximum value to the standard output.

1b. Write a shell script that accepts a path name and creates all the components in that path name as directories. For example, if the script is named as mpc, then the command mpc a/b/c/d should create sub-directories a, a/b, a/b/c, a/b/c/d.

2a. Write a shell script that accepts two filenames as arguments, checks if the permissions for these files are identical and if the permissions are identical, output common permissions otherwise output each filename followed by its permissions.

2b. Write a shell script which accepts valid log-in names as arguments and prints their

corresponding home directories, if no arguments are specified, print a suitable error message.
3a. Create a script file called file properties that reads a filename entered and outputs it properties. 3b. Write a shell script to implement terminal locking (Similar to the lock command). It should prompt for the user for a password. After accepting the password entered by the user, it must prompt again for the matching password as confirmation and if match occurs, it must lock the keyword until a matching password is entered again by the user. Note the Script must be written to disregard BREAK, control-D. No time limit need be implemented for the lock duration.
4a. Write a shell script that accept one or more file names as argument and convert all of them to uppercase, provided they exists in current directory. 4b. Write a shell script that displays all the links to a file specified as the first argument to the script. The second argument, which is optional, can be used to specify in which the search is to begin. If this second argument is not present, the search is to begin in the current working directory. In either case, the starting directory as well as its subdirectories at all levels must be searched. The script need not include error checking.
5a. Write a shell script that accepts filename as argument and display its creation time if file exist and if does not send output error message. 5b. Write a shell script to display the calendar for the current month with current date replaced by * or ** depending whether the date is one digit or two digit.
6a. Write s a shell script to find a file/s that matches a pattern given as command line argument in the home directory, display the contents of the file and copy the file into the directory ~/mydir. 6b. Write a shell script to list all the files in a directory whose filename is at least 10 characters. (use expr command to check the length).
7a. Write a shell script that gets executed and displays the message either “Good Morning” or “Good Afternoon” or “Good Evening” depending upon time at which the user logs in. 7b. Write a shell script that accepts a list of filenames as its argument, count and report occurrence of each word that is present in the first argument file on other argument files.
8a. Write a shell script that determine the period for which as specified user is working on a system and display appropriate message. 8b. Write a shell script that reports the logging on of as specified user within one minute after he/she login. The script automatically terminates if specified user does not login during

specified in period of time.

9a. Write a shell script that accepts the filename, starting and ending line number as an argument and display all the lines between the given line number.

9b. Write a shell script that folds long lines into 40 columns. Thus any line that exceeds 40 characters must be broken after 40th, a "/" is to be appended as the indication of folding and processing is to be continued with the residue. The input is to be supplied through a text file created by the user.

10a. Write an awkscript that accepts date argument in the form of dd-mm-yy and display it in the form month, day and year. The script should check the validity of the argument and in the case of error, display a suitable message.

10b. Write an awkscript to delete duplicated line from a text file. The order of the original lines must remain unchanged.

11a. Write an awk script to find out total number of books sold in each discipline as well as total book sold using associate array down table as given below.

Electrical	34
Mechanical	67
Electrical	80
Computer Science	43
Civil	98
Mechanical	65
Computer Science	64

11b. Write an awkscript to compute gross salary of an employee accordingly to rule given below.

If basic salary < 10000 then HRA=15% of basic & DA=45% of basic.

If basic salary is >=1000 then HRA=20% of basic & DA=50% of basic.

Computer Networks Lab Choice Based Credit System	
Semester:I	CIE Marks:40
Course Code:**20MCA18**	SEE Marks:60
Contact Hours(L:T:P):0:0:4	Exam Hours:03

Course Outcomes: At the end of the course, the students will be able to

1. CO1: Apply the basic concepts of networking and to analyse different parameters such as bandwidth, delay, throughput of the networks for the given problem.
2. CO2:Apply different techniques to ensure the reliable and secured communication in wired and wireless communication
3. CO3:Analyse the networking concepts of TCP/IP for wired and wireless components
4. CO4:Identify the issues of Transport layer to analyse the congestion control mechanism
5. CO5:Design network topology with different protocols and analyse the performance using any simulator

PART-A

Implement the following Computer Networks concepts using C/C++

1. Write a program for distance vector algorithm to find suitable path for transmission.
2. Using TCP/IP sockets, write a client-server program to make the client send the file name and to make the server send back the contents of the requested file if present.
3. Write a program for Hamming code generation for error detection and correction.
4. Write a program for congestion control using leaky bucket algorithm.

PART-B

(Simulate the following Computer Networks concepts using any network simulators)

1. Simulate a three nodes point — to — point network with duplex links between them. Set the queue size and vary the bandwidth and find the number of packets dropped.
2. Simulate the network with five nodes n0, n1, n2, n3, n4, forming a star topology. The node n4 is at the centre. Node n0 is a TCP source, which transmits packets to node n3 (a TCP sink) through the node n4. Node n1 is another traffic source, and sends UDP packets to node n2 through n4. The duration of the simulation time is 10 seconds.
3. Simulate to study transmission of packets over Ethernet LAN and determine the number of packets drop destination.
4. **Simulate working of multicasting routing protocol and analyse the throughput of the network/protocol.**
5. Simulate the different types of internet traffic such as FTP and TELNET over a wired network and analyze the packet drop and packet delivery ratio in the network.

Note 1: In the practical exam student has to execute one program from part-A and one from part-B(equal weightage of marks). For simulation of Part B problems any network simulator (either Graphical user interface or script based)can be used.

Bridge Course: Basics of Programming and Computer Organisation

Choice Based Credit System

Semester: I	CIE Marks:40
Course Code: 20MCA19-BC	SEE Marks:60
Contact Hours(L:T:P): 2: 2:0	Exam Hours:03

Course Outcomes: At the end of the course students will be able to

1. CO1: Demonstrate the key concepts introduced in C programming by writing and executing the programs.
2. CO2: Demonstrate the concepts of structures and pointers for the given application/problem.
3. CO3: Implement the single/multi-dimensional array for the given problem.
4. CO4: Demonstrate the application of logic gates in solving some societal/industrial problems.
5. CO5: Analyse how memory organization, operations, instruction sequencing and interrupts are useful in executing the given program.

Module-1

C Programming: decision making, control structures and arrays

C Structure, Data Types, Input-Output Statements, Decision making with if statement, simple if statement, the if..else statement, nesting of if..else statements, the else.if ladder, the switch statement, the ?: operator, the goto statement, the break statement, programming examples. The while statement, the do...while statement, the for statement, nested loops, jumps in loops, the continue statement, programming examples. One dimensional and two dimensional arrays, declaration and initialization of arrays, reading, writing and manipulation of above types of arrays.

Module-2

Structures

Defining a structure, declaring structure variables, accessing structure members, structure initialization, copying and comparing structure variables, operations on individual members, array of structures, structures within structures, structures and functions, Unions, size of structures.

Module-3

Pointers

Pointers in C, Declaring and accessing pointers in C, Pointer arithmetic, Functions , Call by value, Call by reference, Pointer as function arguments, recursion, Passing arrays to functions, passing strings to functions, Functions returning pointers, Pointers to functions, Programming Examples

Module-4

Binary Systems and Combinational Logic

Digital Computers and Digital Systems, Binary Numbers, Number Base Conversion, Octal and Hexadecimal Numbers, subtraction using r's and r-1 complements, Binary Code, Binary Storage and Registers, Binary Logic, Integrated Circuits, Digital Logic Gates

Module-5

Basic Structure of Computer Hardware and Software

Computer Types, Functional Units, Basic Operational Concepts, Bus structure, Software, Performance, Multiprocessing and Multi computers, Machine Instruction: Memory Locations and Addresses, Memory Operations, Instructions and Instruction Sequencing, Addressing Modes, Interrupts.

Question Paper Pattern:

- The Question paper will have TEN questions
- Each full question will be for 20 marks
- There will be 02 full questions (with maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting one full question from each module.

Textbooks

1. Programming in ANSI C,Balaguruswamy, 7th Edition, McGraw Hill Education

2.C : The Complete Reference, Herbert Schild,4th Edition, McGraw Hill Education

3. Let us C, YashwantKanetkar, BPB Publications

4.M.Morris Mano, "Digital Logic and Computer Design", Pearson, 2012.

5.Carl Hamacher, ZvonkoVranesicSafwatZaky, "Computer Organization", 5th edition, Tata McGraw-Hill, 2011

Database Management System

Choice Based Credit System

Semester: II	CIE Marks:40
Course Code: 20MCA21	SEE Marks: 60
Contact Hours(L:T:P): 3:0:0	Exam Hours:03

Course Outcomes: At the end of the course students will be able to

1. CO1: Apply the basic concepts of database management in designing the database for the given problem.
2. CO2: Design entity-relationship diagrams to the given problem to develop database application with appropriate fields and validations.
3. CO3: Implement a database schema for the given problem domain.

4. CO4: Formulate and execute SQL queries to the given problem.
5. CO5: Apply normalization techniques to improve the database design to the given problem.

Module-1

Characteristics of Database approach, Actors on the Scene, Workers behind the scene, Advantages of using DBMS approach, A Brief History of Database Applications, Data models, schemas and instances, Three-schema architecture and data independence, Database languages and interfaces, the database system environment, Centralized and client-server architectures, Classification of Database Management systems.

Module-2

Structure of Relational Databases, Database Schema, Keys, Relational Query Languages, Relational Operations.

Entity-Relationship Model: Conceptual Database using high level conceptual data models for Database Design, A Sample Database Application, Entity types, Entity sets Attributes and Keys Relationship types, Relationship Sets

Functional Dependencies, Normal Forms based on Primary

Module-3

SQL data definition and data types, specifying constraints in SQL, basic retrieval queries in SQL, Insert, update and delete statements in SQL, aggregate functions in SQL, group by and having clauses.

Module-4

Introduction to triggers in SQL, views in SQL, schema change statements in SQL, stored procedures and functions.

Module-5

Introduction to transaction processing, transaction and system concepts, desirable properties of transactions, transaction support in SQL.

Concurrency control techniques: two-phase locking techniques, concurrency control based on timestamp ordering, multiversion concurrency control techniques, validation concurrency control techniques.

Recovery techniques: recovery concepts, recovery in multidatabase systems, database backup and recovery from catastrophic failures.

Question Paper Pattern:

- The Question paper will have TEN questions
- Each full question will be for 20 marks
- There will be 02 full questions (with maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting one full question from

each module.

Text Books

1. Elmasri and Navathe: Fundamentals of Database Systems, 5th Edition, Addison -Wesley, 2011.
2. Silberschatz, Korth and Sudharshan Data base System Concepts, 6th Edition, Tata McGraw Hill, 2011.

References

1. C.J. Date, A. Kannan, S. Swamynatham: An Introduction to Database Systems, 8th Edition, Pearson education, 2009.
2. Raghu Ramakrishnan and Johannes Gehrke: Database Management Systems, 3rd Edition, McGraw-Hill, 2003.

Object Oriented Programming with Java

Choice Based Credit System(CBCS)

Semester: I	**CIE Marks:40**
Course Code:20MCA22	**SEE Marks:60**
Contact Periods (L:T:P):3-0-0	**Exam Hours:03**

Course Outcomes:

1. CO1: Demonstrate the basic programming constructs of Java and OOP concepts to develop Java programs for a given scenario.
2. CO2: Illustrate the concepts of generalization and run time polymorphism applications to develop reusable components.
3. CO3: Demonstrate the usage of Packages, Interfaces, Exceptions and Multithreading in building given applications.
4. CO4: Apply Enumerations, Wrappers, Auto boxing, Collection framework and I/O operations for effective coding to the given problem.
5. CO5: Implement the concepts of Applets, and networking using Java network classes for developing the distributed applications to the given problem.

Module-1

Java Programming Fundamentals

The Java Language, The Key Attributes of Object-Oriented Programming, The Java Development Kit, A First Simple Program, The Java Keywords, Identifies in Java, The Java Class Libraries.

Introducing Data Types and Operators

Java's Primitive Types, Literals, A Closer Look at Variables, The Scope and Lifetime of Variables, operators, Shorthand Assignments, Type conversion in Assignments, Using Cast.

Program Control Statements

Input characters from the Keyword, if statement, Nested ifs, if-else-if Ladder, Switch Statement, Nested switch statements, for Loop, Enhanced for Loop, While Loop, do-while Loop, Use break,

Use continue, Nested Loops.

Introducing Classes, Objects and Methods

Class Fundamentals, How Objects are Created, Reference Variables and Assignment, Methods, Returning from a Method, Returning Value, Using Parameters, Constructors, Parameterized Constructors, The new operator Revisited, Garbage Collection and Finalizers, The this Keyword.

More Data Types and Operators

Arrays, Multidimensional Arrays, Alternative Array Declaration Syntax, Assigning Array References, Using the Length Member, The For-Each Style for Loop, Strings,

String Handling

String Fundamentals, The String Constructors, Three String-Related Language Features, The Length() Method, Obtaining the characters within a string, String comparison, using indexOf() and lastIndexOf(), Changing the case of characters within a string, StringBuffer and String Builder.

Module-2

A Closer Look at Methods and Classes:

Controlling Access to Class Members, Pass Objects to Methods, How Arguments are passed, Returning Objects, Method Overloading, Overloading Constructors, Recursion, Understanding Static, Introducing Nested and Inner Classes, Varargs: Variable-Length Arguments.

Inheritance:

Inheritance Basics, Member Access and Inheritance, Constructors and Inheritance, Using super to Call Superclass constructors, Using super to Access Superclass Members, Creating a Multilevel Hierarchy, When are Constructors Executed, Superclass References and Subclass Objects, Method Overriding, Overridden Methods support polymorphism, Why Overridden Methods, Using Abstract Classes, Using final, The Object Class.

Module-3

Interfaces

InterfaceFundamentals,CreatinganInterface,Implementingan Interface,Using InterfaceReferences,ImplementingMultipleInterfaces,Constantsin Interfaces, Interfacescanbeextended,NestedInterfaces,FinalThoughtsonInterfaces.

Packages

Package Fundamentals, Packages andMember Access, Importing Packages, Static Import

ExceptionHandling

TheExceptionHierarchy,ExceptionHandlingFundamentals,The Consequencesof an Uncaught Exception, Exceptions Enable you to handle errors gracefully, using Multiple catch clauses, Catching subclass Exceptions, try blocks can be nested, ThrowinganException,A

CloserlookatThrowable,usingfinally,usingthrows,Java's Built-inExceptions,NewExceptionfeaturesaddedbyJDK7, CreatingException Subclasses.

Module-4

MultithreadedProgramming

Multithreadingfundamentals,The ThreadClassandRunnableInterface,Creating Thread, Creating Multiple Threads, Determining When a Thread Ends, Thread Priorities,Synchronization,using SynchronizationMethods,TheSynchronized Statement,ThreadCommunicationusingnotify(),wait()and notifyAll(),suspending, ResumingandstoppingThreads.

Enumerations,AutoboxingandAnnotations

Enumerations, Java Enumeration are class types, The Values() and Valueof() Methods,Constructors,methods,instancevariablesand enumerations,Autoboxing, Annotations(metadata)

Module-5

NetworkingwithJava.net

Networkingfundamentals, TheNetworkingclassesandInterfaces,TheInetAddressclass,The SocketClass,TheURLclass,TheURLConnectionClass,The HttpURLConnectionClass.

The collections Framework: Collections Overview, Recent Changes to Collections, The Collection Interfaces, The Collection Classes, Accessing a collection Via an Iterator, Storing User Defined Classes in Collections, The Random Access Interface, Working With Maps, Comparators, The Collection Algorithms, Why Generic Collections?, The legacy Classes and Interfaces, Parting Thoughts on Collections.

Question Paper Pattern:

- The Question paper will have TEN questions
- Each full question will be for 20 marks
- There will be 02 full questions (with maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting one full question from each module.

Textbooks

1.JavaFundamentals,AcomprehensiveIntroductionbyHerbertSchildt,DaleSkrien.TataMcGrawHill Edition2013.(Chapters:1,2,3,4,5,6,7,8,9,10,11,12,13,15,22,23,24,25,26)

2. Herbert Schildt: JAVA the Complete Reference, 7th/9th Edition, Tata McGraw Hill, 2007. (Chapter 17)

References

1.JavaProgrammingbyHariMohanPandey,PearsonEducation,2012.

2.Java6 Programming,BlackBook,KoGenT, DreamtechPress,2012.

3.Java2Essentials,CayHortsmann,secondedition,Wiley

Web Technologies

Choice Based Credit System

Semester: II	CIE Marks:40
Course Code:20MCA23	SEE Marks:60
Contact Hours(L:T:P): 4:0:0	Exam Hours:03

Course outcomes

1. CO1: Apply the features JQuery for the given web based problem.
2. CO2: Demonstrate the development of XHTML documents using JavaScript and CSS.
3. CO3: Illustrate the use of CGI and Perl programs for different types of server side applications.
4. CO4: Design and implement user interactive dynamic web based applications.
5. CO5:Demonsrtae applications of Angular JS and JQuery for the given problem

Module-1

Web browsers, web servers, MIME, URL, HTTP Introduction to XHTML5 tags, Basic syntax and structure, text markups, images, lists, tables,progress, Media tags-audio and video ,forms, frames.

Module-2

Introduction to CSS, Levels of CSS, Selectors, Font, color and Text Properties, BOX Model, Span and Div tags. Introduction to Javascript, controls statements, Arrays and functions, pattern matching, Element Access, Event Handling.

Module-3

Introduction to Bootstrap, First example, containers, Bootstrap elements: colors, tables, images, buttons, button groups, progress bars, Forms, utilities, Classes, alerts, custom forms, Grid System.

Module-4

Introduction to JQuery, Syntax, selectors, events, JQuery HTML, JQuery Effects, JQuery CSS.

Module-5

Introduction to Angular JS, Directives, Expressions, Directives, Controllers, Filters, Services, Events, Forms, Validations, Examples.

Question Paper Pattern:

- The Question paper will have TEN questions
- Each full question will be for 20 marks

- There will be 02 full questions (with maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting one full question from each module.

Textbooks

1. **Web Programming By Chris Bates , Wiley Publications**
2. **HTML5 Black Book by Dreamtech**
3. **Angular JS By Krishna Rungta**
4. **Bootstrap essentials by Snig by Packt-open source**

Software Engineering

Choice Based Credit System

Semester:II	CIE Marks:40
Course Code:20MCA24	SEE Marks:60
Contact Hours(L:T:P): 3:2:0	Exam Hours:03

Course Outcomes: Students will be able to

CO1: Identify and define different requirements for the given problem and present in the IEEE format.

CO2: Use modern tool to create dynamic diagrams to represent the design for the given problem.

CO3: Draw class diagram , analyse the different types of association that exists as per the given problem and represent them using UML notations.

CO4: Analyse the given system to identify actors, use cases to design use case diagrams for the given problem using RSA/open source tool.

CO5: Design the static/dynamic models to meet application requirements of the given system and generate code (skeleton) using the modern tool.

Module-1

Introduction: Professional Software Development Attributes of good software, software engineering diversity, IEEE/ACM code of software engineering ethics, case studies.

Software Process and Agile Software Development

Software Process models: waterfall, incremental development, reuses oriented, Process activities; coping with change, The Rational Unified Process. Agile Methods, Plan-Driven and Agile Development, Extreme Programming, Agile Project Management, scaling agile

methods.

Module-2

Requirement Engineering: Functional and non-functional requirements, The Software requirements document, Requirements specification, Requirements engineering processes, Requirement elicitation and analysis, Requirement validation, Requirement management.

Module-3

What is object orientation? What is OO development? OO themes; Evidence for usefulness of OO development; OO modelling history, modeling as design Technique: Modelling; abstraction; the three models. Object and class concepts; Link and associations concepts; Generalization and inheritance; A sample class model; Navigation of class models; Practical tips. Advanced objects and class concepts; Associations ends; N-array association; Aggregation, Abstract class; Multiple inheritance; Metadata; Reification; Constraints; Derived data; packages; practical tips.

Module-4

State modelling: Events, States, Transitions and Conditions; State Diagram; State diagram behaviour; Practical tips. Advanced State Modeling: Nested state diagram; Nested states; Signal generalization; Concurrency; A sample state model, Relation of class and state models; practical. Interaction modelling: Use Case models, Sequence models, Activity models, Use case relationships; Procedural sequence models, special constructs for activity models.

Module-5

Project Design and planning:

Process planning, Effort estimation, project scheduling and staffing, Software configuration Management plan, Quality plan, Risk Management, Project Monitoring plan Design: Design concepts, Function oriented design, detailed design, verification, Metrics.

Question Paper Pattern:

- The Question paper will have TEN questions
- Each full question will be for 20 marks
- There will be 02 full questions (with maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting one full question from each module.

Textbooks

1. Ian Sommerville: Software Engineering, 9th Edition, Pearson Education Ltd, 2011

2. Pankaj Jalote, Software Engineering, Wiley India Pvt Ltd (2010) Paul C Jorgensen Software Testing A CraftMan's Approach, 2nd edition, CRC Press.

3. MichelBlaha, James Rumbaugh: Object-Oriented Modelling and Design with UML, 2nd edition, Pearson, 2007.

References
1. Stephan R. Schach, "Object oriented software engineering", Tata McGrawHill,2008 2. Craig Larman, Applying UML and Patterns, 3rd ed, Pearson Education,2005.

Cyber Security

Choice Based Credit System

Semester:II	CIE Marks:40
Course Code:20MCA251	SEE Marks:60
Contact Hours(L:T:P):3:0:0	Exam Hours:03

Course Outcomes: At the end of the course students will be able to

CO1: Apply IT ACT (Cyber law) to the given case/problem and infer from the given case and analyze the gap if exists.

CO2: Analyze the working of cyber security principles in designing the system.

CO3: Analyze the given problem (cybercrime, vulnerability, threat), develop a strategy (physical, logical or administrative controls) to mitigate the problem and articulate consequences on Society and National Economy.

CO4: Examine relevant network defence / web application tool to solve given cyber security problem and evaluate its suitability.

CO5: Evaluate provisions available in Indian cyber law to handle infringement of intellectual property rights that happens on the cyber platform.

Module-1

Introduction to Cybercrime and Laws

Introduction, Cybercrime: Definition and Origins of the word, Cybercrime and information Security, Who are Cybercriminals? Classifications of Cybercrimes. How Criminals Plan Them – Introduction, How Criminals Plan the Attacks, Cybercafé and Cybercrimes, Botnets, Attack Vector, The Indian IT ACT 2000 and amendments.

Module-2

Tools and Methods used in Cybercrime

Introduction, Proxy Server and Anonymizers, Password Cracking, Key loggers and

Spyware, Virus and Warms, Trojan and backdoors, Steganography, DOS and DDOS attack, SQLinjection, Buffer Overflow.

Module-3

Phishing and Identity Theft

Introduction, Phishing – Methods of Phishing, Phishing Techniques, Phishing Toolkits andSpy Phishing. Identity Theft – PII, Types of Identity Theft, Techniques of ID Theft. Digital Forensics Science, Need for Computer Cyber forensics and Digital Evidence, Digital Forensics Life Cycle.

Module-4

Cybercrime: Mobile and Wireless devices, Introduction, proliferation of mobile and wireless devices, Trends in Mobility, credit card frauds in Mobile and wireless computing, Attacks on Mobile/cell phones.

Module-5

Network Defense tools and block chain technology

Firewalls and Packet Filters: Firewall Basics, Packet Filter Vs Firewall, How a Firewall Protects a Network, Packet Characteristic to Filter, Stateless Vs Stateful Firewalls, Network Address Translation (NAT) and Port Forwarding, the basic of Virtual Private Networks, Linux Firewall, Windows Firewall, Snort: Intrusion Detection System, introduction to block chain technology (definition, tools used for implementation) and its applications.

Question Paper Pattern:

- The Question paper will have TEN questions
- Each full question will be for 20 marks
- There will be 02 full questions (with maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting one full question from each module.

Textbooks

Text Books:

1. Anti-Hacker Tool Kit (Indian Edition) by Mike Shema, Publication McGraw Hill. (Chapters: 2, 7, 8, 11)
2. Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives by Nina
Godbole and SunitBelpure, Publication Wiley. (Chapters: 1.1, 1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 2.5, 2.6, 2.7, 6.4,
5.2.1, 5.2.2, 5.2.5, 5.3.1, 5.3.2, 5.3.3, 4.2,
4.4, 4.5, 4.6, 4.7, 4.8, 4.9, 4.10, 4.11)

References

1. Marjie T. Britz - Computer Forensics and Cyber Crime: An Introduction - Pearson
2. Chwan-Hwa (John) Wu,J. David Irwin - Introduction to Computer Networks and Cyber securityCRCPress
3. Bill Nelson, Amelia Phillips, Christopher Steuart - Guide to Computer Forensics and InvestigationsCengage Learning

DataMining with Business Intelligence **Choice Based Credit System**	
Semester:II	CIE Marks:40
Course Code:20MCA252	SEE Marks:60
Contact Hours(L:T:P):3:0:0	Exam Hours:03

Course Outcomes: At the end of the course, students will be able to

CO1: Analyse the concept of data warehouse, Business Intelligence and OLAP

CO2: Demonstrate data pre-processing techniques and application of association rule mining algorithms

CO3: Apply various classification algorithms and evaluation of classifiers for the given problem

CO4: Analyse data mining for various business intelligence applications for the given problem

CO5: Apply classification and regression techniques for the given problem.

Module-1

Overview and concepts Data Warehousing and Business Intelligence:

Why reporting and Analysing data, Raw data to valuable information-Lifecycle of Data - What is Business Intelligence - BI and DW in today's perspective - What is data warehousing - The building Blocks: Defining Features - Data warehouses and data 1marts - Overview of the components - Metadata in the data warehouse - Need for data warehousing - Basic elements of data warehousing - trends in data warehousing.

The Architecture of BI and DW

BI and DW architectures and its types - Relation between BI and DW - OLAP (Online analytical processing) definitions - Difference between OLAP and OLTP - Dimensional analysis - What are cubes? Drill-down and roll-up - slice and dice or rotation - OLAP models - ROLAP versus MOLAP - defining schemas: Stars, snowflakes and fact constellations.

Module-2

Introduction to data mining (DM):

Motivation for Data Mining - Data Mining-Definition and Functionalities – Classification of DM Systems - DM task primitives - Integration of a Data Mining system with a Database or a Data Warehouse - Issues in DM – KDD Process

Data Pre-processing:Why to pre-process data? - Data cleaning: Missing Values, Noisy Data - Data Integration and transformation - Data Reduction: Data cube aggregation, Dimensionality reduction - Data Compression - Numerosity Reduction - Data Mining Primitives - Languages and System Architectures: Task relevant data - Kind of Knowledge to be mined - Discretization and Concept Hierarchy.

Module-3

Concept Description and Association Rule Mining

What is concept description? - Data Generalization and summarization-based characterization - Attribute relevance - class comparisons Association Rule Mining: Market basket analysis - basic concepts - Finding frequent item sets: Apriori algorithm - generating rules – Improved Apriori algorithm – Incremental ARM – Associative Classification – Rule Mining.

Module-4

Classification and prediction:

What is classification and prediction? – Issues regarding Classification and prediction: Classification methods: Decision tree, Bayesian Classification, Rule based, CART, Neural Network Prediction methods: Linear and nonlinear regression, Logistic Regression. Introduction of tools such as DB Miner /WEKA/DTREG DM Tools.

Module-5

Data Mining for Business Intelligence Applications:

Data mining for business Applications like Balanced Scorecard, Fraud Detection, Clickstream Mining, Market Segmentation, retail industry, telecommunications industry, banking & finance and CRM etc., Data Analytics Life Cycle: Introduction to Big data Business Analytics - State of the practice in analytics role of data scientists Key roles for successful analytic project - Main phases of life cycle - Developing core deliverables for stakeholders.

Question Paper Pattern:

- The Question paper will have TEN questions
- Each full question will be for 20 marks
- There will be 02 full questions (with maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting one full question from each module.

Textbook

1. J. Han, M. Kamber, "Data Mining Concepts and Techniques", Morgan Kaufmann

2. M. Kantardzic, "Data mining: Concepts, models, methods and algorithms, John Wiley &Sons Inc.

3. PaulrajPonnian, "Data Warehousing Fundamentals", John Willey.

4. M. Dunham, "Data Mining: Introductory and Advanced Topics", Pearson Education.

5. G. Shmueli, N.R. Patel, P.C. Bruce, "Data Mining for Business Intelligence: Concepts, Techniques, and Applications in Microsoft Office Excel with XLMiner", Wiley India

Enterprise Resource Planning

Choice Based Credit System

Semester: II	CIE Marks:40
Course Code:20MCA253	SEE Marks:60
Contact Hours (L: T:P): 3:0:0	Exam Hours:03

Course Outcomes: At the end of the course students will be able to

CO1: Analyse the essentials of supply chain management in ERP.

CO2: Analyse the implementation of ERP in the context of business of the different organization.

CO3: Analyse and apply ERP for different business modules for the given problem.

CO4: Analyse the given case study of ERP marketing.

CO5: Analyse the design of ERP with future E-commerce and internet.

Module-1

Introduction to Supply Chain Management: Supply chain – objectives – importance – decision phases – process view – competitive and supply chain strategies – achieving strategic fit – supply chain drivers – obstacles – framework – facilities – inventory – transportation – information – sourcing – pricing.

Module-2

ERP Implementation: Implementation of Life Cycle, Implementation Methodology, Hidden Costs, Organizing Implementation, Vendors, Consultants and Users, Contracts, Project Management and Monitoring

Module-3

Business Modules: Business Modules in an ERP Package, Finance, Manufacturing, Human Resource, Plant Maintenance, Materials Management, Quality Management, Sales and Distribution

Module-4

ERP Market: ERP Market Place, SAP AG, People Soft, Baan Company, JD Edwards World Solutions Company, Oracle Corporation, QAD, System Software Associates.

Module-5

ERP–Present And Future: Turbo Charge the ERP System, EIA, ERP and E–Commerce, ERP and Internet, Future Directions in ERP.

Question Paper Pattern:

- The Question paper will have TEN questions
- Each full question will be for 20 marks
- There will be 02 full questions (with maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting one full question from each module.

Textbooks

1. Sunil Chopra and Peter Meindl, Supply Chain Management – Strategy, Planning and Operation, Pearson/PHI, 3rd Edition, 2007

2. Alexis Leon, "ERP Demystified", Tata McGraw Hill, 1999.

3. Joseph A. Brady, Ellen F. Monk, Bret J. Wangner, "Concepts in Enterprise Resource Planning", Thomson Learning, 2001.

Reference

1.Vinod Kumar Garg and N.K .Venkata Krishnan, "Enterprise Resource Planning concepts and Planning", Prentice Hall, 1998.

2. Jose Antonio Fernandz, " The SAP R /3 Hand book", Tata McGraw Hill

User Interface Design

Choice Based Credit System

Semester: II	CIE Marks:40
Course code:20MCA254	SEE Marks:60
Contact Hours (L:T:P): 3:0:0	Exam Hours:3

Course Outcomes: At the end of the course, students will be able to

CO1:Analyse the new technologies that provide interactive devices and interfaces.

CO2: Apply the guidelines to develop the UID and evaluate for the given problem.

CO3: Apply the development methodologies with an analysis of the social impact and legal issuesUnderstand Direct Manipulation and Virtual Environment

CO4: Discuss the command, natural languages and issues in design for maintaining QoS

CO5: Demonstrate techniques for information search and visualization for the given problem.

Module-1

Introduction

Usability of Interactive Systems: Introduction, Usability Goals and Measures, Usability Motivation, Universal Usability, Goals for our profession. Guideline, principles, and theories: Introduction, Guidelines, principles, Theories.

Module-2

Development Processes

Managing Design Processes: Introduction, Organizational Design to support Usability, The Four Pillars of Design, Development methodologies: Ethnographic Observation, Participatory Design, Scenario Development, Social Impact statement for Early Design Review, Legal Issues.

Evaluating Interface Design

Introduction, Expert Reviews, Usability Testing and Laboratories, Survey Instruments, Acceptance tests, Evaluation during Active Use, Controlled Psychologically Oriented Experiments

Module-3

Direct Manipulation and Virtual Environments:

Introduction, Examples of Direct Manipulation, Discussion of direct manipulation, 3D Interfaces, Tele-operation, Virtual and Augmented Reality Menu Selection, Form Filling and Dialog Boxes: Introduction, Task-Related Menu Organization, Single Menus, Combination of Multiple Menus, Content Organization, Fast Movement Through Menus, Data Entry With Menus, Form Filling, Dialog Boxes and Alternatives, Audio Menus and Menus for Small Displays

Module-4

Command and Natural Languages

Introduction, Command-organization functionality strategies and structure, Naming and Abbreviations, Natural Language in computing. Interaction Devices: Introduction, Keyboards and Keypads, Pointing Devices, Speech and Auditory interfaces, Displays-Small and Large

Design Issues

Quality of Service: Introduction, Models of Response-Time Impacts, Expectations and Attitudes, User Productivity, Variability in Response time, Frustrating Experiences Balancing Function and Fashion: Introduction, Error Messages, Nonanthropomorphic Design, Display design, web page design, Window Design, Color

Module-5

User Documentation and Online Help :

Introduction, Online versus paper documentation, Reading from paper versus Displays, Shaping the content of the Manuals, Accessing the Documentation, Online Tutorials and animated demonstrations, Online Communities for User Assistance, The Development Process.

Information Search and Visualization

Introduction, Search in Textual Documents and Database Querying, Multimedia document searches, Advanced filtering and Search Interfaces, Information Visualization: Introduction, Data tyoe by task taxonomy, Challenges for information visualization.

Question Paper Pattern:

- The Question paper will have TEN questions
- Each full question will be for 20 marks
- There will be 02 full questions (with maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting one full question from each module.

Textbooks

1.BenShneiderman, Plaisant, Cohen, Jacobs: Designing the User Interface, 5th Edition, Pearson ,Education, 2010.

References

1 Alan Dix, Janet Finalay, Gregory D AbiwdmRusselBealel: Human-Computer Interaction, III Edition, Pearson , Education, 2008.
2 Eberts: User Interface Design, Prentice Hall, 1994
3 Wilber O Galitz: The Essential Guide to User Interface Design- An Introduction to GUI Design, Principles and Techniques, Wiley-Dreamtech India Pvt Ltd, 2011

Optimization Techniques

Choice Based Credit System

Semester: II	CIE Marks:40
Course Code: 20MCA255	SEE Marks:60
Contact Hours (L:T:P):3:0:0	Exam Hours:03
Course Outcomes: At the end of the course, students will be able to	

CO1: Apply problem solving techniques through OR approaches.

CO2: Formulate the problem using linear programming technique.

CO3: Analyze the optimal solution for the given problem by applying Transportation problems.

CO4: Analyze the strategies with different players through game theory approach.

CO5: Analyze the sequence of jobs to be executed by machines for the given problem.

Module-1

Linear programming problem(LPP): introduction, structure of linear programming model, advantages, general model of Linear programming problem(LPP), examples of LP formulation, graphical solutions of LP problem and Solution of LPP by simplex method:

Module-2

Linear programming problem(LPP):Artificial variables-two-phase method, Big M method. Duality in linear programming, formulation of dual linear programming and examples.

Module-3

Transportation and Assignment Problems: Mathematical model of transportation problem, methods of finding initial solution (Northwest corner rule, Least cost method, Vogel's approximation method), test for optimality in TP using MODI Method. Mathematical model of assignment problem, Hungarian method for solving assignment problem.

Module-4

Theory of games: introduction, two-person zero sum games, pure strategies (MinMax and MaxMin principles), mixed strategies. The rules of principles of dominance, algebraic method to solve games without saddle point, graphical methods to solve games.

Module-5

Network Analysis: PERT and CPM, Network construction anddetermination of critical path, Calculation of ES, EF, LS, LF, TF, FFand IF, Crashing of a project, Scheduling of a project and resourcelevelling.

Question Paper Pattern:

- The Question paper will have TEN questions
- Each full question will be for 20 marks
- There will be 02 full questions (with maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting one full question from each module.

Text books

1. Operations Theory and Applications, J.K. Sharma, 5th edition, MacMillan publisher India(Chapter 1,2,3,4,5,910,11,12,20).

2. Operations Research S.D Sharma, Kedarnath, Ramnath and Co, 2002.

References

1. Operations Research – An Introduction Taha H A- Low price edition 7th edition,2006.
2. Introduction to operation Research, Hiller and Liberman, Mc GRawHill , 5th edition ,2001.
3. Operation Research, Prem Kumar Gupta, D S Heera, S Chand Pub., New Delhi, 2007.

Cryptography and Network Security

Choice Based Credit System

Semester: II	CIE Marks:40
Course Code:20MCA261	SEE Marks:60
Contact Hours(L:T:P): 3:0:0	Exam Hours:03

Course Outcomes: At the of the course students will be able to

CO1: Apply encryption techniques for the given problem and analyse the results.

CO2: Design the Cipher technique and analyse the functioning of Cipher for the given problem.

CO3: Implement the Public and Private key based cryptography algorithms and investigate the results of algorithm based on output.

CO4: Design and implement the cryptographic algorithms using programming languages/ tools for the given problem/context.

CO5: Design the security planning for the given case study for data classification, access control and propose technical solution, and submit the detailed report with plagiarism check.

Module-1

Introduction:OSI Security Architecture, Security Attacks, Security Services, Security Mechanism, model for Network Security.

Classical Encryption Technique: Symmetric Cipher Model, Substitution Techniques, Transposition Techniques.

Module-2

Data Encryption and advanced encryption techniques:

Block Ciphers, Data Encryption Standard and Advanced Encryption Standard

Block Cipher Principles, The Data Encryption Standard, Block Cipher Design Principles and Modes of operation, Evaluation Criteria for AES, AES Cipher-Encryption and Decryption, Data Structure, Encryption Round.

Public Key Cryptography and Key Management: Principles of Public Key Cryptosystem, RSA algorithm, Key management, Diffie Hellman Key exchange.

Module-3

Message Authentication and Hash Function: Authentication Requirement, Authentication Functions, Message Authentication Code, Hash Functions, Digital Signatures, Digital Signature Standard.

Authentication Applications: Kerberos, X.509 Authentication Service

Module-4

Electronic Mail Security: Pretty Good Privacy (PGP), S/MIME

IP Security:IP Security Overview;IP Security Architecture; Authentication Header; Encapsulating SecurityPayload; Combining Security Associations; Key Management.

Module-5

Web Security: Web security Considerations; Secure Socket layer (SSL) and Transport layer Security (TLS); Secure Electronic Transaction (SET).

System Security: Intruders, Intrusion Detection, Firewall Design Principles- Characteristics, Types of Firewall and Firewall Configuration.

Question Paper Pattern:

- The Question paper will have TEN questions
- Each full question will be for 20 marks
- There will be 02 full questions (with maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting one full question from each module.

Text books

1. William Stallings, "Cryptography and Network Security – Principles and Practices", 4th Edition, Pearson Education, 2009. (Chapters: 1, 2.1-2.3, 3.1,3.2,3.5, 5.1,5.2, 6.2, 9.1,9.2, 10.1,10.2, 11.1- 11.4, 13.1, 13.3, 14.1, 4.2, 15.1, 15.2, 16.1-16.6, 17.1-17.3, 18.1, 18.2, 20.1; Exclude the topic not mentioned in the syllabus)

References

1. Behrouz A. Forouzan and DebdeepMukhopadhyay: "Cryptography and Network Security", 2nd Edition, Tata McGraw-Hill, 2010.
2. AtulKahate, "Cryptography and Network Security" 2nd Edition TMH.

Artificial Intelligence

Choice Based Credit System

Semester: II	CIE Marks:40
Course Code:20MCA262	SEE Marks:60
Contact Hours (L: T:P): 3:0:0	Exam Hours:03

Course Outcomes: at the end of the course students will be able to:

CO1: Identify problems that are amenable to solution by AI methods.

CO2: Identify appropriate AI methods to solve a given problem.

CO3: Formalize a given problem in the language/framework of different AI methods.

CO4: Implement basic AI algorithms for the given problem.

CO5: Design and carry out an empirical evaluation of different algorithms on a problem formalisation, and state the conclusions that the evaluation supports.

Module-1

INTRODUCTION TO Al AND PRODUCTION SYSTEMS

Introduction to AI-Problem formulation, Problem Definition -Production systems, Control strategies, Search strategies. Problem characteristics, Production system characteristics - Specialized productions system- Problem solving methods – Problem graphs, Matching, Indexing and Heuristic functions -Hill Climbing-Depth first and Breath first, Constraints satisfaction – Related algorithms, Measure of performance and analysis of search algorithms.

Module-2

REPRESENTATION OF KNOWLEDGE

Game playing – Knowledge representation, Knowledge representation using Predicate logic, Introduction to predicate calculus, Resolution, Use of predicate calculus, Knowledge representation using other logic-Structured representation of knowledge.

Module-3

KNOWLEDGE INFERENCE

Knowledge representation -Production based system, Frame based system. Inference – Backward chaining, Forward chaining, Rule value approach, Fuzzy reasoning – Certainty factors, Bayesian Theory-Bayesian Network-Dempster – Shafer theory.

Module-4

PLANNING AND MACHINE LEARNING

Basic plan generation systems – Strips -Advanced plan generation systems – K strips -

Strategic explanations -Why, Why not and how explanations. Learning- Machine learning, adaptive Learning.

Module-5

EXPERT SYSTEMS

Expert systems – Architecture of expert systems, Roles of expert systems – Knowledge Acquisition – Meta knowledge, Heuristics. Typical expert systems – MYCIN, DART, XOON, Expert systems shells.

Question Paper Pattern:

- The Question paper will have TEN questions
- Each full question will be for 20 marks
- There will be 02 full questions (with maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting one full question from each module.

Text books

1. Kevin Night and Elaine Rich, Nair B., "Artificial Intelligence (SIE)", Mc Graw Hill- 2008. (Units-I,II,VI & V)

2. Dan W. Patterson, "Introduction to AI and ES", Pearson Education, 2007. (Unit-III).

Reference books

1. Peter Jackson, "Introduction to Expert Systems", 3rd Edition, Pearson Education, 2007.

2. Stuart Russel and Peter Norvig "AI – A Modern Approach", 2nd Edition, Pearson Education 2007.

3. Deepak Khemani "Artificial Intelligence", Tata Mc Graw Hill Education 2013.

4. http://nptel.ac.in

Mobile Applications Development

Choice Based Credit System

Semester: II	CIE Marks:40
Course Code:20MCA263	SEE Marks:60
Contact Hours(L:T:P):3:0:0	Exam Hours:03

Course Outcomes:

CO1: Develop effective user interfaces that leverage evolving mobile devices

CO2: Develop applications using software development kits (SDKs), frameworks and toolkits. CO3: Implement suitable methods to integrate database and server-side technologies CO4: Design and develop open source software based mobile application to the given problem. CO5:Build and deploy competent mobile application to solve the societal/industrial problems.
Module-1
Introduction : Preliminary Considerations – Cost of Development – Importance of Mobile Strategies in the Business World – Effective use of Screen Real Estate – Understanding Mobile Applications: Understanding Mobile Applications Users – Understanding Mobile Information Design – Understanding Mobile Platforms – Using the Tools of Mobile Interface Design.
Module-2
Getting Started with Android Programming **What is Android – Obtaining the required tools– Anatomy of an Android Application – Components of Android Applications – Activities – Fragments – Utilizing the Action Bar**
Module-3
Android UI Design and Location Based Services **Views and View Groups – Basic Views – Fragments – Displaying Maps – Getting Location Data – Publishing for Publishing – Deploying APK Files**
Module-4
Android Messaging and Networking **SMS Messaging – Sending Email – Networking – Downloading Binary Data, Text files – Accessing Web Services – Performing Asynchronous Call – Creating your own services – Communicating between a service and an activity – Binding activities to services**
Module-5
Feedback and Oscillator Circuits **iOS – Obtaining the tools and SDK – Components of XCODE – Architecture of iOS – Building Derby App in iOS – Other useful iOS things – Windows Phone: Getting the tools you need – Windows Phone 7 Project** **Building Derby App in Windows Phone 7 – Distribution – Other useful Windows Phone Thing**
Question Paper Pattern: • The Question paper will have TEN questions • Each full question will be for 20 marks • There will be 02 full questions (with maximum of four sub questions) from each

module.

- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting one full question from each module.

Text books

1. **Jeff McWherter and Scott Gowell, "Professional Mobile Application Development", 1st Edition, 2012, ISBN: 978-1-118-20390-3**
2. **Wei-Meng Lee, "Beginning Android Application Development", Wiley 2011.**

References

1. Reto Meier, " Professional Android 4 Application Development ", Wrox Publications 2012.

Distributed Operating System

Choice Based Credit System

Semester: II	CIE Marks:40
Course Code:20MCA264	SEE Marks:60
Contact Hours(L:T:P):3:0:0	Exam Hours:03

Course Outcomes: At the end of the course, students will be able to:

CO1: Analyse design issues and different message passing techniques in DOS, distributed systems

CO2: Analyse RPC implementation and its performance in DOS

CO3: Analyse the major security issues associated with distributed systems and evaluate techniques available for increasing system security

CO3: Apply the concepts of distributed shared memory and resource management for the given problem/ case study.

CO4: Analyse distributed file systems and evaluate the performance in terms of fault tolerance, file replication as major factors

CO5:Apply modification to the existing algorithms to improve the performance of DOS.

Module-1

Fundamentals: What is Distributed Computing Systems? Evolution of Distributed Computing System; Distributed Computing System Models; What is Distributed Operating System? Issues in Designing a Distributed Operating System; Introduction to Distributed

ComputingEnvironment(DCE).**Message Passing:** Introduction, Desirable features of a Good Message Passing System, Issues in PC by Message Passing, Synchronization, Buffering, Multi-datagram Messages, Encoding and Decoding of Message Data, Process Addressing, Failure Handling, Group Communication, Case Study: 4.3 BSD UNIX IPC Mechanism.

Module-2

Remote Procedure Calls: Introduction, The RPC Model, Transparency of RPC, Implementing RPC Mechanism, Stub Generation, RPC Messages, Marshaling Arguments and Results, Server Management, Parameter-Passing Semantics, Call Semantics, Communication Protocols for RPCs, Complicated RPCs, Client-Server Binding, Exception Handling, Security, Some Special Types of RPCs, RPC in Heterogeneous Environments, Lightweight RPC, Optimization for Better Performance, Case Studies: Sun RPC.

Module-3

Distributed Shared Memory: Introduction, General Architecture of DSM systems, Design and Implementation Issues of DSM, Granularity, Structure of Shared Memory Space, Consistency Models, Replacement Strategy, Thrashing, Other approaches to DSM, Heterogeneous DSM, Advantages of DSM. Synchronization: Introduction, Clock Synchronization, Event Ordering, Mutual Exclusion, Dead Lock, Election Algorithms

Module-4

Resource Management: Introduction, Desirable Features of a Good Global Scheduling Algorithm, Task Assignment Approach, Load – Balancing Approach, Load – Sharing Approach **Process Management:** Introduction, Process Migration, Threads.

Module-5

Distributed File Systems: Introduction, Desirable Features of a Good Distributed File System, File models, File–Accessing Models, File – Sharing Semantics, File – Caching Schemes, File Replication, Fault Tolerance, Atomic Transactions and Design Principles.

Question Paper Pattern:

- The Question paper will have TEN questions
- Each full question will be for 20 marks
- There will be 02 full questions (with maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting one full question from each module.

Text books

1. Pradeep. K. Sinha: Distributed Operating Systems: Concepts and Design, PHI, 2007.

References

1. Andrew S. Tanenbaum: Distributed Operating Systems, Pearson Education, 2013.
2. Ajay D. Kshemkalyani and MukeshSinghal, Distributed Computing: Principles, Algorithms and Systems, Cambridge University Press, 2008
3. SunitaMahajan, Seema Shan, " Distributed Computing", Oxford University

Press,2015

Natural Language Processing

Choice Based Credit System

Semester:II	CIE Marks:40
Course Code:20MCA265	SEE Marks:60
Contact Hours(L:T:P):3:0:0	Exam Hours:03

Course Outcomes:

CO1: Apply parsing technique to the given problem and verify the output and give valid conclusions

CO1: Illustrate the approaches to syntax and semantics in NLP.

CO3: Formulate solutions for a range of natural language components using existing algorithms, techniques and frameworks, including part-of-speech tagging, language modelling, parsing and semantic role labelling.

CO4. Evaluate NLP solutions of the given problem and arrive at valid conclusions.

CO5: Illustrate information retrieval techniques.

Module-1

Introduction, Morphology: Knowledge in Speech & Lang Processing, Ambiguity, Models & Algorithms, Language, Thought & Understanding, Some Brief History, The State of the Art & Near-Term Future, Summary Morphology and Finite State Transducers: Survey of English Morphology, Finite state Morphological Parsing, Lexicon-Free FST: The Porter Stemmer, Human Morphological Parsing, Summary, Combining FST Lexicon and Rules.

Module-2

N-Grams: Counting Words in Corpora, Simple N-Grams, Smoothing, Back off, Deleted Interpolation, N-Grams for Spelling and Pronunciation, Entropy, Summary. Word Classes and Part-of- Speech Tagging: English Word Classes, Tag sets for English, Part-of-Speech Tagging.

Module-3

Context-Free Grammars and Predicate Calculus for English: Constituency, Context-Free Rules and Trees, Sentence Level Constructions, Coordination, Agreement, The Verb Phrase Sub Categorization, Auxiliaries, Spoken Language Syntax, Grammar Equivalence and Normal Form, Finite –State and Context- Free Grammars, Grammars and Human Processing, The Early Algorithm, Finite-State Parsing Method, Summary Representing Meaning:

Module-4

Semantic Analysis: Syntax-Driven Semantic Analysis, Attachments for a Fragment of English, Integrating Semantic Analysis into the Earley Parser, Idioms and Compositionality,

Robust Semantic Analysis, Summary. Lexical Semantics: Relations Among Lexemes and Their Senses, WordNet: A Database of Lexical Relations, The Internal Structure of Words, Creativity and the Lexicon, Summary Word Sense Disambiguation and Information

Module-5

Retrieval: Selection Restriction Based Disambiguation, Robust Word Sense Disambiguation, Information Retrieval, Other Retrieval Tasks, and Summary. Case Study of Simple Text Recognition or Content Based Text Extraction System. Evolving Explanatory Novel Patterns for Semantically-Based Text Mining: Related Work, A Semantically Guided Model for Effective Text Mining.

Question Paper Pattern:

- The Question paper will have TEN questions
- Each full question will be for 20 marks
- There will be 02 full questions (with maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting one full question from each module.

Text books

1.DanielJurafsky and James H Martin, "Speech and Language Processing: An introduction to Natural Language Processing, Computational Linguistics and Speech Recognition", 2nd Edition, Prentice Hall, 2009.

References

1. Christopher D.Manning and HinrichSchutze, "Foundations of Statistical Natural LanguageProcessing", MIT Press, 1999.

2.TanveerSiddiqui, U.S. Tiwary, "Natural Language Processing and Information Retrieval", Oxford University Press, 2008.

3.Anne Kao and Stephen R. Poteet (Eds), "Natural Language Processing and Text Mining", Springer Verlag London Limited 2007.

DataBase Management Systems Laboratory

Choice Based Credit System

Semester: II	CIE Marks:40
Course Code:20MCA27	SEE Marks :60
Contact Hours (L:T:P):0:0:4	Exam Hours:03

Course Outcomes: at the end of the course students will be able to

CO1: Design entity-relationship diagrams to solve given database applications

CO2: Implement a database schema for a given problem.

CO3: Formulate SQL queries in Oracle for the given problem.

CO4: Apply normalization techniques to improve the database design for the given problem.

CO5: Build database and verify for its appropriate normalization for any given problem

Instructions for the Exercises:

1. Draw ER diagram based on given scenario with various Constraints.

2. Create Relational Database Schema based on the scenario using Mapping Rules.

3. Perform the given queries using any RDBMS Environment.

4. Suitable tuples have to be entered so that queries are executed correctly.

5. The results of the queries may be displayed directly.

1. Create the following tables with properly specifying Primary keys, Foreign keys and solve the following queries.

BRANCH (Branchid, Branchname, HOD)

STUDENT (USN, Name, Address, Branchid, sem)

BOOK (Bookid, Bookname, Authorid, Publisher, Branchid)

AUTHOR (Authorid, Authorname, Country, age)

BORROW (USN, Bookid, Borrowed_Date)

Execute the following Queries:

i.List the details of Students who are all studying in 2nd sem MCA.

ii.List the students who are not borrowed any books.

iii.Display the USN, Student name, Branch_name, Book_name, Author_name, Books_Borrowed_Date of 2nd sem MCA Students who borrowed books.

iv.Display the number of books written by each Author.

v.Display the student details who borrowed more than two books.

vi.Display the student details who borrowed books of more than one Author.

vii.Display the Book names in descending order of their names.

viii.List the details of students who borrowed the books which are all published by the same publisher.

2. Consider the following schema:

STUDENT (USN, name, date_of_birth, branch, mark1, mark2, mark3, total, GPA)

Execute the following queries:

i. Update the column total by adding the columns mark1, mark2, mark3.

ii. Find the GPA score of all the students.

iii. Find the students who born on a particular year of birth from the date_of_birth column.

iv. List the students who are studying in a particular branch of study.

v. Find the maximum GPA score of the student branch-wise.

vi. Find the students whose name starts with the alphabet "S".

vii. Find the students whose name ends with the alphabets "AR".

viii. Delete the student details whose USN is given as 1001.

3. Design an ER-diagram for the following scenario, Convert the same into a relational model and then solve the following queries.

Consider a Cricket Tournament "ABC CUP" organized by an organization. In the tournament there are many teams are contesting each having a Teamid,Team_Name, City, a coach. Each team is uniquely identified by using Teamid. A team can have many Players and a captain. Each player is uniquely identified by Playerid, having a Name, and multiple phone numbers,age. A player represents only one team. There are many Stadiums to conduct matches. Each stadium is identified using Stadiumid, having a stadium_name,Address (involves city,area_name,pincode). A team can play many matches. Each match played between the two teams in the scheduled date and time in the predefined Stadium. Each match is identified uniquely by using Matchid. Each match won by any of the one team that also wants to record in the database. For each match man_of_the match award given to a player.

Execute the following Queries:

i. Display the youngest player (in terms of age) Name, Team name, age in which he belongs of the tournament.

ii. List the details of the stadium where the maximum number of matches were played.

iii. List the details of the player who is not a captain but got the man_of _match award at least in two matches.

iv. Display the Team details who won the maximum matches.

v. Display the team name where all its won matches played in the same stadium.

4. Design an ER-diagram for the following scenario, Convert the same into a relational model, normalize Relations into a suitable Normal form and then solve the following queries. A country can have many Tourist places . Each Tourist place is identified by using tourist_place_id, having a name, belongs to a state, Number of kilometers away from the

capital city of that state,history. There are many Tourists visits tourist places every year. Each tourist is identified uniquely by using Tourist_id, having a Name, age, Country and multiple emailids. A tourist visits many Tourist places, it is also required to record the visted_date in the database. A tourist can visit a Tourist place many times at different dates. A Tourist place can be visited by many tourists either in the same date or at different dates.

Queries:

i. List the state name which is having maximum number of tourist places.

ii. List details of Tourist place where maximum number of tourists visited.

iii. List the details of tourists visited all tourist places of the state "KARNATAKA".

iv. Display the details of the tourists visited at least one tourist place of the state, but visited all states tourist places.

v. Display the details of the tourist place visited by the tourists of all country.

5. A country wants to conduct an election for the parliament. A country having many constituencies. Each constituency is identified uniquely by Constituency_id, having the Name, belongs to a state,Number_of_voters. A constituency can have many voters. Each voter is uniquely identified by using Voter_id, having the Name, age, address (involves Houseno,city,state,pincode). Each voter belongs to only one constituency. There are many candidates contesting in the election. Each candidates are uniquely identified by using candidate_id, having Name, phone_no, age, state. A candidate belongs to only one party.Thereare many parties. Each party is uniquely identified by using Party_id, having Party_Name,Party_symbol. A candidate can contest from many constituencies under a same party. A party can have many candidates contesting from different constituencies. No constituency having the candidates from the same party. A constituency can have many contesting candidates belongs to different parties. Each voter votes only one candidate of his/her constituencty.

Queries:

i. List the details of the candidates who are contesting from more than one constituencies

which are belongs to different states.

ii. Display the state name having maximum number of constituencies.

iii. Create a stored procedure to insert the tuple into the voter table by checking the voter age. If voter's age is at least 18 years old, then insert the tuple into the voter else display the "Not an eligible voter msg" .

iv. Create a stored procedure to display the number_of_voters in the specified constituency. Where the constituency name is passed as an argument to the stored procedure.

v. Create a TRIGGER to UPDATE the count of " Number_of_voters" of the respective

constituency in "CONSTITUENCY" table , AFTER inserting a tuple into the "VOTERS" table.

Java Programming Lab Choice Based Credit System	
Semester:II	CIE Marks:40
Course Code:20MCA28	SEE Marks:60
Contact Hours (L: T:P):0:0:4	Exam Hours:03

Course Outcomes: at the end of the course the students will be able to

CO1: Demonstrate the fundamental data types and constructs of Java Programming by writing executable/interpretable programs.

CO2: Illustrate the object oriented principles with the help of java programs.

CO3: Develop reusable and efficient applications using inheritance and multi-threading concepts of java.

CO4: Apply client-side programming and networking concepts to develop distributed applications.

CO5: Write java programs to demonstrate the concepts of interfaces, inner classes and I/O streams.

1. Write a JAVA program to demonstrate Constructor Overloading and Method Overloading.

2. Write a JAVA program to implement Inner class and demonstrate its Access protection.

3. Write a program in Java for String handling which performs the following:
   a. Checks the capacity of String Buffer objects.
   b. Reverses the contents of a string given on console and converts the resultant string in upper case.
   c. Reads a string from console and appends it to the resultant string of (ii).

4. Write a JAVA program to demonstrate Inheritance.

Simple Program on Java for the implementation of Multiple inheritance using interfaces to calculate the area of a rectangle and triangle.

5. Write a JAVA program which has:
   a. A Class called Account that creates account with Rs. 500 minimum balance, a deposit() method to deposit amount, a withdraw() method to withdraw amount and also throws LessBalanceException if an account holder tries to withdraw money which makes the balance become less than Rs. 500.
   b. A Class called Less_Balance_Exception which returns the statement that says withdraw amount (Rs.) is not valid.
   c. A Class which creates 2 accounts, both account deposit money and one account tries to withdraw more money which generates a Less Balance Exception take appropriate action for the same.

6. Write a JAVA program using Synchronized Threads, which demonstrates Producer Consumer concept.

7. Write a JAVA program to implement a Queue using user defined Exception Handling (also make use of throw, throws).
   a. Complete the following:
   b. Create a package named shape.
   c. Create some classes in the package representing some common shapes like Square, Triangle, and Circle.
   d. Import and compile these classes in other program.
8. Write a JAVA program to create an enumeration Day of Week with seven values SUNDAY through SATURDAY. Add a method isWorkday() to the DayofWeek class that returns true if the value on which it is called is MONDAY through FRIDAY. For example, the call DayOfWeek.SUNDAY.isWorkDay () returns false.
9. Write a JAVA program which has:
   a. An Interface class for Stack Operations
   b. A Class that implements the Stack Interface and creates a fixed length Stack.
   c. A Class that implements the Stack Interface and creates a Dynamic length Stack.
   d. A Class that uses both the above Stacks through Interface reference and does the Stack
   e. Operations that demonstrates the runtime binding.
10. Write a JAVA program which uses FileInputStream / FileOutPutStream Classes.
11. Write JAVA programs which demonstrate utilities of Linked List Class.

Web Technologies Laboratory **Choice Based Credit System**	
Semester: II	CIE Marks:40
Course Code:20MCA29	SEE Mark :60
Contact Hours(L:T:P) 0:0:4	Exam Hours:03

Course Outcomes: at the end of the course students will be able to

CO1: Apply the concept and usages web based programming techniques.

CO2: Learning and Developing XHTML documents using JavaScript and CSS.

CO3: To be familiar in the use of CGI and Perl programs for different types of server side applications.

CO4: Design and implement user interactive dynamic web based applications.

CO5: Evaluate the given wed application and enhance it using latest web technologies.

Part - A

1.Create an XHTML page that provides information about your department. Your XHTML page must use the following tags:

a) Text Formatting tags

b) Horizontal rule

c) Meta element

d) Links

e) Images

f) Tables (Use of additional tags encouraged).

2.Develop and demonstrate the usage of inline, external and internal style sheet using CSS. Use XHTML page that contains at least three paragraphs of text, listed elements and a table with four rows and four columns.

3.Develop and demonstrate a XHTML file that includes Javascript script for the following problems: a) Input : A number n obtained using prompt Output : The first n Fibonacci numbers b) Input : A number n obtained using prompt Output : A table of numbers from 1 to n and their squares using alert

4.Develop, test and validate an XHTML document that has checkboxes for apple (59 cents each), orange (49 cents each), and banana (39 cents each) along with submit button. Each check boxes should have its own onclick event handler. These handlers must add the cost of their fruit to a total cost. An event handler for the submit button must produce an alert window with the message 'your total cost is $xxx', where xxx is the total cost of the chose fruit, including 5 percent sales tax. This handler must return 'false' (to avoid actual submission of the form data). Modify the document to accept quantity for each item using textboxes.

5. a) Develop and demonstrate, a HTML document that collects the USN (the valid format is : A digit from 1 to 4 followed by two upper-case characters followed by two digits followed by three upper-case characters followed by two digits; (no embedded spaces are allowed) from the user. Use JavaScript that validate the content of the document. Suitable messages should be display in the alert if errors are detected in the input data. Use CSS and event handlers to make your document appealing.b) Modify the above program to get the current semester also(restricted to be a number from 1 to 6)

6. Develop and demonstrate a HTML file which includes JavaScript that uses functions for the following problems:

a. Parameter: A string Output: The position in the string of the left-most vowel. b. Parameter: A number Output: The number with its digits in the reverse order.

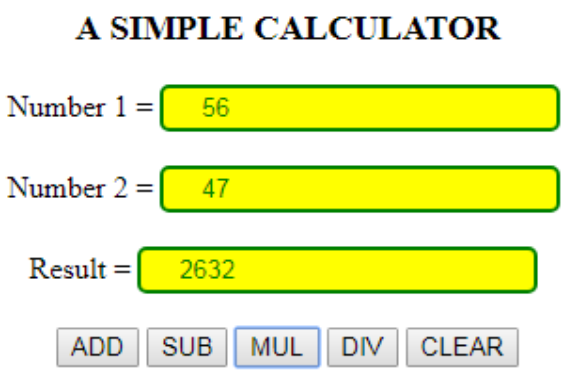
7.Develop and demonstrate a HTML5 page which contains

a) Dynamic Progressive bar.

b) Display Video file using HTML5 video tag.

8.Develop and demonstrate, using JavaScript script, a XHTML document that contains three short paragraphs of text, stacked on top of each other, with only enough of each showing so that the mouse cursor can be placed over some part of them. When the cursor is placed over the exposed part of any paragraph, it should rise to the top to become completely visible. Modify the above document so that when a text is moved from the top stacking position, it returns to its original position rather than to the bottom.

9.Develop a simple calculator to perform arithmetic (addition, subtraction, multiplication and division) operations on given two numbers. Use an HTML tag that allows the user to input two numbers and to display the result of arithmetic operation. Write suitable HTML and JavaScript and CSS to your simple calculator. The following figure show sample document display.



10.Develop and demonstrate using jQuery to solve the following:

a) Limit character input in the text area including count.

b) Based on check box, disable/enable the form submit button.

11.Develop and demonstrate using jQuery to solve the following:

a) Fade in and fade out all division elements.

b) Animate an element, by changing its height and width.

Part-B

Develop a web application (mini-project) using the languages and concepts learnt in the theory and exercises listed in part A with a good look and feel effects. Database connection needs to be implemented.

Note:

1. A team of two students must develop the mini project. However during the examination, each student must demonstrate the project individually.

2. Each students has to execute one program picked from Part-A during the semester end examination.
3. The team must submit a brief project report (20-25 pages) that must include the following

   a. Introduction b. Requirement Analysis c Software Requirement Specification

   d. Analysis and Design, e. Implementation f. Testing

4. Brief synopsis not more than two pages to be submitted by the team as per the format given. It was recommended that students to do prior art search as part of literature survey before submitting the synopsis for the Mini/Major projects.
5. Rubrics may be used to evaluate the Mini-Project.

Data Analytics using Python	
Semester: III	CIE Marks : 40
Subject Code : 20MCA31	SEE Marks : 60
Contact Hours(L:P:T) : 4-0-0	Exam Hours : 03

Course Outcomes:

- CO1: Demonstrate basic data analytics principles and techniques
- CO2: Apply control structures the concepts of inheritance and overloading for a given problem.
- CO3: Perform essential operations using Numpy and Pandas
- CO4: Structuring the data in the dataset for a given problem.
- CO5: Demonstrate the concepts of data visualization.

Module 1 : Python Basic Concepts and Programming

Keywords, Statements and Expressions, Variables, Operators, Precedence and Associativity, Data Types, Indentation, Comments, Reading Input, Print Output, Type Conversions, The type( ) Function and Is Operator, Control Flow Statements, The if Decision Control Flow Statement, The if…else Decision Control Flow Statement, The if…elif…else Decision Control Statement, Nested if Statement, The while Loop, The for Loop, The continue and break Statements, Built-In Functions, Commonly Used Modules, Function Definition and Calling the Function, The return Statement and void Function, Scope and Lifetime of Variables, Default Parameters, Keyword Arguments, *args and **kwargs, Command Line Arguments.

Module 2: Python Collection Objects, Classes

Strings- Creating and Storing Strings, Basic String Operations, Accessing Characters in String by Index Number, String Slicing and Joining, String Methods, Formatting Strings, Lists-Creating Lists, Basic List Operations, Indexing and Slicing in Lists, Built-In Functions Used on Lists, List Methods. Sets, Tuples and Dictionaries. Files: reading and writing files. Class Definition – Constructors – Inheritance – Overloading

Module 3: Introduction to Numpy and Pandas

Numpy:-Understanding datatypes in python, basics of NumPy arrays, computation on NumPy arrays: universal functions. (*refer chapter 2 from python datascience handbook)*

Pandas:-Introducing to pandas data structures, essential functionality, summarizing and computing descriptive statistics, handling missing data. (*refer chapter 5 from python for data Analysis*)

Module 4: Data Loading and Data Wrangling

Reading and writing data in text format, interacting with databases, combining and merging data sets, reshaping and pivoting, data transformation, string manipulation (*refer chapter 6 and 7 from python for data Analysis*

Module 5: Visualization with Matplotlib and Seaborn

General Matplotlib tips, simple line plots, simple scatter plots, visualizing errors, density and contour plots, histograms, binning, and density, customizing plot legends and colorbars, customizing matplotlib, visualization with seaborn.

(*refer chapter 4 from python datascience handbook)*

Text Books:

1. Allen B. Downey, “Think Python: How to Think Like a Computer Scientist‘‘, 2nd edition,Updated for Python 3, Shroff/O‘Reilly Publishers, 2016 (http://greenteapress.com/wp/thinkpython/)
2. Mark Lutz, “Programming Python”, O'Reilly Media, 4th edition, 2010.
3. Jake Vander plas, “Python Data Science Handbook: Essential tools for working with data”, O‘Reilly Publishers, I Edition.
4. Wes Mc Kinney, “Python for Data Analysis”, O'Reilly Media, 2012Mark Lutz, “Programming Python”, O'Reilly Media, 4th edition, 2010.

Reference books:

1. Tim Hall and J-P Stacey, “Python 3 for Absolute Beginners”, Apress, 1st edition, 2009.
2. Magnus Lie Hetland, “Beginning Python: From Novice to Professional”, Apress, Second Edition, 2005.
3. Shai Vaingast, “Beginning Python Visualization Crafting Visual Transformation Scripts”, Apress, 2nd edition, 2014.

Internet of Things

Choice Based Credit System

Semester: III	CIE Marks:40
Subject Code:20MCA32	SEE Marks:60
Contact Hours(L:T:P):4:0:0	Exam Hours:03

CO**1:** Analyse the IoT architecture and design along with functional/compute stack and data management.

CO**2:** Apply IOT architecture for a given problem

CO**3:** Analyse the application protocol, transport layer methods for the given business case.

CO**4:** Analyse the application of data analytics for IOT for a given

CO5: Analyse the architecture and develop programming using modern tools for the given use case

Module-1

What is IoT, Genesis of IoT, IoT and Digitization, IoT Impact, Convergence of IT and IoT, IoT Challenges, IoT Network Architecture and Design, Drivers Behind New Network Architectures, Comparing IoT Architectures, A Simplified IoT Architecture, The Core IoT Functional Stack, IoT Data Management and Compute Stack

Module-2

Smart Objects: The "Things" in IoT, Sensors, Actuators, and Smart Objects, Sensor Networks, Connecting Smart Objects, Communications Criteria, IoT Access Technologies.

Module-3

IP as the IoT Network Layer, The Business Case for IP, The need for Optimization, Optimizing IP for IoT, Profiles and Compliances, Application Protocols for IoT, The Transport Layer, IoT Application Transport Methods.

Module-4

Data and Analytics for IoT, An Introduction to Data Analytics for IoT, Machine Learning, Big Data Analytics Tools and Technology, Edge Streaming Analytics, Network Analytics, Securing IoT, A Brief History of OT Security, Common Challenges in OT Security, How IT and OT Security Practices and Systems Vary, Formal Risk Analysis Structures: OCTAVE and FAIR, The Phased Application of Security in an Operational Environment

Module-5

IoT Physical Devices and Endpoints - Arduino UNO: Introduction to Arduino, Arduino UNO, Installing the Software, Fundamentals of Arduino Programming. IoT Physical Devices and Endpoints - RaspberryPi: Introduction to RaspberryPi, About the RaspberryPi Board: Hardware Layout, Operating Systems on RaspberryPi, Configuring RaspberryPi, Programming

RaspberryPi with Python, Wireless Temperature Monitoring System Using Pi, DS18B20 Temperature Sensor, Connecting Raspberry Pi via SSH, Accessing Temperature from DS18B20 sensors, Remote access to RaspberryPi, Smart and Connected Cities, An IoT Strategy for Smarter Cities, Smart City IoT Architecture,Smart City Security Architecture, Smart City Use-Case Examples.

Question Paper Pattern:

- The Question paper will have TEN questions
- Each full question will be for 20 marks
- There will be 02 full questions (with maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting one full question from each module.

Textbooks

1.David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry,"IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the 2. Internet of Things", 1stEdition, Pearson Education (Cisco Press Indian Reprint). (ISBN: 9789386873743) 2. Srinivasa K G, "Internet of Things",CENGAGE Leaning India, 2017

References

1.Vijay Madisetti and ArshdeepBahga, "Internet of Things (A Hands-on-Approach)", 1stEdition, VPT, 2014. (ISBN: 978-8173719547)

2. Raj Kamal, "Internet of Things: Architecture and Design Principles", 1st Edition, McGraw Hill Education, 2017. (ISBN: 978-9352605224)

Advances in Java

Choice Based Credit System

Semester: III	CIE Marks:40
Subject Code:20MCA33	SEE Exam:60
Contact Hours(L:T:P):4:0:0	Exam Hours:03

Course Outcomes:

CO1: Apply the concept of Servlet and its life cycle to create web application.

CO2: Apply JSP tags and its services to web application.

CO3: Create packages and interfaces in the web application context.

CO4: Build Database connection for the web applications.

CO5: Develop enterprise applications using Java Beans concepts for the given problem.

Module-1

Servlet Structure, Servlet packaging, HTML Building utilities, Lifecycle, Single Thread Model Interface, Handling Client request: Form Data, HTTP Request Headers.

Generating Server Response: HTTP Status Codes, HTTP Response Headers, Handling Cookies, Session Tracking.

Module-2

Introduction to JSP:

Overview of JSP: JSP Technology, Need of JSP, Benefits of JSP, Advantages of JSP, Basic Syntax, Invoking Java code with JSP Scripting Elements, Creating Template Text, Invoking Java Code form JSP, Limiting Java Code in JSP, Using JSP Expressions, Comparing Servlets And JSP, Writing Scriptlets. For Example: Using Scriplets to make parts of JSP Conditional, Using declarations, Declaration Examples.

Module-3

Controlling the structure, Structure of generated Servlets and Java Beans, Controlling the structure of generated Servlets: The JSP Page directive, Import Attribute, Session Attribute, isElignore attribute, Buffer and Autoflush Attribute, Info Attribute, errorPage, and iserrorPage Attributes, isThreadSafe Attribute, extends Attribute, language Attribute, Including Files and Applets in JSP Pages using Java Beans components in JSP documents.

JAR File, Manifest file, Working with Java Beans. Introspection, Customisers, Bean Properties: Simple properties, Design pattern events, Creating bound properties, Bean Methods, Beaninfo class, Persistence.

Module-4

Annotations and JDBC

Annotations: Built-in Annotations with examples, Custom Annotation. Talking to Database, Immediate Solutions, Essentials JDBC program, using prepared statement object, and Interactive SQL tool. JDBC in Action Result sets, Batch updates, Mapping, Basic JDBC data types, Advanced JDBC data types, immediate solutions.

Module-5

EJB and Server Side Components Models

Introduction to EJB: The Problem domain, Breakup responsibilities, Code Smart not hard, the enterprise java bean specification, Components Types.

Server Side Component Types: session Beans, MessageDriven Beans, Entity Beans, The Java Persistence Model. Container services: Dependency Injection, Concurrency, Instance pooling n caching, Transactions, security, Timers, Naming and object stores, Interoperability, Life Cycle Callbacks, Interceptors, platform integration. Developing your first EJB, Models: The Stateless Session Bean, The Stateful Session Bean, the Singleton Session Bean, Message-Driven Beans. EJB and Persistence. Persistence Entity Manager Mapping persistence objects, Entity Relationships.

Question Paper Pattern:

- The Question paper will have TEN questions
- Each full question will be for 20 marks
- There will be 02 full questions (with maximum of four sub questions) from each module.

- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting one full question from each module.

TextBooks

1. Marty Hall,Larry Brown Core Servlets and Java server pages. Vol 1: Core Technologies. 2nd Edition. (Chapter 3,4,5,6,7,8,9,10,11,12,13,14)

2. Java 6 Programming Black Book, Dreamtech press 2012(Chapter 17,18,19,20,21,22,27,28,29,30)

3. Andrew LeeRubinger, Bill Burke. Development Enterprise Java Components. Enterprise JavaBeans 3.1. O'reilly (Chapters 1,2,3,4,5,6,7,8,9,10,11)

References

1. Michel Siklora, EJB 3 Developer Guide, A Practical Guide For Developers And Architects to the Enterprise Java Beans Standard,Shroff Publishers and Distributers Private Limited July2008.

2. Herbert Schildt The Java Complete Reference, 8th Edition, Comprehensive coverage of the Java Language, Tata Mc Graw Hill Edition

Block Chain Technology

Choice Based Credit System(CBCS)

Semester: III	**CIE Marks:40**
Course Code:20MCA341	**SEE Marks:60**
Contact Periods (L:T:P):3-0-0	**Exam Hours:03**

Course Out Comes:

CO1: Demonstrate the basics of Block chain concepts using modern tools/technologies.
CO2: Analyze the role of block chain applications in different domains including cybersecurity.
CO3: Evaluate the usage of Block chain implementation/features for the given problem.
CO4: Exemplify the usage of bitcoins and its impact on the economy.
CO5: Analyze the application of specific block chain architecture for a given problem

Module-1

Introduction to Blockchain, How Blockchain works, Blockchain vs Bitcoin, Practical applications, public and private key basics, pros and cons of Blockchain, Myths about Bitcoin.

Module-2

Blockchain :Architecture , versions ,variants , use cases, Life use cases of blockchain, Blockchain vs shared Database, Introduction to cryptocurrencies, Types, Applications.

Module-3

Concept of Double Spending, Hashing, Mining, Proof of work.
Introduction to Merkel tree, Privacy , payment verification , Resolving Conflicts , Creation of Blocks

Module-4
Introduction to Bitcoin, key concepts of Bitcoin, Merits and De Merits Fork and Segwits, Sending and Receiving bitcoins, choosing bitcoin wallet, Converting Bitcoins to Fiat Currency.
Module-5
Introduction to Ethereum, Advantages and Disadvantages, Ethereum vs Bitcoin, Introduction to Smart contracts, usage, application, working principle , Law and Regulations. Case Study.
Question Paper Pattern: • The Question paper will have TEN questions • Each full question will be for 20 marks • There will be 02 full questions (with maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer FIVE full questions, selecting one full question from each module.
Textbooks
1. Beginning Blockchain: A Beginner's Guide to Building Blockchain Solutions by ArshdeepBikramaditya Signal, GautamDhameja (PriyansuSekhar Panda., APress. 2. Blockchain Applications: A Hands-On Approach by Bahga, Vijay Madisetti 3. Blockchain by Melanie Swan, OReilly
References
1. Bitcoin and Cryptocurrency Technologies by Aravind Narayan. Joseph Bonneau, princton 2. Bitcoin and Blockchain Basics: A non-technical introduction for beginners by Arthu.T Books.

Cloud Computing

Choice Based Credit System(CBCS)

Semester: III	**CIE Marks:40**
Course Code:20MCA342	**SEE Marks:60**
Contact Periods (L:T:P):3-0-0	**Exam Hours:03**

Course Outcomes:

CO1: Demonstrate the system & software models and mechanisms that support cloud computing

CO2: Classify various cloud services and their providers

CO3: Compare various cloud deployment models

CO4: Differentiate various types of computing environments

CO5: Identify enabling technologies of cloud computing.

Module-1
Introduction to Cloud Computing: Eras of computing, The vision of Cloud Computing, Defining a cloud, A closer look, Cloud computing reference model, Historical developments: Distributed systems, Virtualization, Web 2.0; Service oriented computing; Utility oriented computing.
Module-2
Architectures for parallel and distributed computing: Parallel Vs Distributed computing, Elements of distributed computing, Technologies for distributed computing.
Module-3
Virtualization: Introduction, Characteristics of virtualized environments, Taxonomy of virtualization techniques, Virtualization and cloud computing, Pros and cons of virtualization, Technology examples: Xen: Para virtualization, VmWare: Full virtualization, Microsoft Hyper – V.
Module-4
Cloud computing architecture: Introduction, Cloud reference model: Architecture, IaaS, PaaS, SaaS, Types of Clouds: Public, Private, Hybrid and Community clouds, Economics of the cloud, Open challenges.
Module-5
Cloud Tools and Applications: Aneka PaaS; Open stack: Introduction to open stack; Components of open stack; Amazon web services; Google AppEngine; Microsoft Azure; Scientific applications: Healthcare; Biology; Geo-Science, Business and Consumer applications: ARM & ERP; Productivity; Social networking.
Question Paper Pattern: • The Question paper will have TEN questions • Each full question will be for 20 marks • There will be 02 full questions (with maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer FIVE full questions, selecting one full question from each module.
Textbooks
1. RjkumarBuyya, Christian Vecchiola, and ThamaraiSelci, Mastering Cloud Computing, Tata McGraw Hill, New Delhi, India, 2013.
References
1. Cloud Computing for Dummies by Judith Hurwitz, R.Bloor, M. Kanfman, F.Halper (Wiley India Edition) 2. Cloud Computing: A Practical Approach by J.Vette, Toby J. Vette, Robert Elsenpeter (Tata McGraw Hill)

Digital Marketing

Choice Based Credit System(CBCS)

Semester: III	**CIE Marks:40**
Course Code:20MCA343	**SEE Marks:60**
Contact Periods (L:T:P):3-0-0	**Exam Hours:03**

Course Outcomes:

CO1: Demonstrate the key concepts related to e-marketing for the given case.

CO2: Demonstrate the use of different electronic media for designing marketing activities.

CO3: Analyze the role of search engine in improving digital marketing

CO4: Analyze role of social media marketing for the given problem

CO5: Analyze technical solutions to overcome social media threats

Module-1

Introduction to Digital Marketing Evolution of Digital Marketing from traditional to modern era, Role of Internet; Current trends, Info-graphics, implications for business & society; Emergence of digital marketing as a tool; Drivers of the new marketing environment; Digital marketing strategy; P.O.E.M. framework, Digital landscape, Digital marketing plan, Digital marketing models.

Module-2

Internet Marketing and Digital Marketing Mix – Internet Marketing, opportunities and challenges; Digital marketing framework; Digital Marketing mix, Impact of digital channels on IMC; Search Engine Advertising: - Pay for Search Advertisements, Ad Placement, Ad Ranks, Creating Ad Campaigns, Campaign Report Generation Display marketing: - Types of Display Ads - Buying Models - Programmable Digital Marketing - Analytical Tools - YouTube marketing.

Module-3

Social Media Marketing – Role of Influencer Marketing, Tools & Plan– Introduction to social media platforms, penetration & characteristics; Building a successful social media marketing strategy Facebook Marketing: - Business through Facebook Marketing, Creating Advertising Campaigns, Adverts, Facebook Marketing Tools Linkedin Marketing: - Introduction and Importance of Linkedin Marketing, Framing Linkedin Strategy, Lead Generation through Linkedin, Content Strategy, Analytics and Targeting Twitter Marketing: - Introduction to Twitter Marketing, how twitter Marketing is different than other forms of digital marketing, framing content strategy, Twitter Advertising Campaigns Instagram and Snapchat: - Digital Marketing Strategies through Instagram and Snapchat Mobile Marketing: - Mobile Advertising, Forms of Mobile Marketing, Features, Mobile Campaign Development, Mobile Advertising Analytics Introduction to social media metrics

Module-4

Introduction to SEO, SEM, Web Analytics, Mobile Marketing, Trends in Digital Advertising– - Introduction and need for SEO, How to use internet & search engines; search engine and its working pattern, On-page and off-page optimization, SEO Tactics - Introduction to SEM Web Analytics: - Google Analytics & Google AdWords; data collection for web analytics, multichannel attribution, Universal analytics, Tracking code Trends in digital advertising

Module-5

Social Media Channels: Introduction, Key terms and concepts, Traditional media vs Social media. Social media channels: Social networking. Content creation, Bookmarking & aggregating and

Location & social media. Tracking social media campaigns. Social media marketing: Rules of engagement. Advantages and challenges.

Social Media Strategy: Introduction, Key terms and concepts. Using social media to solve business challenges. Step-by-step guide to creating a social media strategy. Documents and processes. Dealing with opportunities and threats. Step-by-step guide for recovering from an online brand attack. Social media risks and challenges

Question Paper Pattern:

- The Question paper will have TEN questions
- Each full question will be for 20 marks
- There will be 02 full questions (with maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting one full question from each module.

Textbooks

1. Seema Gupta "Digital Marketing" Mc-Graw Hill 1st Edition – 2017

References

1. Ian Dodson "The Art of Digital Marketing" Wiley Latest Edition
2. Puneet Singh Bhatia "Fundamentals of Digital Marketing" Pearson 1st Edition – 2017
3. Prof. Nitin C. Kamat, Mr.Chinmay Nitin Kamat Digital Social Media Marketing Himalaya Publishing House Pvt. Ltd. Latest Edition

Software Testing

Choice Based Credit System(CBCS)

Semester: III	**CIE Marks:40**
Course Code:20MCA344	**SEE Marks:60**
Contact Periods (L:T:P):3-0-0	**Exam Hours:03**

Course Outcomes:

CO1: Acquire knowledge of basic principles and knowledge of software testing and debugging and test cases.

CO2: Will be able to understand the perceptions on testing like levels of testing, generalized pseudo code and with related examples.

CO3: To study the various types of testing.

CO4: Differentiate between functional testing and structural testing.

CO5: Analyze the performance of fault based testing, planning and Monitoring the process, Documentation testing.

Module-1

Basics of Software Testing, Basic Principles, Test case selection and Adequacy

Humans, Errors and Testing, Software Quality; Requirements, Behavior and Correctness, Correctness Vs Reliability; Testing and Debugging; Test Metrics; Software and Hardware Testing; Testing and Verification; Defect Management; Execution History; Test Generation Strategies; Static Testing; Test Generation from Predicates. Sensitivity, Redundancy, Restriction, Partition, Visibility and Feedback, Test Specification and cases, Adequacy Criteria, Comparing

Criteria
Module-2
A perspective on Testing Basic definitions, Test cases, Insights from a Venn diagram, Identifying test cases, Error and fault taxonomies, Level of testing, Examples: Generalized pseudo code, The triangle problem, the Next Date function, The commission problem, The SATM (Simple Automation Teller Machine) problem, The currency converter, Saturn windshield wiper
Module-3
Boundary value testing, Equivalence class testing, Decision table based testing Boundary value analysis, Robustness testing, Worst-case testing, special value testing, Examples, Random testing, Equivalence classes, Equivalence test cases for triangle problem, Next Date function and commission problem, Guidelines and observations, Decision tables, Test cases for triangle problem
Module-4
Path Testing, Data flow testing, Levels of Testing, Integration Testing DD Paths, Test coverage metrics, Basis path testing, guidelines and observations, Definition Use testing, Slice based testing, Guidelines and observations. Traditional view of testing levels, Alternative life cycle models, the SATM systems, separating integration and system testing, Guidelines and observations.
Module-5
Fault Based Testing, Planning and Monitoring the Process, Documenting Analysis and Test Assumptions in fault-based testing, Mutation Analysis, Fault-based Adequacy Criteria; Variations on mutation Analysis; From Test case specification to Test Cases, Scaffolding, Generic vs. specific Scaffolding, Test Oracles, Self checks as oracles, Capture and Replay. Quality and Process, Test and Analysis strategies and plans, Risk Planning, Monitoring the Process, Improving the process, The quality team, Organizing documents, Test strategy document, Analysis and test plan, Test design specifications documents, Test and analysis reports.
Question Paper Pattern: • The Question paper will have TEN questions • Each full question will be for 20 marks • There will be 02 full questions (with maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer FIVE full questions, selecting one full question from each module.
Textbooks
1. AdithyaP.Mathur " Foundations of Software Testing – Fundamental Algorithms and Techniques", Pearson Education India, 2011 2. Mauro Pezze, Michael Young, Software testing and Analysis- Process, Principles and Techniques, Wiley India, 2012 3. Paul C Jorgensen, "Software Testing A Craftsman's Approach", Auerbach publications, 3rd edition, 2011.
References
1. KshirasagaraNaik, PriyadarshiTripathy: Software Testing and Quality Assurance, Wiley India

2012
2. M.G.Limaye: Software Testing-Principles, Techniques and Tools – McGraw Hill, 2009

NOSQL

Choice Based Credit System(CBCS)

Semester: III	**CIE Marks:40**
Course Code:20MCA345	**SEE Marks:60**
Contact Periods (L:T:P):3-0-0	**Exam Hours:03**

Course outcomes: The students will be able to:

CO1: Demonstrate the concepts of unstructured data

CO2: Analyse and Manage the Data using CRUD operations

CO3: Develop the applications using NoSQL

CO4: Realize the concept of Map Reduce its applicability in the real world application development

CO5: Analyze the framework of NOSQL

Module-1

Introduction to NoSQL
Definition of NoSQL, History of NoSQL and Different NoSQL products.
Exploring NoSQL
Exploring Mongo DB Java/Ruby/Python, Interfacing and Interacting with NoSQL.

Module-2

NoSQL Basics :NoSQL Storage Architecture, CRUD operations with Mongo DB, Querying, Modifying and Managing.

Data Storage in NoSQL: NoSQL Data Stores, Indexing and ordering datasets (MongoDB/CouchDB/Cassandra)

Module-3

Advanced NoSQL, NoSQL in Cloud, Parallel Processing with Map Reduce, Big Data with Hive.

Module-4

Working with NoSQL, Surveying Database Internals, Migrating from RDBMS to NoSQL, Web Frameworks and NoSQL, using MySQL as a NoSQL.

Module-5

Developing Web Application with NOSQL and NOSQL Administration

Php and MongoDB, Python and MongoDB, Creating Blog Application with PHP.

Question Paper Pattern:

- The Question paper will have TEN questions

• Each full question will be for 20 marks • There will be 02 full questions (with maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer FIVE full questions, selecting one full question from each module.
Textbooks
1.Professional NOSQL Shashank Tiwari WROX Press
References
2. The Definitive Guide to Mongo DB, The NOSQL Database for cloud and Desktop Computing EelcoPlugge, Peter Membreyand Tim Hawkins APress

Deep Learning **Choice Based Credit System(CBCS)**	
Semester: III	**CIE Marks:40**
Course Code:20MCA351	**SEE Marks:60**
Contact Periods (L:T:P):3-0-0	**Exam Hours:03**
Course Outcomes: 1. Demonstrate the basics of deep learning for a given context. 2. Implement various deep learningmodels for the given problem 3. Realign high dimensional data using reductiontechniques for the given problem 4. Analyze optimization and generalization techniques of deeplearning for the given problem. 5. Evaluate the given deep learningapplication and enhance by applying latest techniques.	
Module-1	
Introduction to machine learning- Linear models (SVMs and Perceptron's, logistic regression)- Intro to Neural Nets: What a shallow network computes- Training a network: loss functions, back propagation and stochastic gradient descent- Neural networks as universal function approximates	
Module-2	
DEEP NETWORKS : History of Deep Learning- A Probabilistic Theory of Deep Learning- Backpropagation and regularization, batch normalization- VC Dimension and Neural Nets-Deep Vs Shallow NetworksConvolutional Networks- Generative Adversarial Networks (GAN), Semi-supervised Learning	
Module-3	
DIMENTIONALITY REDUCTION : Linear (PCA, LDA) and manifolds, metric learning - Auto encoders and dimensionality reduction in networks - Introduction to Convnet - Architectures – AlexNet, VGG, Inception, ResNet - Training a Convnet: weights initialization, batch normalization, hyperparameter optimization	
Module-4	
OPTIMIZATION AND GENERALIZATION Optimization in deep learning– Non-convex optimization for deep networks- Stochastic Optimization Generalization in neural networks- Spatial Transformer Networks- Recurrent networks, LSTM - Recurrent Neural Network	

Language Models- Word-Level RNNs & Deep Reinforcement Learning - Computational & Artificial Neuroscience

Module-5

CASE STUDY AND APPLICATIONS Imagenet- Detection-Audio Wave Net-Natural Language Processing Word2Vec - Joint Detection BioInformatics- Face Recognition- Scene Understanding-Gathering Image Captions

Question Paper Pattern:

- The Question paper will have TEN questions
- Each full question will be for 20 marks
- There will be 02 full questions (with maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting one full question from each module.

Textbooks :

1. CosmaRohillaShalizi, Advanced Data Analysis from an Elementary Point of View,2015.

References:

1. Deng & Yu, Deep Learning: Methods and Applications, Now Publishers,2013.
2. Ian Goodfellow, YoshuaBengio, Aaron Courville, Deep Learning, MIT Press,2016.

Michael Nielsen, Neural Networks and Deep Learning, Determination Press,2015.

Big data Analytics

Choice Based Credit System(CBCS)

Semester: III	**CIE Marks:40**
Course Code:20MCA352	**SEE Marks:60**
Contact Periods (L:T:P):3-0-0	**Exam Hours:03**

Course Outcomes:

CO1: Identify the business problem for a given context and frame the objectives to solve it through data analytics tools.

CO2: Apply various algorithms for handling large volumes of data.

CO3: Illustrate the architecture of HDFS and explain functioning of HDFS clusters.

CO4: Analyse the usage of Map-Reduce techniques for solving big data problems.

CO5: Conduct experiment with various datasets for analysis / visualization and arrive at valid conclusions.

Module-1

Big Data and Analytics

Example Applications, Basic Nomenclature, Analysis Process Model, Analytical Model Requirements , Types of Data Sources, Sampling, Types of Data Elements, Data Exploration, Exploratory Statistical Analysis, Missing Values, Outlier Detection and Treatment, Standardizing Data Labels, Categorization

Module-2

Big Data Technology

Hadoop's Parallel World, Data discovery, Open source technology for Big Data Analytics, Cloud and Big Data, Predictive Analytics, Mobile Business Intelligence and Big Data, Crowd Sourcing

Analytics, Inter- and Trans-Firewall Analytics.

Module-3

Meet Hadoop

Data, Data Storage and Analysis, Comparison with Other Systems, RDBMS, Grid Computing, Volunteer Computing, A Brief History of Hadoop, Apache Hadoop and the Hadoop Ecosystem Hadoop Releases Response.

Module-4

The Hadoop Distributed File system

The Design of HDFS, HDFS Concepts, Blocks, Namenodes and Datanodes, HDFS Federation, HDFS High-Availability, The Command-Line Interface, Basic Filesystem Operations, Hadoop Filesystems Interfaces, The Java Interface, Reading Data from a Hadoop URL, Reading Data Using the FileSystem API, Writing Data, Directories, Querying the Filesystem, Deleting Data, Data Flow Anatomy of a File Read, Anatomy of a File Write, Coherency Model, Parallel Copying with distcp Keeping an HDFS Cluster Balanced, Hadoop Archives.

Module-5

A Weather Dataset ,Data Format, Analysing the Data with Unix Tools, Analyzing the Data with Hadoop, Map and Reduce, Java MapReduce, Scaling Out, Data Flow, Combiner functions, Running a Distributed MapReduce Job, Hadoop Streaming, Hadoop Pipes, Compiling and Running, Developing a MapReduce Application, The Configuration API, Combining Resources, Variable Expansion, Configuring the Development Environment, Managing Configuration, GenericOptionsParser, Tool and ToolRunner, Writing a Unit Test, Mapper, Reducer, Running Locally on Test Data, Running a Job in a Local Job Runner, Testing the Driver, Running on a Cluster, Packaging, Launching a Job, The MapReduce Web UI, Retrieving the Results, Debugging a Job, Hadoop Logs, Remote Debugging.

Question Paper Pattern:

- The Question paper will have TEN questions
- Each full question will be for 20 marks
- There will be 02 full questions (with maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting one full question from each module.

Textbooks

1. Bart Baesens, “Analytics in a Big Data World: The Essential Guide to Data Science and its Applications” Wiley.

2. Michael Minelli, Michehe Chambers, “Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today’s Businesses”, 1st Edition, Michael Minelli, Michele Chambers, AmbigaDhiraj, Wiley CIO Series, 2013.

3. Tom White, “Hadoop: The Definitive Guide”, 3rd Edition, O’reilly, 2012.

References

1.Boris Lublinsky, Kevin T. Smith, Alexey Yakubovich, “Professional Hadoop Solutions”, Wiley, ISBN: 9788126551071, 2015.

2. Chris Eaton, Dirk deroos et al., “Understanding Big data”, McGraw Hill, 2012.

3. Vignesh Prajapati, “Big Data Analytics with R and Haoop”, Packet Publishing 2013.

4. Tom Plunkett, Brian Macdonald et al, “Oracle Big Data Handbook”, Oracle Press, 2014.

Choice Based Credit System (CBCS) and Outcome Based Education(OBE)
SEMESTER – III

Wireless Ad Hoc Networks

Course Code : 20MCA353	**CIE Marks : 40**
Contact Periods (L:T:P): 3:0:0	**SEE Marks : 60**
Credits : 03	**Exam Hours : 03**

Course outcomes

CO1: Analyze the issues of ad-hoc wirelessnetwork
CO2 : Evaluate the existing network and improve its quality ofservice
CO3 : Choose appropriate protocol for variousapplications and design the architecture
CO4: Examine security measures present at differentlevels and identify the possible improvements for the latest version of the ad hoc network IEEE standard
CO5 : Analyze energy consumption andmanagement in ad-hoc wirelessnetworks

Module-1

Ad-hoc Wireless Networks Introduction, Issues in Ad-hoc Wireless Networks, Ad-hoc Wireless Internet; MAC Protocols for Ad-hoc Wireless Networks: Introduction, Issues in Designing a MAC Protocol, Design Goals of MAC Protocols, Classification of MAC protocols, Contention- Based Protocols, Contention-Based Protocols with Reservation Mechanisms, Contention-Based Protocols with Scheduling Mechanisms, MAC Protocols that Use Directional Antennas.

Module -2

Routing Protocols for Ad-hoc Wireless Networks Introduction, Issues in Designing a Routing Protocol for Ad-hoc Wireless Networks; Classification of Routing Protocols; Table Driven Routing Protocols; On-Demand Routing Protocols, Hybrid Routing Protocols, Hierarchical Routing Protocols and Power-Aware Routing Protocols.

Module – 3

Multicast Routing in Ad-hoc Wireless Networks Introduction, Issues in Designing a Multicast Routing Protocol, Operation of Multicast Routing Protocols, An Architecture Reference Model for Multicast Routing Protocols, Classifications of Multicast Routing Protocols, Tree-Based Multicast Routing Protocols and Mesh-Based Multicast Routing Protocols.

Module-4

Transport Layer and Security Protocols for Ad-hoc Networks: Introduction, Issues in Designing a Transport Layer Protocol; Design Goals of a Transport Layer Protocol; Classification of Transport Layer Solutions; TCP over Transport Layer Solutions; Other Transport Layer Protocols for Ad-hoc Networks; Security in Ad-hoc Wireless Networks, Issues and Challengesin Security Provisioning, Network Security Attacks, Key Management and Secure Touting Ad-hoc Wireless Networks.

Module-5

Quality of Service and Energy Management in Ad-hoc Wireless Networks: Introduction, Issues and Challenges in Providing QoS in Ad-hoc Wireless Networks, Classification of QoS Solutions, MAC Layer Solutions, Network Layer Solutions; Energy Management in Ad-hoc Wireless Networks: Introduction, Need for Energy Management in Ad-hoc Wireless Networks, Classification of Energy Management Schemes, Battery Management Schemes, Transmission Management Schemes, System Power Management Schemes.
Question Paper Pattern: • The Question paper will have TEN questions • Each full question will be for 20 marks • There will be 02 full questions (with maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer FIVE full questions, selecting one full question from each module.
Textbook
1. Ad-hoc Wireless Networks, C. Siva Ram Murthy& B. S. Manoj, Pearson Education, 2nd Edition, 2011
Reference Books
1. Ad-hoc Wireless Networks, Ozan K. Tonguz and John Wiley, 2007 ,Gianguigi Ferrari
2. Ad-hoc Wireless Networking. Xiuzhen Cheng, Xiao Hung, Ding-Zhu Du, Kluwer Academic Publishers, 2004
3. Ad-hoc Mobile Wireless Networks- Protocols and Systems, C.K. Toh, Pearson Education, 2002

Software Project Management

Choice Based Credit System(CBCS)

Semester: III	**CIE Marks:40**
Course Code:20MCA354	**SEE Marks:60**
Contact Periods (L:T:P):3-0-0	**Exam Hours:03**

Course Out Comes:
CO1:Apply thepracticesandmethodsforsuccessfulsoftwareprojectmanagement
CO2:Identifytechniquesforrequirements,policiesanddecisionmakingforeffectiveresource management
CO3:Illustratetheevaluationtechniquesforestimatingcost,benefits,scheduleandrisk
CO4:Deviseaframeworkforsoftwareprojectmanagementplanforactivities,risk,monitoring andcontrol
CO5:Designaframeworktomanagepeople

Module-1

INTRODUCTIONTOSOFTWAREPROJECTMANAGEMENT
Introduction,WhyisSoftwareProjectManagementimportant?Whatisa Project?, ContractManagement,ActivitiesCoveredbySoftwareProjectManagement, Plans, MethodsandMethodologies,Somewaysof categorizingsoftwareprojects, Stakeholders,SettingObjectives,BusinessCase,ProjectSuccessandFailure,Whatis Management? Management Control, Traditional versus Modern Project ManagementPractices

Module-2

PROJECTEVALUATION&FINANCE

Evaluationof IndividualProjects,CostBenefitEvaluationTechniques,RiskEvaluation, ProgrammeManagement,Managingallocationof ResourceswithinProgrammes, FinancialAccounting–Anoverview– Accountingconcepts,Principles&Standards, Ledgerposting,Trialbalance,ProfitandLossaccountBalancesheet
Module-3
ACTIVITYPLANNING ObjectivesofActivityPlanning,Whento Plan,ProjectSchedules,Sequencingand SchedulingActivities,NetworkPlanningModels,ForwardPass– BackwardPass, Identifyingcriticalpath,ActivityFloat,ShorteningProjectDuration,Activityon Arrow Networks RiskManagement,NatureofRisk,CategoriesofRisk,Aframeworkfordealingwith Risk, Risk Identification, Risk analysis and prioritization, risk planning and risk monitoring
Module-4
MONITORINGANDCONTROL CreatingtheFramework,CollectingtheData,Review,ProjectTerminationReview, VisualizingProgress,CostMonitoring,EarnedValueAnalysis,PrioritizingMonitoring, GettingProjectBackToTarget,ChangeControl,SoftwareConfiguration Management
Module-5
MANAGINGPEOPLEANDWORKINGINTEAMS Introduction,UnderstandingBehavior,OrganizationalBehavior:A Background, SelectingtheRightPersonfortheJob,InstructionintheBestMethods,Motivation, TheOldham–HackmanJobCharacteristicsModel,Stress–HealthandSafety WorkingInTeams,BecomingaTeam,DecisionMaking,Leadership.
Question Paper Pattern: • The Question paper will have TEN questions • Each full question will be for 20 marks • There will be 02 full questions (with maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer FIVE full questions, selecting one full question from each module.
Textbooks
1.BobHughes, MikeCotterell, RajibMall, "Software Project Management", Fifth Edition,TataMcGrawHill,2011. 2."AccountingforManagement"JawaharLal,5th Edition,WheelerPublications,Delhi.
References
1.JackMarchewka," Information Technology-Project Management", Wiley Student Version,4th Edition,2013. 2.JamesPLewis,"ProjectPlanning,Scheduling&Control",McGrawHill,5th Edition, 2011. 3.Pankaj Jalote," Software Project Management in Practise", Pearson Education, 2002.

Software Defined Networks **Choice Based Credit System(CBCS)**	
Semester: III	**CIE Marks:40**
Course Code:20MCA355	**SEE Marks:60**
Contact Periods (L:T:P):3-0-0	**Exam Hours:03**

Course Outcomes:
CO1: Apply the fundamentals of Software Defined Networks for the given problem
CO2: Illustrate the basics of Software Defined Networks Operations and Data flow
CO3: Apply different Software Defined Network Operations and Data Flow
CO4: Analyse alternative definitions of Software Defined Networks
CO5: Apply different Software Defined Network Operations in real world problem

Module-1

Introduction to SDN

Understanding the SDN, Understanding the SDN technology, Control Plane, Data Plane, Moving information between planes, separation of the control and data planes, Distributed control planes, Load Balancing, Creating the MPLS Overlay, Centralized control planes.

Module-2

Working of SDN

Evaluation of Switches and Control planes, SDN Implications, Data centre Needs, Forerunner of SDN, Software Defines Networks is Born, Sustain SDN interoperability, Open source contribution, Fundamental Characteristics of SDN, SDN Operations, SDN Devices, SDN Controllers, SDN Applications, Alternate SDN methods.

Module-3

The Open Flow Specifications

Open Flow Overview, Open Flow Basics, Open Flow 1.0 additions, Open Flow 1.1 additions, Open Flow 1.2 additions, Open Flow 1.3 additions, Open Flow limitations.

Module-4

SDN via APIS, SDN via Hypervisor-Based Overlays, SDN via Opening up the device, Network function virtualization, Alternative Overlap and Ranking.

Module-5

Data centres definition, Data centres demand, tunnelling technologies for Data centres Path technologies in data centres, Ethernet fabrics in Data centres, SDN use case in Data centres.

Question Paper Pattern:

- The Question paper will have TEN questions
- Each full question will be for 20 marks
- There will be 02 full questions (with maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting one full question from each module.

Textbooks

1. Software Defined Networking by Thomas D Nadeau and Ken Gray.
2. Software Define Networks, A Comprehensive Approach, Paul Goransson, Chuck Black. MK Publications.

References

1. Software Defined Networking for Dummies brought you by cisco, Brian Underdahl and Gary Kinghorn.

Data Analytics Lab

Choice Based Credit System

Semester:III	CIE Marks:40
Subject Code:20MCA36	SEE Marks:60
Contact Hours(L:T:P):0:0:4	Exam Hours:03

Course Outcomes:

1.Develop python program to perform search/sort on a given data set

2.Demonstrate object oriented principles

3. Demonstrate data visualization using Numpy for a given problem

4. Demonstrate regression model for a given problem

5.Deign and develop an application for the given problem

1.Write a Python program to perform linear search

2.Write a Python program to insert an element into a sorted list

3.Write a python program using object oriented programming to demonstrate encapsulation, overloading and inheritance

4.Implement a python program to demonstrate

1) Importing Datasets 2) Cleaning the Data 3) Data frame manipulation using Numpy

5.Implement a python program to demonstrate the following using NumPy

a) Array manipulation, Searching, Sorting and splitting.

b) broadcasting and Plotting NumPy arrays

6. Implement a python program to demonstrate

Data visualization with various Types of Graphs using Numpy

7.Write a Python program that creates a mxn integer arrayand Prints its attributes using matplotlib

8.Write a Python program to demonstrate the generation of linear regression models.

9.Write a Python program to demonstrate the generation of logistic regression models using Python.

10.Write a Python program to demonstrate Timeseries analysis with Pandas.

11.Write a Python program to demonstrate Data Visualization using Seaborn.

Part-B

6. Students shall carry out a mini project using python/pandas to demonstrate the data analysis.
7. A team of two students must develop the mini project. However during the examination, each student must demonstrate the project individually.
8. The team must submit a brief project report (20-25 pages) that must include the following

a. Introduction b. Requirement Analysis c Software Requirement Specification
d. Analysis and Design, e. Implementation f. Testing

9. Brief synopsis not more than two pages to be submitted by the team as per the format given. It is recommended that students to do prior art search as part of literature survey before submitting the synopsis for the Mini/Major projects.
10. Rubrics may be used to evaluate the Mini-Project

Each students has to execute one program picked from Part-A during the semester end examination. In SEE Part-A and Part-B shall be given 50% weightage each.

Mini project with IOT Lab

Choice Based Credit System

Semester :III	CIE Marks:40
Subject Code:20MCA37	SEE Exam:60
Contact Hours(L:T:P)0:0:4	Exam Hours:03

Course Outcomes:

CO**1:** Demonstrate theIoT architecture design for a given problem

CO**2:** Apply IOT techniques for a given problem

CO**3:** Analyse the application protocol, transport layer methods for the given business case.

CO**4:** .Design and develop an application for the given problem for the societal/industrial problems

CO5: Develop python program by applying suitable feature for the given problem and verify the output

1.Run some python programs on Pi like: Read your name and print Hello message with name Read two numbers and print their sum, difference, product and division.Word and character count of a given string Area of a given shape (rectangle, triangle and circle) reading shape and appropriate values from standard input Print a name 'n' times, where name and n are read from standard input, using for and while loops. Handle Divided by Zero Exception. Print current time for 10 times with an interval of 10 seconds.

Read a file line by line and print the word count of each line.

2.Get input from two switches and switch on corresponding LEDs

3.Flash an LED at a given on time and off time cycle, where the two times are taken from a file.

4.Switch on a relay at a given time using cron, where the relay's contact terminals are connected to a load.

5.Access an image through a Pi web cam

6.Control a light source using web page.

7.Implement an intruder system that sends an alert to the given email.

8.Get the status of a bulb at a remote place (on the LAN) through web.
9.Get an alarm from a remote area (through LAN) if smoke is detected. The student should have hands on experience in using various sensors like temperature, humidity, smoke, light, etc. and should be able to use control web camera, network, and relays connected to the Pi.
Part-B
1. A team of two students must develop the mini project. However during the examination, each student must demonstrate the project individually. 2. The team must submit a brief project report (20-25 pages) that must include the following a. Introduction b. Requirement Analysis c Software Requirement Specification d. Analysis and Design, e. Implementation f. Testing 3. Brief synopsis not more than two pages to be submitted by the team as per the format given. It is recommended that students to do prior art search as part of literature survey before submitting the synopsis for the Mini/Major projects. 4. Rubrics may be used to evaluate the Mini-Project Each students has to execute one program picked from Part-A during the semester end examination. In SEE Part-A and Part-B shall be given 50% weightage each.

Advances in Java Lab **Choice Based Credit System**	
Semester: III	CIE Marks:40
Subject Code:20MCA38	SEE Marks:60
Contact Hours(L:T:P):0:0:4	Exam Hours:03
Course Outcomes: at the end of the course students will be able to CO1: Apply the concept of Servlet and its life cycle to create web application. CO2: Apply JSP tags and its services to web application. CO3: Create packages and interfaces in the web application context. CO4: Build Database connection for the web applications. CO5: Develop application programs using beans concept.	
1.Write a JAVA Servlet Program to implement a dynamic HTML using Servlet (user name and	

Password should be accepted using HTML and displayed using a Servlet).
2.Write a JAVA Servlet Program to Auto Web Page Refresh (Consider a webpage which is displaying Date and time or stock market status. For all such type of pages, you would need to refresh your web page regularly; Java Servlet makes this job easy by providing refresh automatically after a given interval).
3.Write a JAVA Servlet Program to implement and demonstrate GET and POST methods (Using HTTP Servlet Class).
4.Write a JAVA Servlet Program using cookies to remember user preferences.
5.Write a JAVA Servlet program to track HttpSession by accepting user name and password using HTML and display the profile page on successful login.
6.Write a JSP Program which uses jsp:include and jsp:forward action to display a Webpage.
7.Write a JSP Program which uses tag to run an applet
8.Write a JSP Program to get student information through a HTML and create a JAVA Bean class, populate Bean and display the same informationthrough another JSP
9. Write a JSP program to implement all the attributes of page directive tag.
10.Write a JAVA Program to insert data into Student DATA BASE and retrieve info based on particular queries (For example update, delete, search etc…).
11.An EJB application that demonstrates Session Bean (with appropriate business logic).
12.An EJB application that demonstrates MDB (with appropriate business logic).
13. An EJB application that demonstrates persistence (with appropriate business logic).

Semester-IV

Sl. No.	Course Type	Course Code	Title	Teaching Hours/Week			Examination				Credits
				Tutorial (T)	Lecture (L)	Practical (P) / Seminar (S)	Duration (in Hrs.)	CIE Marks	SEE Marks	Total Marks	
1.	PCC	20MCA41	Advances in web technologies	2	2	-	3	40	60	100	2
2.	PCC	20MCA42	Programming using C#	2	2	-	3	40	60	100	2
	PCC	20MCA43	Industry Internship (4 weeks)	-	-	-	-	100	-	100	2
3.	PCC	20MCA44	Project Work (16 Weeks)	-	-	2*	3	40	60	100	20
			TOTAL	4	4	2	-	220	180	400	26

**** Two hours per week is allocated to the faculty members in order to review the progress of the students' projects. The students will present the progress to the faculty member or discuss about the further direction of project work during the allocated hours. Students shall maintain diary where in he/she records the weekly work done duly signed by internal/external guides.***

Advances in Web Technologies

Choice Based Credit System

Semester: IV	CIE Marks:40
Course Code:20MCA41	SEE Marks:60
Contact Hours (L:T:P): 2:2:0	Exam Hours:03

Course Outcomes: At the end students will be able to

CO1: Build the Web Applications using JQuery, PHP, XML for the given problem

CO2: Design the Web Pages using AJAX for the given problem.

CO3: Analyse the advances in Web2.0 and demonstrate its usage for the problem considered.

CO4 Analyse the web services and demonstrate its usage for the problem considered.

CO5: Design responsive web applications using Bootstrap for the given problem.

Module-1

Module 1:

Introduction to PHP: Origins and uses of PHP, Overview of PHP, General syntactic characteristics, Primitives, operations andexpressions, Output, Control statements, Arrays, Functions, Pattern matching.

Building Web applications with PHP:

Form handling, Files, Tracking users, cookies, sessions, Using databases, Handling XML.

Module-2

Introduction to Ruby and Introduction to Rails:

Origins and uses of Ruby, Scalar types and their operations ,Simple input and output, Controlstatements, Arrays, Hashes, Methods, Classes, Codeblocks and iterates, Pattern matching.

Overview of Rails, Document requests, Processing forms, Layouts. Rails applications with Databases.

Module-3

Rich Internet Applications With Ajax: Limitations of Classic Web application model, AJAX principles,Technologies behind AJAX, Examples of usage of AJAX; Asynchronous communication and AJAXapplication model.

Ajax with XMLHTTP object: Part 1

Creating Ajax Applications: An example, Analysis of example ajax.html, Creating the JavaScript, Creatingand opening the XMLHttpRequest object, Data download, Displaying the fetched data, Connecting tothe server, Adding Server-side programming, Sending data to the server using GET and POST.

Module-4

Ajax with XMLHTTP object: Part 2

Handling multiple XMLHttpRequest objects in the same page, Using two XMLHttpRequest objects, Usingan array of XMLHttpRequestobjects,AJAX Patterns – Predictive Fetch, Multi-stage download, PeriodicRefresh and Fallback patterns, Submission throttling.

Module-5

Introduction to Bootstrap:

What Is Bootstrap? Bootstrap File Structure, Basic HTML Template, Global Styles, Default Grid System,Basic Grid HTML, Offsetting Columns, Nesting Columns, Fluid Grid System, Container Layouts,Responsive Design. Typography, Emphasis Classes, Lists, Code, Tables, Optional Table Classes, Table RowClasses, Forms, Buttons, Images, Icons.

Question Paper Pattern:

- The Question paper will have TEN questions
- Each full question will be for 20 marks
- There will be 02 full questions (with maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting one full question from each module.

Textbooks

1. RobertW.Sebesta: Programming the Worldwide Web, 4thEdn, Pearson, 2012
2. Professional AJAX – Nicholas C Zakas et al, Wrox publications, 2008.
3. Steven Holzner: Ajax: A Beginner's Guide, Tata McGraw Hill, 2014.
4. Jake Spurlock: "Bootstrap: Responsive Web Development", O'Reilly Media, 2014.

Reference books

1. Thomas A. Powel: Ajax The Complete reference, McGraw Hill,2008.
2. AravindShenoy, Ulrich Sossou: Learning Bootstrap, Packt, Dec 2014.
3. Dana Moore, Raymond Budd, Edward Benson: Professional Rich Internet Applications: AJAX andBeyond, Wiley 2012.

Programming using C#

Choice Based Credit System(CBCS)

Semester: IV	**CIE Marks:40**
Course Code:20MCA42	**SEE Marks:60**
Contact Periods (L:T:P): 2:2:0	**Exam Hours:03**

Course Out Comes:

CO1:Analyse C#andclient-serverconceptsusing.NetFrameWork Components.

CO2:Applydelegates,eventandexceptionhandlingtoincorporatewithASP,WinForm, ADO.NET.

CO3:Analyzetheuseof.NetComponentsdependingontheproblemstatement.

CO4:Implement&developawebbasedandConsolebasedapplicationwithDatabase connectivity

CO5: Implement & develop a web based application with Databaseconnectivity

Module-1

Gettingstartedwith.NETFramework4.0andC#

Understanding PreviousTechnologies, Benefitsof.NETFramework,Architecture of.NETFramework 4.0,.NET Execution Engine, Components of.NET Framework 4.0: CLR,CTS,MetadataandAssemblies,.NETFrameworkClassLibrary,WindowsForms, ASP.NETand ASP.NETAJAX,ADO.NET,WindowsworkflowFoundation,Windows PresentationFoundation,WindowsCommunicationFoundation,WidowsCardSpace andLINQ.

IntroducingC#

Creating aSimple C# Console Application, Identifiers and Keywords. System DataTypes,Variablesand Constants:ValueTypes,ReferenceTypes,UnderstandingType Conversions,BoxingandUnBoxing.Namespaces,TheSystemnamespace,.NETArray Types.

Module-2

Classes,ObjectsandObjectOrientedProgramming

Classes and Objects: Creating a Class, Creating an Object, Using this Keyword, CreatinganArrayofObjects,UsingtheNestedClasses,DefiningPartialClassesand Method,ReturningaValuefroma MethodandDescribingAccessModifiers.Static Classes and StaticMembers, Properties: Read-only Property, Static Property, Indexers,Structs:SyntaxofastructandAccessModifiersforstructs,System.ObjectClass

Encapsulation: Encapsulation using accessors and mutators, Encapsulation using Properties. Inheritance: Inheritanceand Constructors, Sealed Classes and Sealed Methods,Extensionmethods.

Polymorphism:Compiletime Polymorphism/Overloading,RuntimePolymorphism/ Overriding.Abstraction:Abstractclasses,Abstract methods.Interfaces:Syntaxof Interfaces,ImplementationofInterfacesandInheritance.

Module-3

Delegates,Events,ExceptionHandlingandADO.NET

Delegates:CreatingandusingDelegates,MuticastingwithDelegates. Events:Event Sources,EventHandlers,EventsandDelegates,MultipleEventHandlers.

Exception Handling: The try/catch/throw/finally statement, Custom Exception.System.Exception, HandlingMultipleException.\

DataAccesswithADO.NET:UnderstandingADO.NET:DescribingtheArchitectureof ADO.NET,ADO.NET,ADO.NETEntityFramework.CreatingConnectionStrings:Syntax forConnectionStrings.Creatinga Connectiontoa Database:SQLServerDatabase,

OLEDBDatabase,ODBCDataSource.Creatinga CommandObject.Workingwith DataAdapters:CreatingDataSetfromDataAdapter.
Module-4
GraphicalUserInterfacewithWindowsFormsandWPF WindowsForms:Introduction,WindowsForms,EventHandling:A SimpleEvent- Driven GUI, Control Properties and Layout, Labels, TextBoxesand Buttons, GroupBoxesand Panels,CheckBoxesand RadioButtons,ToolTips,Mouse-Event Handling, Keyboard-Event Handling. Menus, Month Calendar Control, LinkLabelControl,ListBoxControl, ComboBoxControl,TreeViewControl,ListViewControl, TabControlandMultipleDocumentInterface(MDI)Windows. WPF:New WPF Controls,WPF Architecture:PresentationFramework,Presentation Core, WindowsBase, MILorMilcore,Working withWPFWindows: UsingXAMLin WPF4.0Applications: Contentsof XAMLandWPFApplications:XAMLElements NamespaceandXAML,XAMLPropertySyntax,MarkupExtensions.
Module-5
WebAppDevelopmentandDataAccessusingADO.NET Introduction,WebBasics,MultitierApplicationArchitecture,Your First Web Application: Building Web-Time Application, Examining Web-Time.aspx'sCode-BehindFile,UnderstandingMasterpages, StandardWebControls:DesigningaForm, Validation Controls, GridViewControl, DropDownList, Session Tracking, ASP.NET AJAX:ExploringAJAX,NeedforAJAX,AJAXand otherTechnologies,AJAXServer Controls,ScriptManagercontrol, UpdatePanel, UpdateProgressControl,Creating SimpleApplicationusingAJAXServerControls
Question Paper Pattern: • The Question paper will have TEN questions • Each full question will be for 20 marks • There will be 02 full questions (with maximum of four sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer FIVE full questions, selecting one full question from each module.
Textbooks
1. .NET4.0Programming(6-in-1),BlackBook,KogentLearningSolutionsInc.,Wiley-DreamTechPress.(Chapters:1,10,11,12,13,14and19). 2. PaulDeitelandHarveyDeitel:C#2010forProgrammers,4th Edition,PearsonEducation. (Chapters:14,15,19and27.3)
References
1.AndrewTrolsen:ProC#5.0andthe.NET4.5Framework,6th Edition,Wiley-Appress. 2.BartDeSmet:C#4.0Unleashed,PearsonEducation-SAMSSeries. 3.HerbertSchildt:CompleteReferenceC#4.0,TataMcGrawHill,2010.

Industry Internship **Choice Based Credit System**	
Semester: IV	CIE Marks: 100
Course Code: 20MCA43	SEE Marks:---
Contact Hours (L:T:P/S): 0:0:0	Exam Hours:-

Course outcomes:

CO1: Analyse the real-time industry/research work environment with emphasis on organizational structure/job process/different departments and functions / tools /technology.

CO2: Develop applications using modern tools and technologies.

CO3: Demonstrate self-learning capabilities with an effective report and detailed presentation.

General Rules

1) All the students have to undergo mandatory internship of 4 weeks during the vacation of 3rd semester to take up individual project in companies/respective Colleges at higher than the mini project standards already taken up during previous semesters.
2) Internship shall be considered as a head of passing and shall be considered for the award of degree.
3) Those, who do not take-up/complete the internship shall be declared as fail in internship course and have to complete the same during the subsequent semester.
4) After satisfying the internship requirements the degree will be awarded.
5) However, student can carry out 4thsemester project without completing the internship.
6) The student can present the progress about the internship to the committee at the department level.
7) CIE marks shall be evaluated with a weightage of Internship presentation for 50 marks and reports for 50 marks . The marks can be awarded to the student based on the criteria/rubrics formulated by the department.
8) The student has to submit a report about the outcome of the internship at the end of the semester along with the project report.
9) The internship report submitted by the studenthas to be evaluated by the guide concerned / a committee constituted by the head of the department.
10) The report shall be preserved at the department for future reference.

Project Work

Choice Based Credit System

Semester: IV	CIE Marks:40
Course Code:20MCA44	SEE Marks:60
Contact Hours (L:T:P/S): 0:0:0/2	Exam Hours:03

Course outcomes:

Course outcomes: At the end of this course, the students will be able to

CO1: Identify a suitable problem making use of the technical and engineering knowledgegained from previous courses with the awareness of impact of technology on the societyand their ethical responsibilities.

CO2: Work as an individual and team to segregate work and execute/implement

projects using appropriate tools.
CO3: Develop skills to disseminate technical and general information by means of oral aswell as written presentation and professional skills.
CO4: To conduct testing of application using appropriate techniques and tools.
CO5: To enhance interpersonal skills and group cohesion among the peers during the project work

General Rules

- The candidate should carry out the project individually in any industry or R&D institution or educational institution under a guide/co-guide.
- The candidate has to present the work carried out before the examiners during the University examination.
- The work out carried out should be free from plagiarism as per the guideline provided by the university.
- The literature study may be clearly written which may be summary of existing project and highlight of what are the functionalities that are proposed to this project.
- Student shall indicate the different research papers, documents refereed as a part of the literature study. It is recommended to do prior art search as part of literature survey before submitting the synopsis for the projects.
- This is an individual project for a duration of minimum of 4 months or duration of the semester.
- Regular project work weekly diary should be maintained by the students, signed by the external guide and internal guide in order to verify the regularity of the student.
- Project work may be application/testing or research-oriented and accordingly the project report contents may vary.
- The presentation should be given at various levels such as Synopsis, SRS, Design and Project implementation/ completion levels.
- Student has to publish a paper in conference or journal of either National or International level
- Paper publication in an indexed journal/conference is compulsory as part of the project work.
- Publications follow the Thesis. 10% weightage is given in SEE.
- There shall be three project presentations each to be considered for 5 marks (5X3= 15 marks) and a final presentation for 15 marks. Presentation may be given using Power point presentation/demonstrations of the work. Synopsis submitted in a proper format is to be evaluated for 10 marks.
- The students are informed to strictly follow the report format as prescribed by the University. However as per the title/domain of the project with a suitable justification guide/department can make the minor changes.
- If the project report is not as per the format, internal guide / external examiner will have every right to reject the project.
- The Students are encouraged and appreciated to show their project demo along

with their power pointduring their viva-voce exams as an added advantage.

- In case of the paper publication could not be completed before the submission of the report, or acceptance received from the organiser of the conference / journal authorities should be included while uploading/submitting the report to the university.

Rubrics / Scheme of Evaluation:

Course Code	Title	Internal (CIE)					External (SEE)			Total Marks
		Review-1	Review-2	Review-3	Final Review	Synopsis	Dissertation evaluation	Paper Publication	Viva-Voce	
20MCA44	Project Work	5	05	05	15	10	24	6	30	100

Each Faculty member shall be allocated to supervise individual internship/project work as an internal guide and review the internship/ project work carried out on weekly basis for a minimum of one hour duration. The review carried out shall be recorded week-wise in a dairy maintained for it.

VISVESVARAYA TECHNOLOGICAL UNIVERSITY

JNANA SANGAMA, BELAGAVI

Internship Report on

<INTERNSHIP TOPIC>

Submitted in partial fulfillment of the requirements of the 4th Semester in

MASTER OF COMPUTER APPLICATIONS

BY

<<STUDENT NAME>>

<<USN>>

Under the Guidance of

<<Guide1Name1>>

<<Designation>>

<<Guide**2** Name**2**>>

<<Designation>>

<<Affiliated College Logo>>

<< College Name and Address>>

2021-22 Even Semester

<< College name and Address.>

<<College Logo>>

INTERNSHIP CERTIFICATE

This is to certify that <<**Student Name**>> bearing <<**USN**>> has satisfactorily completed the Internship – 20MCA43entitled **<<Topic>>** in the academic year **2021-22**as prescribed by VTU for IV Semester of Master of Computer Applications.

Signature of the internal/external Guide **Signature of the HOD**

ACKNOWLEDGEMENT

<College name Address>>

<<College Logo>>

VISION

MISSION

PROGRAMME EDUCATIONAL OBJECTIVES

PEO 1

Develop innovative IT applications to meet industrial and societal needs

PEO 2

Adapt themselves to changing IT requirements through life-long learning

PEO 3

Exhibit leadership skills and advance in their chosen career

PROGRAM OUTCOMES

PO1: Apply knowledge of computing fundamentals, computing specialization, mathematics and domain knowledge to provide IT solutions

PO2: Identify, analyse and solve IT problems using fundamental principles of mathematics and computing sciences

PO3: Design, Develop and evaluate software solutions to meet societal and environmental concerns

PO4: Conduct investigations of complex problems using research based knowledge and methods to provide valid conclusions.

PO5: Select and apply appropriate techniques and modern tools for complex computing activities

PO6: Practice and follow professional ethics and cyber regulations

PO7: Involve in life-long learning for continual development as an IT professional.

PO8: Apply and demonstrate computing and management principles to manage projects in multidisciplinary environments by involving in different roles

PO9: Comprehend& write effective reports and make quality presentations.

PO10: Understand and assess the impact of IT solutions on socio-environmental issues

PO11: Work collaboratively as a member or leader in multidisciplinary teams.

PO12: Identify potential business opportunities and innovate to create value to the society and seize that opportunity

Internship (20MCA43)

Course Outcomes

1. Analyse the real-time industry/research work environment with emphasis on organizational structure/job process/different departments and functions / tools /technology.
2. Develop applications using modern tools and technologies.
3. Demonstrate self-learning capabilities with an effective report and detailed presentation.

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3		3					2		
CO2			3	3	3						2	
CO3						3	3		3			

Rubrics for Internship Presentation Assessment

	Excellent (10)	V. Good (8)	Good (6)	Satisfactory (4)	Poor (2)	Final Score
Knowledge on Industry experience /Research work	Demonstrates in depth knowledge about Industry / Research processes; answered all questions with elaboration	Adequate knowledge on most of the industry/ Research processes. Answered all questions but failed to elaborate	Knowledge to a limited extent on major processes. Able to answer most of the questions though not elaborate	Superficial knowledge of topic; only able to answer basic questions	Does not have any knowledge; Unable to answer questions	
Organization of the presentation	Presented in logical sequence; introduction and background given in proper context; key points and conclusions are clear and well presented with citations and references	Most information presented in logical sequence; clear introduction; adequate background; some irrelevant information. Some References are overlooked	Organized in a presentable manner though lacks details of some of the topics. Or very less references and citations.	Problems with sequencing, lacks clear transitions; incomplete or overly detailed introduction, emphasis given to less important information	Little or no organization, difficult to follow; missing or ineffective introduction; confusing background; key points unclear	
Usage of Modern tools and technologies	Effectively utilized appropriate tools and technologies for implementation.	Involved sufficiently in developing applications by	Developed applications, though not very effectively. Fair	Sufficient for understanding but not clearly elaborated about usage of tools	Too brief or insufficient for understanding or too detailed	

		utilizing modern tools and technologies	enough.	and technologies		
Presentation Skills	Clear articulation about tools/technology, steady delivery rate, good posture and eye contact, confident and appropriately dressed	Clear articulation about tools/technology but not very polished. Able to recover from minor mistakes. Appropriately dressed	Good articulation about tools/technology and not very polished. Not able to realize minor mistakes. Presentable attire	Refers to slides to make points, occasional eye contact, incorrect pronunciations, and Voice fluctuation.	No clarity in sentence, Inaudible or too loud, no eye contact, delivery rate is too slow or too fast, not in formal attire	
Visuals	Visually pleasing and easy to read; good use of white space, colour, backgrounds; images and Graphics support.	Adequate layout, but with some fonts, colours, backgrounds difficult to read	Good visuals but can be improved largely.	Difficult to read, cluttered appearance; images improperly sized; some distracting graphics or animations	Confusing layout, text extremely difficult to read; many graphics, sounds, animations distract from the presentation	
Total Score						

Rubrics for Internship Report Assessment

	Excellent (10)	V. Good (8)	Good(6)	Satisfactory (4)	Poor (2)	Final Score
Purpose and Objective of Internship	The purpose and objective of the Internship report is made clear, and the report addresses the objective(s) in a focused and logical manner.	The purpose and objective of the Internship report is made clear, and the report addresses the objective(s).	Documented well but with slight ambiguity in analyzing the problems	Purpose and objectives are stated ambiguously	The report does not clearly address the objective(s) of Internship.	
Documenting the essence of Tools/Technology used, Grammar & Spelling	Complete information is provided about tools/technology, Very few spelling errors, correct punctuation, grammatically correct, complete sentences.	Information is provided about tools/technology, Occasional lapses in spelling, punctuation, grammar, but not enough to seriously distract the reader.	Average technical details on tools/technology usage, Grammatical mistakes not corrected.	Less technical details, sentences are not framed properly and with a few spelling mistakes	No details about tools/technology, Numerous spelling errors, non-existent or incorrect punctuation, and/or severe errors in grammar that interfere with understanding.	
Code Development / self learning	Design and Code is self-developed wherever applicable.	Design and Code is self-developed wherever applicable. Code snippets are partially cited	Design and Code is not partially self-developed wherever applicable	Major part of the implementation is copied.	No details about design and development	
Report Format	All required elements of the report are present	All required elements of the report are present	All required elements are	All required elements are	Key elements of the report are not	

	and completed efficiently.	and completed to a satisfactory standard.	present but some of them are not given completely	provided but in a haphazard way	provided. Overall presentation of the document is not to a professional standard.	
Plagiarism Check	Uniqueness 90% and above	Uniqueness 85% to 89%	Uniqueness 80% to 85%	Uniqueness between 75% to 79%	Uniqueness less than 75%	
	Total Score					

Rubrics for Internship Presentation and Question/ Answer

(Knowledge on Industry experience /Research work) Assessment (out of 25+ 25marks)

Rubrics for Internship Report Assessment (out of 50 marks) =

Total Marks (Out of 100 marks) =

Signature of Project Guide

Table of Contents

Page No.

Department of Master of Computer Applications

Rubrics for Technical/Research Seminar Presentation Assessment

Name of the Student: **USN:**

Seminar Guide:

Particulars	Excellent (4)	Good (3)	Fair (2)	Poor (1)	Final Score
Knowledge of the topic at analyse level	Demonstrates in depth knowledge; answered all questions with elaboration	Adequate knowledge on most of the topics. Answered all questions but failed to elaborate	Superficial knowledge of topic; only able to answer basic questions	Does not have any knowledge; Unable to answer questions	
Organization of the presentation	Presented in logicalsequence; introductionand background giveproper context; key pointsand conclusions are clearand well presented	Most information presented in logical sequence; clear introduction; adequate background; some irrelevant information	Problems withsequencing, lacks clear transitions; incomplete or overly detailed introduction, Emphasis given to less important information	Little or no organization, difficult to follow; missing or ineffective troduction; confusing background; key points unclear	
Level of Understanding	Sufficient for understanding and presented very effectively	Sufficient for understanding and presented well	Sufficient for understanding but not clearly presented	Too brief or insufficient for understanding or too detailed	

Presentation Skills	Clear articulation, steady delivery rate, good posture and eye contact, confident and appropriately dressed	Clear Articulation but not very polished. Able to recover from minor mistakes. Appropriately dressed	Refers to slides to make points, occasional eye contact, incorrect pronunciations, and Voice fluctuation.	Inaudible or too loud, no eye contact, delivery rate is too slow or too fast, not in formal attire	
Visuals	Visually pleasing and easy to read; good use of white space, colour, backgrounds; images and Graphics support.	Adequate layout, but with some fonts, colours, backgrounds difficult toread	Difficult to read, cluttered appearance; images improperly sized; some distracting graphics or animations	Confusing layout, text extremely difficult to read;many graphics, sounds, animations distract from the presentation	
				Total Score	

Rubrics for Seminar Report Assessment

	Excellent (2)	**Good (1)**	**Poor(0)**	**Final Score**
Objective, relevance, impact and conclusion	The purpose and objective, relevance and impact of the topic is made clear, and the report addresses them in a focused and logical manner.	The purpose and objective, relevance and impact of the topic is made clear, and the report addresses them.	The report does not clearly address any of them.	

Grammar & Spelling	Very few spelling errors, correct punctuation, grammatically correct, complete sentences.	Occasional lapses in spelling, punctuation, grammar, but not enough to seriously distract the reader.	Numerous spelling errors, non-existent or incorrect punctuation, and/or severe errors in grammar that interfere with understanding.	
References	Sources are acknowledged with full reference details.	Sources are acknowledged with bare reference details.	Sources are not acknowledged.	
Report Format	All required elements of the report are present and completed efficiently.	All required elements of the report are present and completed to a satisfactory standard.	Key elements of the report are not provided. Overall presentation of the document is not to a professional standard.	
Plagiarism Check	Plagiarism below 10%	Plagiarism between 10% and 25%	Plagiarism more than 25%	
Total Score				

The seminar rubrics can be mapped to the following POs:

POs / Rubrics	PO1/PO2	PO5/PO6	PO7	PO9	PO10
Knowledge of the topic	3		3		2
Organization of the presentation& Report	2	3	3	3	
Level of Understanding			3		1
Presentation Skills			3	3	
Visuals		3	3	3	

PO1: Apply knowledge of computing fundamentals to provide IT solutions.

PO2: Analyse IT problems using fundamental principles of mathematics and computing sciences

PO5: modern tool usage [for references handling, plagiarism check, spelling check etc]

PO6: Understand professional ethics, cyber regulations, and responsibilities.

PO7: Engage and learn independently for continual development as an IT professional.

PO9: Comprehend, write effective reports and make quality presentations.

PO10: Understand the impact of IT solutions on socio-environmental issues

Course outcomes: At the end of the Seminar Course, students will be able to

CO1: Analyse relevant topic in computing sciences and make valid conclusions on industry/society/environment using fundamental/ research based knowledge

[mapped to PO1, PO2 and PO10]

CO2: Demonstrate self-learning by making effective presentation and report writing

[Mapped to PO7 and PO9]

CO3: Understand ethics, cyber regulations / responsibilities and demonstrate the same by using relevant / modern tool [mapped to PO5 and PO6]

Rubrics for Seminar Presentation Assessment (out of 50 marks) =

Rubrics for Seminar Report Assessment(out of 50 marks) =

Total Marks (Out of 100 marks) =

Note : Marks obtained out of 100 may be considered as attainment of CO1, CO2 and CO3 taken together.

Signature of Seminar Guide / Coordinator

1. **Name:**
   Signature:

2. Name:
Signature:

Signature of HOD

Note: Department offering MCA programme can define its own programme outcomes/course outcomes/rubrics. Sample of such items given here may be referred.

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI.

Scheme of Teaching and Examinations and Syllabus

MASTER OF BUSINESS ADMINISTRATION

(Effective from Academic year 2020 - 21)

SCHEME OF TEACHING AND EXAMINATION

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI
Scheme of Teaching and Examinations – 2020 - 21
MASTER OF BUSINESS ADMINISTRATION
Choice Based Credit System (CBCS) and Outcome Based Education(OBE)

I SEMESTER

Sl. No	Course	Course Code	Course Title	Teaching Hours /Week		Examination				Credits
				Theory	Practical component	Duration in hours	CIE Marks	SEE Marks	Total Marks	
1	PCC	20MBA11	Management & Organizational Behavior	03	02	03	40	60	100	4
2	PCC	20MBA12	Managerial Economics	03	02	03	40	60	100	4
3	PCC	20MBA13	Accounting for Managers	03	02	03	40	60	100	4
4	PCC	20MBA14	Business Statistics	03	02	03	40	60	100	4
5	PCC	20MBA15	Marketing Management	03	02	03	40	60	100	4
6	PCC	20MBA16	Managerial Communication	03	02	03	40	60	100	4
			TOTAL	**18**	**12**	**18**	**240**	**360**	**600**	**24**

Note:
PCC: Professional Core Course
Practical /Field Work / Assignment are part of contact hours for the faculty and must be considered in the workload.
Four credit courses are designed for 50 hours Teaching – Learning process.

Note:

1. Each course has a theory component of 3hrs (3credits) and a practical component of 2hrs (1credit). The time-table allotment for each course should be 5hrs (3+2). For the practical component it is mandatory to maintain a record.
2. 20% of marks should be allocated for application oriented questions in the **Semester End Examination (SEE)** question paper based on practical component.
3. Each course content has indicative case studies which can be dealt in the class by the course instructor. In addition to this the course instructor may use an extra case from Harvard/Case Centre. The student cannot assume the same cases will be part of the SEE question paper.
4. One industrial visit per semester is mandatory. The department shall insist on report submission by each student and shall maintain this as a documentary proof. The format of the report shall be prescribed by the department.
5. Students and course instructor/s to involve either individually or in groups to interact together to enhance the learning and application skills.
6. **Practical component:**
   Students should interact with industry (small, medium and large) to understand their problems or foresee what can be undertaken for study in the form of research/ testing / projects and for creative and innovative methods for guidance and to solve the identified problem.
7. **The students shall**
   (a) Gain confidence in modeling of management systems.
   (b) Work on different software/s (tools) to simulate, analyse and authenticate the output to interpret and conclude.
   (c) Involve in case studies and field visits/ field work.
   (d) Accustom with the use of standards to narrow the gap between academia and industry.

   All activities should enhance student's abilities to employment and/or self-employment opportunity, management skills, statistical analysis, fiscal expertise etc.

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI
Scheme of Teaching and Examinations – 2020 - 21
MASTER OF BUSINESS ADMINISTRATION
Choice Based Credit System (CBCS) and Outcome Based Education(OBE)

II SEMESTER

Sl. No	Course	Course Code	Course Title	Teaching Hours /Week		Examination				Credits
				Theory	Practical Component	Duration in hours	CIE Marks	SEE Marks	Total Marks	
1	PCC	20MBA21	Human Resource Management	03	02	03	40	60	100	4
2	PCC	20MBA22	Financial Management	03	02	03	40	60	100	4
3	PCC	20MBA23	Research Methodology	03	02	03	40	60	100	4
4	PCC	20MBA24	Operations Research	03	02	03	40	60	100	4
5	PCC	20MBA25	Strategic Management	03	02	03	40	60	100	4
6	PCC	20MBA26	Entrepreneurship & Legal Aspects	03	02	03	40	60	100	4
TOTAL				**18**	**12**	**18**	**240**	**360**	**600**	**24**

Note:
PCC: Professional Core Course
Practical /Field Work / Assignment are part of contact hours for the faculty and must be considered in the workload.
Four credit courses are designed for 50 hours Teaching – Learning process.

Note:

1. Each course has a theory component of 3hrs (3credits) and a practical component of 2hrs (1credit). The time-table allotment for each course should be 5hrs (3+2). For the practical component it is mandatory to maintain a practical record.
2. 20% of marks should be allocated for application oriented questions in the SEE Question Paper, based on practical component.
3. Each course content has indicative case studies which can be dealt in the class by the course instructor. In addition to this the course instructor may use an extra case from Harvard/Case Centre. The student cannot assume the same cases will be part of the question paper.
4. One industrial visit per semester is mandatory. The department shall insist on report submission by each student and shall maintain this as a documentary proof. The format of the report shall be prescribed by the department.
5. Internship (four weeks) to be carried out by students after second semester during vacation and the report submitted by the students be assessed internally during the third semester.

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI
Scheme of Teaching and Examinations – 2020 - 21
MASTER OF BUSINESS ADMINISTRATION
Choice Based Credit System (CBCS) and Outcome Based Education(OBE)

III SEMESTER(Core Courses and Specialisation Courses)

Sl. No	Course	Course Code			Teaching Hours /Week		Examination				Credits
		Marketing	Finance	Human Resource	Theory	Practical Component	Duration in hours	CIE Marks	SEE Marks	Total Marks	
1	PCC	20MBA301*	20MBA301*	20MBA301*	03	02	03	40	60	100	4
2	PCC	20MBA302*	20MBA302*	20MBA302*	03	02	03	40	60	100	4
3	PEC	20MBAMM303	20MBAFM303	20MBAHR303	03	02	03	40	60	100	4
4	PEC	20MBAMM304	20MBAFM304	20MBAHR304	03	02	03	40	60	100	4
5	PEC	20MBAMM305	20MBAFM305	20MBAHR305	03	02	03	40	60	100	4
6	PEC	20MBAMM306	20MBAFM306	20MBAHR306	03	02	03	40	60	100	4
7	PCC	20MBA IN 307	20MBA IN 307	20MBA IN 307	-	08	-	40	60	100	4
TOTAL					**18**	**20**	**18**	**280**	**420**	**700**	**28**

Note:
PCC: Professional Core Course, PEC: Professional Elective Course.
Practical /Field Work / Assignment are part of contact hours for the faculty and must be considered in the workload.
Four credit courses are designed for 50 hours Teaching – Learning process.
*** Interdisciplinary Core Courses may be taught by engineering faculty/subject expert.**

Note:

1. Each course has a theory component of 3hrs (3credits) and a Practical component of 2hrs (1credit). The time-table allotment for each course should be 5hrs (3+2). For the practical component it is mandatory to maintain a practical record.
2. 20% of marks should be allocated for application oriented questions in the SEE Question Paper, based on practical component.
3. One industrial visit per Semester is mandatory. The Department shall insist on report submission by each student and shall maintain this as a documentary proof. The format of the report shall be prescribed by the department.
4. Each course content has indicative case studies which can be dealt in the class by the course instructor. In addition to this the course instructor may use an extra case from Harvard/Case Centre. The student cannot assume the same cases will be part of the question paper.
5. Project (six weeks) to be carried out by students after third semester and the report submitted by the students during the fourth semester.

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MASTER OF BUSINESS ADMINISTRATION
Choice Based Credit System (CBCS) and Outcome Based Education(OBE)

III SEMESTER (Core Courses and Dual Specialisation)

Sl. No	Course	Course Code			Teaching Hours /Week		Examination				Credits
		Marketing & Finance	Finance& Human Resource	Human Resource & Marketing	Theory	Practical Component	Duration in hours	CIE Marks	SEE Marks	Total Marks	
1	PCC	20MBA301*	20MBA301*	20MBA301*	03	02	03	40	60	100	4
2	PCC	20MBA302*	20MBA302*	20MBA302*	03	02	03	40	60	100	4
3	PEC	20MBAMM303	20MBAFM303	20MBAHR303	03	02	03	40	60	100	4
4	PEC	20MBAMM304	20MBAFM304	20MBAHR304	03	02	03	40	60	100	4
5	PEC	20MBAFM303	20MBAHR303	20MBAMM303	03	02	03	40	60	100	4
6	PEC	20MBAFM304	20MBAHR304	20MBAMM304	03	02	03	40	60	100	4
7	PCC	20MBA IN 307	20MBA IN 307	20MBA IN 307	--	08	--	40	60	100	4
TOTAL					**18**	**20**	**18**	**280**	**420**	**700**	**28**

Note:
PCC: Professional Core Course, PEC: Professional Elective Course.
Practical /Field Work / Assignment are part of contact hours for the faculty and must be considered in the workload.
Four credit courses are designed for 50 hours Teaching – Learning process.
*** Interdisciplinary Core Courses may be taught by engineering faculty/subject expert.**

Note:

1. Each course has a theory component of 3hrs (3credits) and a practical component of 2hrs (1credit). The time-table allotment for each course should be 5hrs (3+2). For the practical component it is mandatory to maintain a practical record.
2. 20% of marks should be allocated for application oriented questions in the SEE Question Paper, based on practical component.
3. One industrial visit per semester is mandatory. The Department shall insist on report submission by each student and shall maintain this as a documentary proof. The format of the report shall be prescribed by the department.
4. Each course content has indicative case studies which can be dealt in the class by the course instructor. In addition to this the course instructor may use an extra case from Harvard/Case Centre. The student cannot assume the same cases be part of the question paper.
6. Project (six weeks) to be carried out by students after third semester and the report submitted by the students during the fourth semester.

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MASTER OF BUSINESS ADMINISTRATION
Choice Based Credit System (CBCS) and Outcome Based Education(OBE)

III SEMESTER
Core Courses

Subject Code	Title of the Subject		Subject Code	Title of the Subject		Subject Code	Title of the Subject
20MBA301	Emerging Exponential Technologies		20MBA301	Emerging Exponential Technologies		20MBA301	Emerging Exponential Technologies
20MBA302	Technology & Operational Strategy		20MBA302	Technology & Operational Strategy		20MBA302	Technology & Operational Strategy

Specialisation Courses

Marketing Professional Elective Courses			**Finance Professional Elective Courses**			**Human Professional Elective Courses**	
Subject Code	**Title of the Subject**		**Subject Code**	**Title of the Subject**		**Subject Code**	**Title of the Subject**
20MBAMM303	Services Marketing		20MBAFM 303	Investment Management		20MBAHR303	Recruitment & Selection
20MBAMM304	Marketing Research & Analytics		20MBAFM304	Direct Taxation		20MBAHR304	Human Resource Analytics
20MBAMM305	Consumer Behaviour		20MBAFM305	Banking and Financial Services		20MBAHR305	Industrial Relations and Labour Laws
20MBAMM306	Retail Management		20MBAFM306	Advanced Financial Management		20MBAHR306	Compensation & Reward System
20MBAIN307	Internship		20MBAIN307	Internship		20MBAIN307	Internship

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MASTER OF BUSINESS ADMINISTRATION
Choice Based Credit System (CBCS) and Outcome Based Education(OBE)

IV SEMESTER (Specialisation Courses)

Sl. No	Course	Specialisation Courses			Teaching Hours /Week		Examination				Credits
		Marketing	Finance	Human Resource	Theory	Practical Component	Duration in hours	CIE Marks	SEE Marks	Total Marks	
1	PEC	20MBAMM401	20MBAFM401	20MBAHR401	03	-	03	40	60	100	3
2	PEC	20MBAMM402	20MBAFM402	20MBAHR402	03	-	03	40	60	100	3
3	PEC	20MBAMM403	20MBAFM403	20MBAHR403	03	-	03	40	60	100	3
4	PEC	20MBAMM404	20MBAFM404	20MBAHR404	03	-	03	40	60	100	3
5	PEC	20MBAMM405	20MBAFM405	20MBAHR405	03	-	03	40	60	100	3
6	PEC	20MBAMM406	20MBAFM406	20MBAHR406	03	-	03	40	60	100	3
7	PCC	20MBAPR407	20MBAPR407	20MBAPR407	-	12	-	40	60	100	6
TOTAL					**18**	**12**	**18**	**280**	**420**	**700**	**24**

Note:
PEC: Professional Elective Course.
Practical /Field Work / Assignment are part of contact hours for the faculty and must be considered in the workload.
Three credit courses are designed for 40 hours Teaching – Learning process.

Note:
1. Each Course has a theory component of 3hrs (3credits). The Time-Table allotment for each course should be 3hrs.
2. 20% of marks should be allocated for application oriented questions in the SEE Question Paper, based on practical component.

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MASTER OF BUSINESS ADMINISTRATION
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IV SEMESTER(Dual Specialisation)

Sl. No	Course	Subject Code			Teaching Hours /Week		Examination				Credits
		Marketing & Finance	Finance& Human Resource	Human Resource & Marketing	Theory	Practical Component	Duration in hours	CIE Marks	SEE Marks	Total Marks	
1	PEC	20MBAMM401	20MBAFM401	20MBAHR401	03	-	03	40	60	100	3
2	PEC	20MBAMM402	20MBAFM402	20MBAHR402	03	-	03	40	60	100	3
3	PEC	20MBAMM403	20MBAFM403	20MBAHR403	03	-	03	40	60	100	3
4	PEC	20MBAFM401	20MBAHR401	20MBAMM401	03	-	03	40	60	100	3
5	PEC	20MBAFM402	20MBAHR402	20MBAMM402	03	-	03	40	60	100	3
6	PEC	20MBAFM403	20MBAHR403	20MBAMM403	03	-	03	40	60	100	3
7	PCC	20MBAPR407	20MBAPR407	20MBAPR407	-	12	-	40	60	100	6
TOTAL					**18**	**12**	**18**	**280**	**420**	**700**	**24**

Note:
PEC: Professional Elective Course.
Practical /Field Work / Assignment are part of contact hours for the faculty and must be considered in the workload.
Three credit courses are designed for 40 hours Teaching – Learning process.

Note:
1. Each Course has a theory component of 3hrs (3credits). The Time-Table allotment for each course should be 3hrs.
2. 20% of marks should be allocated for application oriented questions in the SEE Question Paper, based on practical component.

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Scheme of Teaching and Examinations – 2020 - 21
MASTER OF BUSINESS ADMINISTRATION
Choice Based Credit System (CBCS) and Outcome Based Education(OBE)

IV SEMESTER (Specialisation Courses)

Marketing Specialization			Financial Specialization			Human Resource Specialization	
Subject Code	**Title of the Subject**		**Subject Code**	**Title of the Subject**		**Subject Code**	**Title of the Subject**
20MBAMM401	B2B Marketing Management		20MBAFM401	Risk Management and Insurance		20MBAHR401	Organizational Leadership
20MBAMM402	Logistics and Supply Chain Management		20MBAFM402	Financial Derivatives		20MBAHR402	Personal Growth & Interpersonal Effectiveness
20MBAMM403	Digital Marketing Management		20MBAFM403	Indirect Taxation		20MBAHR403	International Human Resource Management
20MBAMM404	Strategic Brand Management		20MBAFM404	Mergers, Acquisitions & Corporate Restructuring		20MBAHR404	Organization Change and Development
20MBAMM405	Agri Business Marketing		20MBAFM405	Corporate Valuation		20MBAHR405	Human Recourse Audit
20MBAMM406	International Marketing Management		20MBAFM406	International Financial Management		20MBAHR406	Management Consulting for Business Excellence
20MBAPR407	Project Report		20MBAPR407	Project Report		20MBAPR407	Project Report

Programme Outcomes (POs)

1. Students are given sufficient theoretical knowledge and are enabled to apply them to solve practical problems in business and other organizations/institutions of importance
2. Students are provided effective communication skills with a high degree of lateral and critical thinking that enhances learn ability, developed for being continuously employable.
3. Students are instilled with leadership qualities, ethically sound, enabled with decision making skills that reflect a high degree of social consciousness
4. Students are trained for sustained research orientation to comprehend a growingly complex, economic, legal and ethical environment
5. Students are equipped with self sustaining entrepreneurship qualities that encourages calculated risk taking.

MANAGEMENT & ORGANIZATIONAL BEHAVIOUR			
Course Code	20MBA11	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Course Objectives

1. The student will be able to recite the theories and models of Management and Organisational Behavior.
2. The student will be able to apply and solve the workplace problems.
3. The student will be able to classify in differentiating between the best methods to solve the problem.
4. The student will be able to compare the appropriate framework for solving the problems at the workplace
5. The student will be able to design model in dealing with the problems in the organisation.

Module-1 Introduction to Management **9 hours**

Management -Introduction, Meaning, Nature, Objectives, Importance, Difference between Administration and Management, Levels of Management, Types of Managers, Managerial Skills, Managerial Competencies, Scope of Management, Functions of Management, Evolution of Management Thought, Fayol's fourteen principles of Management, Recent Trends in Management.

Module -2 Functions of Management **10 hours**

Planning- Definition, Features, Nature, Importance, Types, Steps in Planning, Planning Tools and Techniques, Essentials of a Good Plan. **Organisation-**Definitions, Importance, Principles, Types of Organisation Structures, Span of Control, Centralisation and Decentralisation of Authority. **Directing-**Definitions, Importance, Elements of Directing, Principles of Directing, Characteristics of Directing; **Controlling-**Definitions, Need of Controlling, Characteristics of Control, Steps in the Controlling Process, Resistance to Control, Design of Effective Control System, Types of Control, Control Techniques. **Decision-making-** Concepts, Types, Models, Difficulties in Decision-making, Decision-making for Organisational Effectiveness, Decision-making Styles.

Module -3 Organisational Behaviour **10 hours**

Organisational Behaviour: Introduction, Definitions, Nature, Goals, Importance, Approaches to Organisational Behaviour, Models. **Attitude-** Meaning, Definition, Types, Components, Attitudes and Behaviour, Changing Attitudes in the Workplace; **Perception-**Perception, Perceptual Process, Factors Influencing Perception, Perception and Decision-making; **Personality-**Definitions, Factors Influencing Personality, Big Five Personality Traits, Myers–Briggs Type Indicator (MBTI), Personality Tools and Tests; **Motivation-**Definitions, Process of Motivation (Cycle of Motivation), Nature, Importance, Types, Theories.

Module -4 Managing Human at Work **7 hours**

Group Dynamics- Meaning of Group, Group Characteristics, Classification of Groups, Models of Group Development, Meaning of Group Dynamics, Group Behaviour, Impact of Group on Individual's Behaviour, Impact of External Factors on Group Behaviour. **Teamwork-** Nature of Teams, Team Characteristics, Teams Versus Groups, Teamwork, Processes of Teamwork, Types of Teams, Reasons for Team Failure, Creating Effective Teams.

Module-5 Organizational Power, Politics and Culture **7 hours**

Power and Politics- Nature of Power and Politics, Early Voices, Questioning Power and Authority, Sources of Power for Individuals, Managing Organisational Politics. **Culture-** Definitions of Organisational Culture, Strong Versus Weak Culture, Characteristics, Types, Levels, Dimensions, Creating Organisational Culture, Changing Organisational Culture.

Module - 6 Change and Stress Management **7 hours**

Change- Nature, Characteristics, Process, Forces Responsible for Change in Organizations, Resistance to Change, Managing Resistance to Change. **Stress Management-**Definitions, Understanding Stress, Relation between Stress and Performance, Level, Signs and Symptoms of Stress, Types of Stress, Causes of Stress, Managing Stress.

Course Outcomes:

1. Gain practical experience in the field of Management and Organization Behaviour
2. Acquire the conceptual knowledge of Management, various functions of Management and theories in Organizational Behaviour.
3. Apply managerial and behaviour knowledge in real world situations.
4. Develop a greater understanding about Management and Behavioural aspects to analyse the concepts related to individual behavior, attitude, perception and personality.
5. Understand and demonstrate their exposure on recent trends in management.

Practical Component:

- Visit an Organisation and meet HR / Manager and note the Roles played in a Day.
- Conduct an event and try understanding the dynamics that goes on group.
- Develop few questions, interact with people in the organisation and try observing personality and reaction.
- Meet any Leader / HOD / Dean and observe the Management of depts. under the leader.

Note: Faculty can either identify the organizations/ leaders/job profile or students can be allowed to choose the same.

CO-PO Mapping

CO	PO				
	PO1	PO2	PO3	PO4	PO5
CO1	X	X	X		X
CO2	X			X	
CO3	X				X
CO4	X	X	X		X
CO5	X	X	X	X	X

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have 8 full questions carrying equal marks.
- Each full question is for 20 marks.
- Each full question will have sub question covering all the topics under a Module.
- The students will have to answer five full questions; selecting four full question from question number one to seven and question number eight is compulsory.
- 100 percent theory in the SEE

Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Essentials of Management	Koontz	McGraw Hill	8e, 2014
2	Principles and Practices of Management and Organisational Behaviour	Chandrani Singh and Aditi Khatri	Sage Publication	2016
3	Organizational behaviour	Stephen P Robbins, Timothy	Pearson	14e, 2012
Reference Books				
1	Organizational Behaviour	Fred Luthans,	McGraw Hill International	12/e, 2011
2	Principles of Management	Ramesh B. Rudani	Tata McGraw-Hill	2013
3	Masters of Management Thought	Mahanand Charati& M M Munshi	Swapna Book House	2015

MANAGERIAL ECONOMICS			
Course Code	20MBA12	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Course Objectives:

1. To introduce the fundamentals, tools and theories of managerial economics.
2. To provide an understanding of the application of Economics in Business
3. To learn the basic Micro and Macroeconomic concepts.
4. To have an understanding of Demand, Production, Cost, Profit and Market competitions with reference to a firm and industry.

Module -1 Introduction **7 hours**

Managerial Economics: Meaning, Nature, Scope, & Significance, Uses of Managerial Economics, Role and Responsibilities of Managerial Economist. Theory of the Firm: Firm and Industry, Objectives of the firm, alternate objectives of firm. Managerial theories: Baumol's Model, Marris's Hypothesis, Williamson's Model.

Module -2 Demand Analysis **9 hours**

Law of Demand, Exceptions to the Law of Demand, Elasticity of Demand –Classification of Price, Income & Cross elasticity, Advertising and promotional elasticity of demand. Uses of elasticity of demand for Managerial decision making, Measurement of elasticity of demand. Law of supply, Elasticity of supply, Demand forecasting: Meaning & Significance, Methods of demand forecasting. (No problems).

Module -3 Cost Analysis & Production analysis **9 hours**

Concepts of Production, production function with one variable input - Law of Variable Proportions. Production function with 2 variable inputs and Laws of returns to scale, Indifference Curves, ISO-Quants & ISO-Cost line, Least cost combination factor, Economies of scale, Diseconomies of scale. Technological progress and production function. Types of cost, Cost curves, Cost – Output Relationship in the short run and in the long run, LAC curve **Break Even Analysis** – Meaning, Assumptions, Determination of BEA, Limitations, Uses of BEA in Managerial decisions (with simple Problems).

Module -4 Market structure and Pricing Practices **9 hours**

Perfect Competition, Features, Determination of price under perfect competition, Monopoly: Features, Pricing under monopoly, Price Discrimination. Monopolistic Competition: Features, Pricing Under monopolistic competition, Product differentiation. Oligopoly: Features, Kinked demand Curve, Cartels, Price leadership.

Descriptive Pricing Approaches: Full cost pricing, Product line pricing, Pricing Strategies: Price Skimming, Penetration Pricing, Loss leader pricing, Peak Load pricing.

Module -5 Indian Business environment **9 hours**

Nature, Scope, Structure of Indian Business Environment – Internal and External Environment. Political and Legal Environment, Economic Environment, Socio – Cultural Environment, Global Environment

Basic Macro Economic Concepts: Open and Closed Economies, Primary, secondary and Tertiary sectors and their contribution to the economy. SWOT Analysis for the Indian economy. Measuring the Economy: Measuring GDP and GDP Growth rate, Components of GDP.

Module-6 Indian Industrial Policy **7 hours**

Industrial Policies and Structure: A critical look at Industrial Policies of India, New Industrial Policy 1991; - Private Sector- Growth, Problems and Prospects, SMEs –Significance in Indian economy-problems and prospects. **Fiscal policy and Monetary Policy. Foreign Trade:** Trends in India's Foreign Trade, Impact of WTO on India's Foreign Trade.

Course outcomes:

At the end of the course the student will be able to:

1. The student will understand the application of Economic Principles in Management decision making.
2. The student will learn the micro economic concepts and apply them for effective functioning of a Firm and Industry.
3. The Student will be able to understand, assess and forecast Demand.
4. The student will apply the concepts of production and cost for optimization of production.
5. The student will design Competitive strategies like pricing, product differentiation etc. and marketing according to the market structure.
6. The student will be able to understand macroeconomic concepts.

Practical Component:

- Assessment of Demand Elasticity – Price, Income, Cross, Advertising.
- Demand Forecasting:
- Application of qualitative and quantitative methods of demand forecasting to various sectors (Automobile, Service, Pharmaceutical, Information Technology, FMCG, Hospitality etc.) in India.
- Preparing a Project proposal for a Business Venture.(Compulsory)

CO-PO MAPPING

CO	PO				
	PO1	PO2	PO3	PO4	PO5
CO1	X		X		
CO2	X	X		X	
CO3	X				X
CO4	X				X
CO5	X			X	
CO6	X			X	

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have 8 full questions carrying equal marks.
- Each full question is for 20 marks.
- Each full question will have sub question covering all the topics under a Module.
- The students will have to answer five full questions; selecting four full question from question number one to seven and question number eight is compulsory.
- 80 percent theory and 20 percent problems in the SEE.

Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Managerial Economics	Geethika, Ghosh & Choudhury	McGraw Hill	2/e, 2011
2	Managerial Economics	Dominick Salvotore,	Oxford Publishers	2e, 2016

Reference Books

1	Managerial Economics	R. Panneerselvam, P. Sivasankaran, P. Senthilkumar	Cengage	2015
2	Managerial Economics	Samuelson & Marks	Wiley	5/e, 2015
3	Managerial Economics	D.M Mithani	HPH	2016
4	Managerial Economics	H.L Ahuja Samuelson & Marks	S.Chanda	2014

ACCOUNTING FOR MANAGERS			
Course Code	20MBA13	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Course Objectives

1. To explain fundamental accounting concepts, the elements of financial statements, and basic accounting vocabulary.
2. To explain and use the accounting equation in basic financial analysis and explain how the equation is related to the financial statements.
3. To prepare basic entries for business transactions and present the data in an accurate and meaningful manner.
4. Prepare basic financial statements and explain the articulation between the basic statements.
5. To analyze a company's financial statements and come to a reasoned conclusion about the financial situation of the company.

Module-1 Introduction to Accounting **7 hours**

Financial Accounting: Need and Types of Accounting, Single Entry System, Double Entry System, Concepts and Conventions of Accounting, Relation of Accounting with other disciplines, Journal, Ledgers, Trial balance.

Module -2 Financial Statements **10 hours**

Preparation of final accounts of companies in vertical form as per Companies Act of 2013 (Basic problems of Final Accounts), Window dressing. Case Study problem on Final Accounts of Company-Appropriation accounts.

Module -3 Analysis of Financial Statements **10 hours**

Limitations of Financial Statements; Meaning and Purpose of Financial Statement Analysis, Trend Analysis, Comparative Analysis, Financial Ratio Analysis, Preparation of Financial Statements using Financial Ratios, Case Study on Financial Ratio Analysis. Preparation of Cash flow Statement (indirect method). **Lab compulsory for Financial Statement Analysis using excel.**

Module -4 Management Accounting **9 hours**

Scope, Purpose of Management Accounting

Cost Volume Profit Analysis: Meaning-Methods of determination-Applications. Managerial Decision-Making-Make /Buy etc: Short-run Decision Analysis-Decision situations: Sales-volume related, Sell or further process, Make or Buy, Operate or shut-down.

Module -5 Functional and Flexible Budgeting **7 hours**

Functional budgets, Flexible Budgets: Meaning-Measure of Volume-Cost Behaviour with change in volume-Fixed, variable & mixed costs.Variance Analysis: Cost Variances – Revenue Variances-Variance Reporting-Disposition of variances.

Module-6 Emerging Issues in Accounting and Computerised Accounting **7 hours**

Emerging Issues in Accounting: Human Resource Accounting, Forensic Accounting, Sustainability Reporting, Applicability of Ind AS – Indian Accounting Standards.

Computerised Accounting Systems-Structuring Database for Accounting- Accounting system Using Database Management systems- Illustration of Accounting Database.

Course outcomes:

At the end of the course the student will be able to:

1. Demonstrate theoretical knowledge and its application in real time accounting.
2. Capable of preparing financial statement of companies.
3. Independently undertake financial statement analysis and take decisions.
4. Comprehend emerging trends in accounting and computerization of Accounting systems.

Practical Components:

- To collect Annual reports of the companies and analyzing the financial statements using different techniques and presenting the same in the class.
- To analyze the companies' cash flow statements and presenting the same in the class.
- To get exposed to use of accounting software's (preferably Tally. ERP 9).
- To identify the sustainability report of a company and study the contents.

CO-PO MAPPING

CO	PO				
	PO1	PO2	PO3	PO4	PO5
CO1	X		X		X
CO2	X	X	X		
CO3	X	X	X		
CO4	X	X		X	X

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have 8 full questions carrying equal marks.
- Each full question is for 20 marks.
- Each full question will have sub question covering all the topics under a Module.
- The students will have to answer five full questions; selecting four full question from question number one to seven and question number eight is compulsory.
- 40 percent theory and 60 percent problems in the SEE.

Textbooks

Sl. No.	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Accounting for Management-Text & Cases	S.K.Bhattacharya & John Dearden	Vikas Publishing House Pvt. Ltd.	3e, 2018
2	Financial Accounting	S.N.Maheshwari, Suneel K. Maheshwari, Sharad K. Maheshwari	Vikas Publishing House Pvt. Ltd.	6e, 2018
3	Computerized Accounting	Neeraj Goyal, Rohit Sachdeva	Kalyani Publishers	1e, 2018
Reference Books				
1	Accounting for Managers	J.Made Gowda	Himalaya Publishing House	1e, 2007
2	Financial Accounting for Management	N. Ramachandran, Ram Kumar Kakani	McGraw Education (India) Private Limited	4e., 2016
3	Management Accounting : Text, Problems and Cases	M Y Khan, P K Jain	Tata McGraw-Hill Education	7e, 2007
4	Accounting and Finance for Non-finance Managers	Jai Kumar Batra	Sage Publications	1e, 2018

BUSINESS STATISTICS			
Course Code	20MBA14	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Course Objectives:

1. To make the students learn about the applications of statistical tools and Techniques in decision making.
2. To emphasize the need for statistics and decision models in solving business problems.
3. To enhance the knowledge on descriptive and inferential statistics.
4. To develop analytical skills in students in order to comprehend and practice data analysis at different levels.
5. To familiarize the students with analytical package MS Excel.

Module -1 Introduction to Statistics **9 hours**

Introduction to Statistics: Meaning and Definition, functions, scope and limitations, Collection and presentation of data, frequency distribution, measures of central tendency - Mean, Median, Mode, Geometric mean, Harmonic mean. **Measures of dispersion:** Range – Quartile Deviation – Mean Deviation -Standard Deviation – Variance- Coefficient of Variance - Comparison of various measures of Dispersion.

Module -2 Correlation and Regression **7 hours**

Scatter Diagram, Karl Pearson correlation, Spearman's Rank correlation (one way table only), simple and multiple regressions (problems on simple regression only).

Module -3 Probability Distribution **9 hours**

Probability Distribution: Concept and definition - Rules of probability –Random variables – Concept of probability distribution – Theoretical probability distributions: Binomial, Poisson, Normal and Exponential – Baye's theorem (No derivation) (Problems only on Binomial, Poisson and Normal).

Module -4 Time Series Analysis **8 hours**

Time Series Analysis –Objectives, Variations In Time Series - Methods Of Estimating Trend: Freehand Method - Moving Average Method - Semi-Average Method - Least Square Method. Methods of Estimating Seasonal Index: Method Of Simple Averages - Ratio To Trend Method - Ratio To Moving Average Method.

Module -5 Hypotheses **7 hours**

Types, characteristics, source, formulation of hypotheses, errors in hypotheses. Parametric and Non-Parametric Tests- t-test, z-test, f-test, u-test, K-W Test (problems on all tests). Normality and reliability of hypothesis. Statistical analysis- Bivariate and Multivariate Analysis- ANOVA-one-way, two-way classification (theory only).

Module-6 Computer lab for Statistics **10 hours**

MS Excel: Functions, Formulas, Types of errors in excel, Data analysis using MS-Excel- Mean, Median, Mode, Geometric Mean, Harmonic mean, Standard Deviation, Correlation

Course Outcomes:

At the end of the course the student will be able to:

1. Facilitate objective solutions in business decision making under subjective conditions.
2. Demonstrate different statistical techniques in business/real-life situations.
3. Understand the importance of probability in decision making.
4. Understand the need and application of analytics.
5. Understand and apply various data analysis functions for business problems.

Practical Component:

- Students are expected to have a basic excel classes.
- Students need to be encouraged to do a small primary research inside the classroom in groups and to analyze the data using statistical tools like Mean, SD, Correlation(Ex: Motivation, Stress etc)
- Students can also be encouraged to go out for a live survey in Malls, Showrooms and in other Colleges to collect data's and to analyze it. Ex: Buying behavior, Brand aspects etc)

Lab compulsory-minimum 10 hours.

CO-PO MAPPING

CO	PO				
	PO1	PO2	PO3	PO4	PO5
CO1	X			X	X
CO2	X	X	X		X
CO3	X		X		X
CO4	X		X		
CO5	X	X	X	X	X

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have 8 full questions carrying equal marks.
- Each full question is for 20 marks.
- Each full question will have sub question covering all the topics under a Module.
- The students will have to answer five full questions; selecting four full question from question number one to seven and question number eight is compulsory.
- 40 percent theory and 60 percent problems in the SEE.

Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Fundamentals of Statistics	S C Gupta	Himalaya Publications	2012
2	Research Methodology	Ranjit Kumar	Sage Publications	2018
3	Parametric and Non Parametric Statistics	Vimala Veeraraghavan and Suhas	Sage Publication	2017
Reference Books				
1	Statistical Methods	Dr. S P Gupta	Sultan Chand Publications	2014
2	Research Methodology	C R Kothari	Viswa Prakasam Publication	2015
3.	Business Research Methods	S.N.Murthy and U.Bhojanna.	Excel Books	3e, 2016

MARKETING MANAGEMENT			
Course Code	20MBA15	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Course Objectives

1. Make students have an understanding of the fundamental concepts of marketing & the environment in which marketing system operates.
2. To analyze the motives influencing buying behaviour & Describe major bases for segment marketing, target marketing, and market positioning.
3. Identify a Conceptual framework, covering basic elements of the marketing mix.
4. To understand fundamental premise underlying market driven strategies.
5. Giving them hands on practical approach to subject study.

Module-1 Introduction to Marketing **9 hours**

Marketing V/s Selling, Customer value, Components of customer value and components of customer cost. Marketing Ethics- green marketing and green economy. Marketing Myopia.Marketing Environment - Components of Environment to be analysed- Micro/ Macro Environment, Technological environment, Socio-cultural environment, Economic Environment, Legal Environment, Consumer/demographic environment, Government policies, Political environment. Techniques used in Environment Analysis. Contemporary Indian Marketing Environment. Cause and Social Marketing alternate concepts like 3V concepts of Nirmalaya Kumar Social Responsibility of marketing- new marketing realities, new responsibilities, new-age marketing, societal marketing concept, Corporate Social Responsibility. Emerging areas- Neuro Marketing , Sensory Marketing- concepts only. **Assignment:** Contemporary Indian Marketing Environment

Module -2 Analysing Consumer Behaviour **9 hours**

Connecting with consumers and consumer in sighting, Factors influencing Consumer Behaviour, Consumer characteristics influencing buying behaviour- personal factors and cultural factors. Consumer Buying Decision Process, Buying Roles, Buying Motives. The black box model of consumer behaviour. Psychological Processes underlying consumer behaviour. **Market Segmentation:** Concept of Market Segmentation, Benefits, Requisites of Effective Segmentation, Bases for Segmenting Consumer Markets, Market Segmentation Strategies. Segmentation method – Geographic segmentation and Demographic segmentation, psychographic segmentation, behavioural segmentation, volume segmentation, deep segmentation. Indian Consumer- Features about consumer India, Classifying Indian consumer by Income B2B marketing Vs Consumer Marketing. **Assignment- Live projects on Consumer Behaviour.**

Module -3 Product, Brand Equity, Services Marketing **9 hours**

Product Management- fundamentals, primary objective of product management, product hierarchy, product line, product mix, product mix strategies, Appraisal of product lines, products and brands. Managing PLC of product/brand, New Product Development, packing as a marketing tool, Role of labelling in packing. Main tasks in product management. Components of Product personality. Brand- selecting brand name, selecting logo, brand extension- effects. Introducing new product, innovations, new product development, stages in new product development, pricing strategy for new product. Branding - Concept of Branding, Types, Brand Equity, Branding strategies.Services Marketing & its Characteristics- tasks involved in service marketing, differentiating, positioning and brand building in services, premiumisation in service marketing.Market Segmentation, Targeting & Positioning (STP): Targeting - Bases for identifying target Customer target Marketing strategies, Positioning - Meaning, Product Differentiation Strategies, Tasks involved in Positioning. Monitoring brands performance and positioning.

Module -4 Pricing , Marketing Channels **7 hours**

Pricing decisions: Significance of pricing, factor influencing pricing (Internal factor and External factor), objectives, Pricing Strategies-Value based, Cost based, Market based, Competitor based, Pricing Procedure.
Marketing Channels: Roles and purpose of Marketing Channels, Factors Affecting Channel Choice, Channel Design, Channel Management Decision, Channel Conflict, Designing a physical Distribution System, Network Marketing. Contemporary Channels and Retailing in India.**Product Distribution Logistics:** Product distribution Concept. Distinction between distribution logistics and Supply Chain Management..

Module -5 Direct Marketing & Digital Marketing: **9 hours**

Concept and scope of direct marketing, concept and components of digital marketing. Digital marketing communications, digital marketing in India. **Promotions**- Marketing communications- Integrated Marketing

Communications (IMC)-communication objectives, steps in developing effective communication, Stages in designing message. Advertising: Advertising Objectives, Advertising Budget, Advertising Copy, AIDA model, Traditional Vs Modern Media- Online and Mobile Advertising, Social Media for Advertising. Customer Relationship Management- components. Significance of Marketing Research- importance of data.

Module - 6 Sales Promotion, Marketing Planning and Rural Marketing 7 hours

Sales Promotion: Tools and Techniques of sales promotion, Push-pull strategies of promotion. Personal selling: Steps/process involved in Personal Selling. Publicity/Public Relation-word of mouth, sponsorships. Database marketing: Basic concepts of e-commerce, e-marketing, m-Commerce, m-marketing, e-networking, CRM, MkIS.
Marketing Planning: Meaning, Steps involved in Marketing planning. Marketing Audit- Meaning, components of Marketing Audit. Market Share analysis, Marketing cost analysis, Marketing Strategic Planning Process.
Concept of Rural Marketing: Flumist (HBR) and Saffola Journey- Case Studies
Classroom Exercise: Brand Communication (create and enact a commercial)

Course outcomes:

At the end of the course the student will be able to:

1. Develop an ability to assess the impact of the environment on marketing function.
2. To formulate marketing strategies that incorporate psychological and sociological factors which influence buying .
3. Understand concept of Branding, development of product and significance of market segmentation , targeting and positioning.
4. Identifying marketing channels and the concept of product distribution.
5. Identifying techniques of sales promotion , significance of marketing research.
6. Synthesize ideas into a viable marketing plan for various modes of marketing

Practical Components:

- Understanding Contemporary Indian Marketing Environment.
- Understanding and demonstrating their exposure on consumer behaviour
- Effectively using their skill in creating and enacting a commercial on brand communication.

CO-PO MAPPING

CO	PO				
	PO1	PO2	PO3	PO4	PO5
CO1	X		X		
CO2	X	X	X		X
CO3	X	X	X		
CO4	X	X			X
CO5	X			X	
CO6	X			X	X

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have 8 full questions carrying equal marks.
- Each full question is for 20 marks.
- Each full question will have sub question covering all the topics under a Module.
- The students will have to answer five full questions; selecting four full question from question number one to seven and question number eight is compulsory.
- 100 percent theory in the SEE.

Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Marketing Management- Indian Context, Global Perspective.	Ramaswamy & Namakumari	SAGE	6th Edition

2	Marketing Management: A South Asian Perspective.	Kotler, Keller, Koshy & Jha	Pearson Education	Latest edition
3	New Product Management	Merle Crawford and Anthony Di Benedetto	McGraw-Hill	Latest Editon
4	Advertisement Brands & Consumer Behaviour	Ramesh Kumar	Sage Publications	2020
Reference Books				
1	Marketing in India: Text and Cases	Neelamegham S	Vikas	Latest edition
2	Marketing	Lamb, Hair, Mc Danniel	Cengage Learning	Latest edition
3	Fundamentals of Marketing Management,	Etzel M J BJ Walker & William J Stanton	Tata Macgraw Hill	Latest edition

MANAGERIAL COMMUNICATION			
Course Code	20MBA16	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Course Objectives:

1. To enable the students to become aware of their communication skills and sensitize them to their potential to become successful managers.
2. To enable learners with the mechanics of writing and also help them to draft business letters in English precisely and effectively.
3. To introduce the students to some of the practices in managerial communication those are in vogue.
4. To prepare students to develop the art of business communication with emphasis on analysing business situations.
5. To train Students towards drafting business proposals.

Module -1 Introduction **7 hours**

Introduction: Meaning & Definition, Role, Classification – Purpose of communication – Communication Process – Characteristics of successful communication. Communicating within Organizations – Levels of communication, Communication flow, Communication barriers, Media choices, Legal Consequences and Ethics, Communication in a cross-cultural setting.

Module -2 Oral Communication **7 hours**

Oral Communication: Meaning – Principles of successful oral communication, Conversation control –Reflection and Empathy: two sides of effective oral communication.

Oral Presentation: Role of business presentations, Planning and Organizing Presentation, Planning Team and Online Presentations, Developing Visual Support for Business presentation, Practicing and Delivering Presentation - Refining your delivery.

Business Pitch:10 steps in Pitching, Elevator Pitching

Class room Exercise: Business pitch with video recording using PowerPoint and feedback.

Module -3 Written Communication **9 hours**

Written Communication: Purpose of writing – Clarity in writing –Principles of effective writing – Approaching the writing process systematically: The 3X3 writing process for business communication Pre writing – Writing – Revising. Audience analysis, Writing Positive, Neutral, Persuasive and Bad-news Messages

Types of Written Communication in Business: Business Letters, Employee Reviews, Recommendation Letters, Thank You Letters, Memos, proposals and Reports, Planning Documents, Press Releases, Proactive Media Writing and E-mail.

Module -4 Business Reports **9 hours**

Business Reports: Purpose, Kinds and Objectives of reports – Organization & Preparing reports, short and long reports Writing, writing executive summary.

Business Case Analysis: What is a case? Characteristics of Case and its Analysis, Process of Case Analysis, Requirements of Case analysis, The structure of written cases analysis.

Meeting Documentation: Notice, Agenda, and Resolution & Minutes

Assignment: Executive summary to be submitted.

Module -5 Employment communication **9 hours**

Employment communication: Putting your best self forward, Preparing your resume, Writing covering letters and Inquiry Emails, Preparing for a Job Interview, Conducting Yourself during the Interview, Following up throughout the process, Practicing business etiquette.

Business Meetings: Format, planning, facilitating, participating and following-up.

Lab component: Video conferencing across stakeholders.

Module-6 Interpersonal Communication **9 hours**

Interpersonal Communication: Nonverbal communication and Listening.

Conflict Management and Negotiation skills: Meaning and characteristics of Conflict, Conflict management through communication, Managing the process of communication in Conflict, Verbal skills for communicating in conflict. Communication for effective negotiation – Meaning, nature and need for negotiation, Factors affecting negotiation, stages in negotiation process, Negotiation strategies.

Technological Advancement and Business Communication: Intranet, Internet, Teleconference, Video conference, Blogs, Webinars, Chat rooms, Voice and Text messaging.

Social Media: Introduction, Characteristics, Classification, Nature and scope of Six types of Social Media, Choosing the most suitable social media. Using Social Media to build business relationships.

Lab component: Creating a Blog

Note: Suggested for practical component: Effective Communication Development.

Subject faculty to design suitable practical components for the topics in syllabus.

Course Outcomes:

At the end of the course the student will be able to:

1. The students will be aware of their communication skills and know their potential to become successful managers.
2. The students will get enabled with the mechanics of writing and can compose the business letters in English precisely and effectively.
3. Students will get exposure in drafting business proposals to meet the challenges of competitive environment.
4. The students will be introduced to the managerial communication practices in business those are in vogue.
5. Students will get trained in the art of Interpersonal communication and technological advancement and social media usage in communications, with emphasis on analysing business situations.

Practical component:

- Make students enact and analyze the non-verbal cues.
- Conduct a mock meeting of students in the class identifying an issue of their concern. The students should prepare notice, agenda and minutes of the meeting.
- Organize a mock press conference addressing to the launch of new product by an organization.
- Students should be given an assignment to draft a proposal to undertake research project.
- Video conferencing across stakeholders
- Create a Blog
- Business pitch with video recording using PowerPoint and feedback

CO-PO MAPPING

CO	PO				
	PO1	PO2	PO3	PO4	PO5
CO1	X	X		X	
CO2	X	X	X		
CO3	X	X	X		X
CO4	X	X			
CO5	X	X	X		X

Question paper pattern:
The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have 8 full questions carrying equal marks.
- Each full question is for 20 marks.
- Each full question will have sub question covering all the topics under a Module.
- The students will have to answer five full questions; selecting four full question from question number one to seven and question number eight is compulsory.
- 100 percent theory in the SEE

Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Communicating in Business	Ober Newman	Cengage	8th Edition, 2018
2	BCOM A South-Asian Perspective	Lehman, Dufrene,Sinha	Cengage Learning	2nd Edition, 2012
3	Business Communication	P D Chaturvedi Mukesh Chaturvedi	Pearson	3rd Edition, 2013
4	Business and Professional Communication	Kelly m. Quintanilla Shawn T. Wahl	SAGE South Asia Edition	2017

Reference Books

1	Communicating in Business	Williams,Krizan Logan,Merrier	Cengage Learning	8th Edition, 2017
2	Business Communication: Process	Mary Ellen Guffey	Cengage Learning	3rd Edition, 2002
3	Business Communication	Lesikar,Flatley,Rentz ,Pande	TMH	11th Edition, 2011
4	Communicating in Business	Williams, Krizan, Logan & Merrier	Cengage Learning	8e, 2014

II SEMESTER

HUMAN RESOURCE MANAGEMENT			
Course Code	20MBA21	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Course Objectives

1. The student will be able to recite the theories and various functions of Human Resources Management
2. The student will be able to describe and explain in her/his own words, the relevance and importance of Human Resources Management at workplace
3. The student will be able to apply and solve the workplace problems through Human Resources Management intervention
4. The student will be able to classify and categorise in differentiating between the best method to solve the problem
5. The student will be able to compare and contrast different approaches of HRM for solving the complex issues and problems at the workplace
6. The student will be able to design and develop an original framework and model in dealing with the problems in the organization.

Module-1 Introduction **7 hours**

Human Resource Management and Personnel Management, The Importance of Human Resource Management, Models of Human Resource Management, Evolution of Human Resource Management, HRM in India, The Factors Influencing Human Resource Management , Human Resource Management and Line Managers, The HR Competencies, Human Resource Management and Firm Performance.

Module -2 Human Resource Planning **9 hours**

Importance of HR Planning, Manpower Planning to HR Planning, Factors Affecting HR Planning, Benefits of HR Planning, HRP Process, Tools for Demand Forecasting, Attributes of an Effective HR Planning, Barriers to HR Planning, The Challenges for HR, Process of Job Analysis and Job Evaluation.

Recruitment and Selection: Importance of Recruitment, Recruitment Policies, Factors Influencing Recruitment, Recruitment Process, Sources, Evaluation of Recruitment Process, Recruitment Strategy ; Selection, Future Trends in Recruitment; Selection Process; Selection Tests; Factors Influencing Selections, Challenges in Selection, Application Tracking System using MS-Excel

Learning, Training, and Development: Training, Learning and Development, Learning Theories, The Future of Training, Learning, and Development: Crystal Gazing into the Future, World of Learning. Process of training and Techniques of Training

Module -3 Performance Management and Appraisal **9 hours**

Objectives of Performance Management, Performance Management and Performance Appraisal, Common Problems with Performance Appraisals, Performance Management Process, Types of Performance Rating Systems, Future of Performance Management.

Compensation and Benefits

Introduction, Definitions, Total Compensation, Total Rewards System, Forms of Pay, Theories of Compensation, External Factors, Internal Factors, Establishing Pay Rates, Employee Benefits.

Industrial Relations

Decent Workplace: International Labor Organisation, Industrial Relations, The Objectives of Industrial Relations, Approaches of Industrial Relations Systems, The Actors in Industrial Relations, Indian Context, Industrial Relations and Human Resource Management.

Employment Relations - The Definition, Traditional Employment Relations, Actors in the Fray: Role-taking, The New Frameworks for Employment Relations, The Future of Employee Relations.

Module -4 Human Resource Management in Small and Medium Enterprises **9 hours**

Definition of SMEs, Human Resource Management and Performance in SMEs, The Difference in Adoption of Human Resource Management: SMEs and Large Firms, Indian Experience, Impact of Weak Adoption of Human Resource Management in SMEs, Factors Influencing the Adoption of Human Resource Management Practices in SMEs, Future of Human Resource. Management in SMEs.

Human Resource Management in the Service Sector

Introduction, The Emergence of the Services Sector, Implications for Human Resource, Management Function, Differences Between Services Sector and the Manufacturing Sector, Difference in Human Resource Management

Practices in Services and Manufacturing Sectors, Human Resource Management and Service Quality Correlation, Some Specific Industries in Services Sector, Trade Unions in Services Sector, Models of Union Strategies.
Case Study on "Training Program at ABC Cement". .

Module -5 Human Resource Management Innovations **9 hours**

Introduction, Human Resource Management and Innovations, Factors Affecting the Innovation Process in Organisations, Characteristics of Human Resource Management Innovations, Conditions Necessary for Successful HRMI Implementation, Current Trends in Human Resource Management Innovations, Innovative Human Resource Management Practices in India, How Human Resource Management Practices Contribute to Organisational Innovation, How to Make Human Resource Management Innovations Sustainable.

Module - 6 HR Leadership and Organisation Transformation **7 hours**

Future of Human Resource Management: The next generation HR professionalism, Critical HR Issues of Today and Tomorrow, Changing Mental Models: HR's Most Important Task, HR roles critical for business survival, HR profession in today's changeful workplace, HR and Technology.

Course Outcomes:

At the end of the course the student will be able to:

1. Gain practical experience in the field of Human Resource Concepts, functions and theories.
2. Acquire the conceptual insight of Human Resource and various functions of HR.
3. Apply personnel, managerial and welfare aspects of HR.
4. Develop a greater understanding about HR practices, analyse the trends in the field of HR.

Practical Component:

- An visit to Organisation and interact with HR Manager and list out the roles played by HR manager.
- Meet Recruitment Manager and ask- 10 questions one asks during Interview.
- Meet Training and Development Manager and list out various training given to employees; basis of training program; Need analysis.
- Visit any Service Organisation and observe HR functions; List them.

CO-PO MAPPING

CO	PO				
	PO1	PO2	PO3	PO4	PO5
CO1	X	X	X		X
CO2	X	X		X	
CO3	X	X	X		
CO4	X			X	

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have 8 full questions carrying equal marks.
- Each full question is for 20 marks.
- Each full question will have sub question covering all the topics under a Module.
- The students will have to answer five full questions; selecting four full question from question number one to seven and question number eight is compulsory.
- 100 percent theory in the SEE

Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Human Resource Management: Theory and Practices,	R. C. Sharma, Nipun Sharma	Sage Publication India Pvt. Ltd.,	2019
2	Human Resource Management: Concepts	Amitabha Sengupta	Sage Publication India Pvt. Ltd.	2019

3	Leadership: Theory and Practices	Peter G. Northouse	Sage Publication	2016
4	Human Resources Management	T.P RenukaMurthy	HPH.	2015
Reference Books				
1	The HR Scorecard: Linking People, Strategy, and Performance	Brian Becker, Dave Ulrich, and Mark A. Huselid	Harvard Business School Press	2001
2	The HR Answer Book: An Indispensable Guide for Managers and Human Resources Professionals	Shawn Smith and Rebecca Mazin	AMACOM	2011
3	Performance Management and Appraisal Systems HR Tools for Global Competitiveness	T. V. Rao		First Edition, 2004
4	Human Resource Management	Appasaba L.V and Kadakol A M	College Book House	2016
5	Human Resource Management	V.S.P Rao		2014

FINANCIAL MANAGEMENT			
Course Code	20MBA22	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Course Objectives:

1. To familiarize the students with basic concepts of financial management and financial system.
2. To understand concept of time value of money and its implication.
3. To evaluate the investment proposals.
4. To understand the management of working capital in an organization.
5. To analyze capital structure and dividend decision.

Module-1 Introduction **9 hours**

Meaning and objectives of Financial Management, changing role of finance managers. Interface of Financial Management with other functional areas. Indian Financial System: Financial markets, Financial Instruments, Financial institutions and financial services. Emerging issues in Financial Management: Risk Management, Behavioural Finance, Financial Engineering, Derivatives (Theory).

Module-2 Time value of money **9 hours**

Meaning of Time value of money –Future value of single cash flow & annuity, present value of single cash flow, annuity & perpetuity. Simple interest & Compound interest, Capital recovery & loan amortization. (Theory & Problem). Case Study on Loan amortization. Computer lab for calculation of future value, present value and loan amortisation in MS excel.

Module-3 **9 hours**

Sources of Financing: Shares, Debentures, Term loans, Lease financing, Hybrid financing, Venture Capital, Angel investing and private equity, Warrants and convertibles (Theory Only). **Cost of Capital:** Basic concepts. Cost of debenture capital, cost of preferential capital, cost of term loans, cost of equity capital (Dividend discounting and CAPM model) - Cost of retained earnings - Determination of Weighted average cost of capital (WACC) and Marginal cost of capital. (Theory & Problem). Case Study on WACC.

Module-4 Investment Decisions **9 hours**

Capital budgeting process, Investment evaluation techniques – [Net present value, Internal rate of return, Modified internal rate of return, Profitability index, Payback period, discounted payback period, accounting rate of return Problem). Risk analysis in capital budgeting-Case Study on replacement of capital project. (Numerical problems). Computer lab for calculation of NPV, IRR, PI, Payback period, ARR in MS excel.

Module-5 Working Capital Management **7 hours**

Factors influencing working capital requirements - Current asset policy and current asset finance policy- **Determination of operating cycle and cash cycle on Excel**- Estimation of working capital requirements of a firm. (Does not include Cash, Inventory & Receivables Management). Case study on Working Capital Determination and the impact of negative working capital Amazon-negative working capital and profitability. Computer lab for calculation of working capital cycle and operating cycle in MS excel.

Module-6 Capital structure and dividend decisions **7 hours**

Capital structure and dividend decisions – Planning the capital structure-Governance of Equity and Debt, Fall in interest rates and perils of Debt funding. Leverages, EBIT and EPS analysis. ROI & ROE analysis. Capital structure policy. Dividend policy – Factors affecting the dividend policy - Dividend Policies- Stable Dividend, Stable Payout (No dividend theories to be covered). Case Study on EBIT-EPS analysis & Leverages.

Course outcomes:

At the end of the course the student will be able to:

1. Understand the basic financial concepts
2. Apply time value of money
3. Evaluate the investment decisions
4. Estimate working capital requirements
5. Analyze the capital structure and dividend decisions

Practical Components:

- Identifying the small or medium sized companies and understanding the Investment evaluation techniques used by them.
- Using the annual reports of selected companies, students can study the working capital management employed by them. Students can also compare the working capital management of companies in the same sector.
- Students can choose the companies that have gone for stock split and Bonus issue in the last few years and study the impact of the same on the stock price.
- Students can study any five companies capital structure
- Students can do Company analysis for select companies using profitability and liquidity ratios.

CO-PO MAPPING

CO	PO				
	PO1	PO2	PO3	PO4	PO5
CO1	X				
CO2	X	X			
CO3	X		X		
CO4	X		X	X	
CO5	X		X		

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have 8 full questions carrying equal marks.
- Each full question is for 20 marks.
- Each full question will have sub question covering all the topics under a Module.
- The students will have to answer five full questions; selecting four full question from question number one to seven and question number eight is compulsory.
- 40 percent theory and 60 percent problems in the SEE.

Textbooks

Sl. No.	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Financial Management	Khan M. Y.& Jain P. K,	TMH	7/e,
2	Financial Management	Prasanna Chandra	TMH	9/e,
3	Financial Management	Prahlad Rathod ,Babitha Thimmaiah and Harish Babu	HPH	1/e, 2015
4	Financial Management: A Strategic Perspective	Nikhil Chandra Shil & Bhagaban Das	Sage Publications	1/e, 2016

Reference Books

1	Financial Management	I M Pandey	Vikas Publishing	11/e, 2012
2	Principles of Corporate Finance	Brealey, Myers, Allen & Mohanty	McGraw Hill Education	11/e, 2014
3	Cases in Financial Management	I.M.Pandey & Ramesh Bhat	McGraw Hill Education	3/e, 2015
4	Corporate Finance	Vishwanath S. R.	Sage Publications	3/e, 2019

RESEARCH METHODOLOGY			
Course Code	20MBA23	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Course Objectives:

1. To understand the basic components of research design.
2. To Gain an insight into the applications of research methods.
3. To equip students with various research analytical tools used in business research.
4. To equip students with necessary critical thinking skills using excel.

Module-1 Business Research **9 hours**

Business Research: Meaning, types, process of research- management problem, defining the research problem, formulating the research Hypothesis, developing the research proposals, research design formulation, sampling design, planning and collecting the data for research, data analysis and interpretation. Research Application in business decisions, Features of good research study.

Module -2 Business Research Design **9 hours**

Meaning, types and significance of research design. Exploratory and Conclusive Research Design.

Exploratory Research: Meaning, purpose, methods- Literature search, experience survey, focus groups and comprehensive case methods. Conclusive Research Design - Descriptive Research - Meaning, Types – Cross sectional studies and longitudinal studies.

Experimental Research Design – Meaning and classification of experimental designs- formal and informal, Pre experimental design, Quasi-experimental design, True experimental design, statistical experimental design.

Module -3 Sampling **7 hours**

Sampling: Concepts- Types of Sampling - Probability Sampling – simple random sampling, systematic sampling, stratified random sampling, cluster sampling -Non Probability Sampling –convenience sampling-judgemental sampling, snowball sampling- quota sampling - Errors in sampling.

Module -4 Data Collection **9 hours**

Meaning of Primary and Secondary data, Primary data collection methods - observations, survey, interview and Questionnaire, Qualitative Techniques of data collection, Questionnaire design – Meaning - process of designing questionnaire. Secondary data -Sources – advantages and disadvantages.

Measurement and Scaling Techniques: Basic measurement scales-Nominal scale, Ordinal scale, Interval scale, Ratio scale. Attitude measurement scale - Likert's Scale, Semantic Differential Scale, Thurstone scale, Multi-Dimensional Scaling. Case Study as per the chapter needs.

Module -5 **7 hours**

Data Analysis and Report Writing: Editing, Coding, Classification, Tabulation, Validation Analysis and Interpretation- Report writing and presentation of results: Importance of report writing, types of research report, report structure, guidelines for effective documentation.

Module – 6 **9 hours**

Advanced Excel and real time application: V Look Up, H Look up, Sort and filter, concatenate, Conditional Formatting., Pivot Table, If statement, Nested If, Charts. Statistical tests and how to interpret statistical outputs.

Course outcomes:

At the end of the course the student will be able to:

1. Understand various research approaches, techniques and strategies in the appropriate in business.
2. Apply a range of quantitative / qualitative research techniques to business and day to day managemen problems.
3. Demonstrate knowledge and understanding of data analysis, interpretation and report writing.
4. Develop necessary critical thinking skills in order to evaluate different research approaches in Business using excel in particular

Practical components:

- To identify research problem and collect relevant literatures for data analysis.
- To write the research design by using Exploratory and Descriptive Research methods.
- To conduct Market survey and to investigate consumer perception towards any FMCG and to conduct the data analysis using excel and need to submit a small report.

• To demonstrate Report writing and Presentation methods.

CO-PO MAPPING

CO	PO				
	PO1	PO2	PO3	PO4	PO5
CO1	X			X	
CO2	X			X	
CO3	X	X	X		X
CO4	X		X	X	X

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have 8 full questions carrying equal marks.
- Each full question is for 20 marks.
- Each full question will have sub question covering all the topics under a Module.
- The students will have to answer five full questions; selecting four full question from question number one to seven and question number eight is compulsory.
- 100 percent theory in the SEE.

Textbook/ Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Research Methodology	C R Kothari	Viswa Prakasam Publication	2014
2	Business Research Methods	S. N. Murthy & U. Bhojanna	Excel Books	3e, 2016
3	Research Methods	M MMunshi & K Gayathri Reddy	HPH	2015
Reference Books				
1	Research Methodology	Ranjit Kumar	Sage Publications	
2	Excel for dummies	Harvey .G	John Wiley & Sons	2016
3	Research Methodology	Deepak Chawla and Neena Sondhi	Vikas Publications	2014

OPERATIONS RESEARCH			
Course Code	20MBA24	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Course objectives:

- Understand the mathematical tools that are needed to solve optimisation problems
- Solve linear programming problems using appropriate techniques to take informed Decision
- To understand and practice allocation problems, Assignments problems, Transportation problems and Network Analysis (PERT & CPM).

Module -1 Introduction **7 hours**

Definition, scope of Operations Research, characteristics, advantages and limitations. Quantitative approach to decision making models (Theory Only)

Module -2 Linear programming **9 hours**

Structure of linear program model, Assumption, Advantages, Limitations, General mathematical model, Guidelines for formulation of linear programming model, Formulation of problems, graphical method.

Module -3 Transportation problem **7 hours**

General structure of transportation problem, methods of finding initial basic feasible solution (NWCM, LCM & VAM), Degeneracy, Optimality Test using Stepping Stone and MODI Methods (theory only). Assignment problems - Introduction, General structure. Problems on minimization & maximization.

Module -4 Decision theory **9 hours**

Decision under uncertainty- Maxmin & Minmax, Decision under Risk- Expected Value, Simple decision tree problems. (Only theory). Job Sequencing- N Jobs-two machines and N Jobs-three machines, 2 jobs-M machines cases. (Only theory).

Module -5 Theory of games **9 hours**

Formulation of game models, Two person Zero sum games & their solution, 2 x N and M x 2 games, pure strategy games with saddle point, Mixed strategies (Graphical and algebraic methods), Limitations of game theory.

Simulation: process of simulation, types of simulation, steps in simulation process, Monte Carlo simulation, Simple problems on Simulation applications in Inventory, Queuing, finance problems, Advantages & Disadvantages.

Module-6 Project management **9 hours**

Structure of projects, phases of project management-planning, scheduling, controlling phase, work breakdown structure, project control charts, network planning, PERT & CPM, Network components & precedence relationships, critical path analysis, probability in PERT analysis, Theory of crashing (Theory Only), Theory of Constraints (Theory only).

Course outcomes:

1. Get an insight into the fundamentals of Operations Research and its definition, characteristics and phases
2. Use appropriate quantitative techniques to get feasible and optimal solutions
3. Understand the usage of game theory , Queuing Theory and Simulation for Solving Business Problems
4. Understand and apply the network diagram for project completion

Practical component:

- Learn and use TORA Software for analysis of all the ORTechniques and Real life Problems.
- Student should demonstrate the application of the techniques covered in this course.

CO – PO MAPPING.

CO	PO				
	PO1	PO2	PO3	PO4	PO5
CO1	X				
CO2	X		X	X	X
CO3	X		X		X
CO4	X		X		X

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have 8 full questions carrying equal marks.
- Each full question is for 20 marks.
- Each full question will have sub question covering all the topics under a Module.
- The students will have to answer five full questions; selecting four full question from question number one to seven and question number eight is compulsory.
- 40 percent theory and 60 percent problems in the SEE.

Textbook/ Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Operation Research: An Introduction	H.A. Taha	Pearson Publication	2012
2	Operation Research	J K Sharma	McMillan Publications	2014
Reference Books				
1	Quantitative Techniques in management	N D Vohra	McGraw Hill	2015
2	Operation Research	J K Sharma	McMillan Publications	2016

STRATEGIC MANAGEMENT			
Course Code	20MBA25	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Course objectives:

1. To provide insights into the core concepts of strategic management.
2. To evaluate various business strategies in dynamic market environments.
3. To gain insights into various strategic management models.

Module-1 Introduction **7 hours**

Meaning and Nature of Strategic Management, its Importance and Relevance and. Characteristics of Strategic Management, The Strategic Management Process. Relationship Between a Company's Strategy and its Business Model. **Case Study related to the Module.**

Module -2 External Analysis **9 hours**

Strategically Relevant Components of a Company's External Environment – Industry Analysis - Factors Driving Industry Change and its Impact - Porter's Dominant Economic Feature - Competitive Environment Analysis - Porter's Five Forces Model – Key Success Factors Concept and Implementation. **Case Study on external analysis.**
Students Assignment: Industry External Analysis.

Module -3 Internal Analysis **9 hours**

Describe Strategic Vision, Mission, Goals, Long Term Objectives, Short-Term Objectives and Discuss Their Value to the Strategic Management Process, Resources, Capabilities, Competencies, Resource Based View of the firm (RBV), Balanced Score Card, SWOC Analysis, Value Chain Analysis, Benchmarking. **Case Study on internal analysis.**
Students Assignment: Industry Internal Analysis.

Module -4 Strategy Formulation **9 hours**

Business Strategies –Porter's Generic Strategies: Low Cost, Differentiation, Best Cost, Focused Low Cost and Focused Differentiation, Corporate Strategies – Growth Strategies (Internal Growth, External Growth, Integration, Diversification, Mergers, Strategic Alliances), Ansoff's Matrix, Stability Strategies (No-Change, Profit and Proceed With Caution), Retrenchment Strategies (Turnaround, Divestment and Liquation), International Business Level Strategies. **Case Study on Strategic Formulation. Students Assignment: Strategies of listed companies**.

Module -5 Strategy Implementation **9 hours**

Strategy Implementation -Organisational Structure, Strategic Leadership and Organisational Culture
Strategy and Innovation - Introduction to Innovation: Process, Product and Platform; Creative Destruction and Disruptive Technologies; Designing Organisations for Innovation; Innovation Environments: Institutional Innovation and Environments, The Co-creation of Value, Open Innovation and Open Strategy, National Innovation Systems, Learning Networks and Clusters, Social Innovation. **Case Study on Strategy Implementation**.

Module - 6 Strategic Control **7 hours**

Strategic Control: Focus of Strategic Control, Establishing Strategic Controls (Premise Control, Strategic Surveillance, Special Alert Control, Implementation Control), Exerting Strategic Control (through Competitive Benchmarking, Performance and Formal and Informal Organisations). Case Study on Strategic Control.

Course outcomes:

At the end of the course the student will be able to:

1. Students should get clear idea about the concept of Strategic Management, its relevance, Characteristics, process nature and purpose.
2. Student to acquire an understanding of how firms successfully institutionalize a strategy and create an organizational structure for domestic and overseas operations and gain competitive advantage.
3. To give the students an insight on strategy at different levels of an organization to gain competitive advantage.
4. To help students understand the strategic drive in multinational firms and their decisions in different markets.
5. To enable the students to gain knowledge of strategy implementation and the control measures for effective decision-making.

Practical Component:

- Analyzing the Mission and Vision statements of selected Indian companies.
- Applying Michael Porter's model to an industry (Retail, Telecom, Infrastructure, FMCG, Insurance, Banking etc(Industry Note to be submitted)
- Internal Analysis & Strategies of a listed company in the form of the report to be submitted.
- Pick a company that has performed very badly compared to its competitors. Collect information on why the

company failed. What were the issues in strategy and execution that were responsible for the company's failure in the market; analyze the internal and external factors.

- Map out GE 9-cell matrix and BCG matrix for some companies and compare them.
- Conduct SWOT analysis of companies around your campus.

CO-PO MAPPING

CO	PO				
	PO1	PO2	PO3	PO4	PO5
CO1	X				
CO2	X	X	X		
CO3	X		X		
CO4	X		X	X	X
CO5	X		X	X	X

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have 8 full questions carrying equal marks.
- Each full question is for 20 marks.
- Each full question will have sub question covering all the topics under a Module.
- The students will have to answer five full questions; selecting four full question from question number one to seven and question number eight is compulsory.
- 100 percent theory in the SEE.

Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Crafting and Executing Strategy: The Quest for Competitive Advantage – Concepts and Cases	Arthur A. Thompson Jr. Margaret A. Peteraf John E. Gamble A. J. Strickland III Arun K. Jain	McGraw Hill Education	19/e 2017
2	Strategic Management: A South-Asian Perspective	Michael A. Hitt R. Duane Ireland Robert E. Hoskisson S. Manikutty	Cengage Learning	9/e 2016

Reference Books

1	Strategy: Theory & Practice	Stewart Clegg Chris Carter Marting Kornberger Jochen Schweitzer	Sage Publications	3/e ,2020
2	Strategy Management: Theory & Practice	John Parnell	Biztantra	2004
3	Strategic Management: Planning for Domestic and Global Competition	John A. Pearce Richard B. Robinson	McGraw Hill Education	14/e 2015

ENTREPRENEURSHIP AND LEGAL ASPECTS			
Course Code	20MBA26	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Course Objectives:

1. To develop and strengthen entrepreneurial quality and motivation in students.
2. To impart basic entrepreneurial skills and understandings to run a business efficiently and effectively.
3. To provide insights to students on entrepreneurship opportunities, sources of funding and institutions supporting entrepreneurs.
4. To make students understand the ways of starting a company of their own.

Module -1 Introduction to Entrepreneur & Entrepreneurship **7 hours**

Meaning of entrepreneur - Evolution of the concept - Functions of an Entrepreneur - Types of Entrepreneur - Intrapreneur- an emerging class - Concept of Entrepreneurship -Entrepreneurial Culture - Stages in entrepreneurial process.

Creativity and Innovation: The role of creativity – The innovation Process – Sources of New Ideas – Methods of Generating Ideas – Creative Problem Solving – Entrepreneurial Process.

Module -2 Developing Business Model **9 hours**

Importance of Business Model – Starting a small scale industry -Components of an Effective Business Model, Osterwalder Business Model Canvas.

Business Planning Process: Meaning of business plan - Business plan process - Advantages of business planning - Final Project Report with Feasibility Study - preparing a model project report for starting a new venture.

Lab Component and assignment: Designing a Business Model Canvas

Module -3 Marketing function and forms of organisation **9 hours**

Industry Analysis – Competitor Analysis – Marketing Research for the New Venture – Defining the Purpose or Objectives – Gathering Data from Secondary Sources – Gathering Information from Primary Sources – Analyzing and Interpreting the Results – The Marketing Process

Forms of business organization: Sole Proprietorship – Partnership – Limited liability partnership - Joint Stock Companies and Cooperatives.

Module -4 Entrepreneurial finance **7 hours**

Entrepreneurial finance- Estimating the financial needs of a new venture, internal sources of finance, external sources of finance, components of financial plan

Institutions supporting Entrepreneurs: Small industry financing developing countries - A brief overview of financial institutions in India - Central level and state level institutions - SIDBI - NABARD - IDBI - SIDCO - Indian Institute of Entrepreneurship - DIC - Single Window - Latest Industrial Policy of Government of India.

Module -5 Rules And Legislation **9 hours**

Applicability of Legislation; Industries Development (Regulations) Act, 1951; Factories Act, 1948; Industrial Employment (Standing Orders) Act, 1946, Suspension, Stoppage of work, Termination of employment; Karnataka Shops and Establishment Act, 1961; Environment (Protection) Act, 1986; The sale of Goods Act, 1930; Industrial Dispute Act 1947.

Module-6 Company Incorporation **9 hours**

Process of Company Incorporation; process of registration; Importance of Marketing; Funding, Four stages of Start Up.

Intellectual property protection and Ethics: Patents – Copyright - Trademark- Geographical indications – Ethical and social responsibility and challenges.

Course outcomes:

At the end of the course the student will be able to:

1. Display keen interest and orientation towards entrepreneurship, entrepreneurial opportunity Modules' in order to setup a business and to think creatively.
2. To know about the various business models and B-Plans across Business sectors.
3. Able to understand the importance of marketing and different forms of businesses.
4. Become aware about various sources of funding and institutions supporting entrepreneurs.
5. Awareness about legal aspects and ways to protect the ideas.
6. To understand the ways of starting a company and to know how to protect their ideas.

Practical Component:

- Make a business plan for your intended business - talk to bankers to find out what they look for in a business plan - modify accordingly and present it in the class.
- Analyze the performance of listed family firms. How is their performance compared to the performance of other firms? Does a family firm successfully manage to create wealth for non-family investors?
- Design a Business Model Canvas
- Interview a local entrepreneur to find out his/her major motivations to start a business - which of the skills and characteristics do you find in the entrepreneur?
  -Examine how he/she started a business, funding opted, protection of ideas etc.
- Study a local for-profit business and try to list out the positive social impacts of the business.
- Visit a trade show and try to compare the marketing activities of various stalls in that show - make a list of good practices you come across in the show.

CO-PO MAPPING

CO	PO				
	Po1	**PO2**	**PO3**	**PO4**	**PO5**
CO1	**X**				**x**
CO2	**x**	**X**			**X**
CO3	**x**		**x**	**X**	
CO4	**x**		**X**		
CO5	**x**		**X**		X
CO6	**x**		**X**		**x**

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have 8 full questions carrying equal marks.
- Each full question is for 20 marks.
- Each full question will have sub question covering all the topics under a Module.
- The students will have to answer five full questions; selecting four full question from question number one to seven and question number eight is compulsory.
- 100 percent theory in the SEE.

Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Vasant Desai	The Dynamics of Entrepreneurial Development and Management	Himalaya Publishing House	2010
2	Donald F. Kuratko and Richard M. Hodgetts	Entrepreneurship	South-Western	2012
Reference Books				
1	Gupta S.L., Arun Mittal	Entrepreneurship Development	International Book House	2012
2	Sudha G. S	Management and Entrepreneurship Development	Indus Valley Publication	2009

III SEMESTER
CORE COURSES

EMERGING EXPONENTIAL TECHNOLOGIES			
Course Code	20MBA301	CIE Marks	40
Teaching Hours/Week	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Objective of the Course:

1. To understand the emerging technologies applicable in field of Management.
2. To study data science as a tool for decision making in Management
3. To understand the concept of AI, IOT and AR.
4. To study other emerging technologies in Management.

Module -1 Introduction to Emerging Technologies **9 hours**

Evolution of technologies; Introduction to Industrial revolution; Historical background of the Industrial Revolution; Introduction to Fourth industrial revolution (IR 4.0); Role of data for Emerging technologies; Enabling devices and networks for emerging technologies (programmable devices); Human to Machine Interaction; Future trends in emerging technologies.

Module -2 Data Science **7 hours**

Overview for Data Science; Definition of data and information; Data types and representation; Data Value Chain; Data Acquisition; Data Analysis; Data Curating; Data Storage; Data Usage; Basic concepts of Big Data.

Module -3 Artificial Intelligence(AI) **9 hours**

Concept of AI, meaning of AI, History of AI, Levels of AI, Types of AI, Applications of AI in Agriculture, Health, Business (Emerging market), Education, AI tools and platforms (eg: scratch/object tracking).

Module -4 Internet of Things (IoT) **9 hours**

Overview of IOT; meaning of IOT; History of IOT; Advantages of IOT; Challenges of IOT; IOT working process; Architecture of IOT; Devices and network; Applications of IOT at Smart home; Smart grid; Smart city; Wearable devices; Smart farming; IOT tools and platforms; Sample application with hands on activity.

Module-5 Augmented Reality (AR) and Virtual Reality (VR) **9 hours**

Introduction to AR, Virtual reality (VR), Augmented Reality (AR) vs mixed reality (MR), Architecture of AR systems. Application of AR systems (education, medical, assistance, entertainment) workshop oriented hands demo.

Module-6 Ethics, Professionalism and Other Emerging Technologies **7 hours**

Technology and ethics, Digital privacy, Accountability and trust, Treats and challenges.

Other Technologies: Block chain technology, Cloud and quantum computing, Autonomic computing, Computer vision, Cyber security, Additive manufacturing (3D Printing)

Course Outcomes:

By the end of this course the student will able to:

1. Identify different emerging technologies
2. Select appropriate technology and tools for a given task
3. Identify necessary inputs for application of emerging technologies
4. Understand the latest developments in the area of technology to support business

Practical Component:

- Big data analysis using an analytical tool
- Study the Application of AI in any one field and prepare a Report
- Study the Ethical practices of a Company
- 3D model Printing by Group or team
- Exposing the students to usage of IoT

CO-PO mapping

CO	PO				
	PO1	PO2	PO3	PO4	PO5
CO1	×				
CO2	×	×		×	
CO3	×	×		×	
CO4	×				

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have 8 full questions carrying equal marks.
- Each full question is for 20 marks.
- Each full question will have sub question covering all the topics under a Module.
- The students will have to answer five full questions; selecting four full question from question number one to seven and question number eight is compulsory.
- 100 percent theory in the SEE.

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Designing for Emerging Technologies: UX for Genomics, Robotics, and the Internet of Things	Follett, J.	O'Reilly Media	2014
2	Emerging Technologies for Emerging Markets	Vong, J., & Song, I.	Springer Singapore	2014
3	Disruption: Emerging Technologies and the Future of Work	Del Rosal, V.	Emtechub.	2015
4	Emerging Internet-Based Technologies	Sadiku, M. N. O	CRC Press	2019
Reference Books				
1	Digital Economy. Emerging Technologies and Business Innovation,	Mohamed Anis Bach Tobji, Rim Jallouli, Yamen Koubaa, Anton Nijholt		2018
2	Virtual & Augmented Reality for Dummies	Paul Mealy,		2018
3	Augmented Reality and Virtual Reality: Empowering Human, Place and Business,	Timothy Jung, M. Claudia tom Dieck		**2019**

Technology & Operational Strategy			
Course Code	20MBA302	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Course Objectives

1. To acquaint the student with the basic management principles with respect to production and operations management.
2. To Familiar the student with different types of Production Systems.
3. To explain the students regarding various techniques used in Operations Management.

Module-1 Introduction to Production and Operation Management (POM) 7 hours

Introduction Operations Management: Meaning, Definition, Scope and Functions. Difference Between Production and Operations Management. Management Guru's and their Contribution. The Roles and Functions of Operations Manager. Industry 4.0; Productions and Operations Management in Indian Context.

Module -2 Process Management Mapping 9 hours

Process Mapping, Process Flow charts, Ishikawa Diagrams, Fishbone Diagram and Cause and Effect Relationship, 5M, 8P, and 4S Systems, Theory Z Approach.

Module -3 Lean Manufacturing 9 hours

Concept of Lean Manufacturing; meaning of lean manufacturing; History of Lean Operations, Types of Waste, "5S" Technique of Eliminating the Waste, Lean Operations in the service sector, Role of Leadership, Lean Operations and Just In Time(JIT).

Module -4 Production System 9 hours

Production System: Meaning, Types- Batch and Continuous Production, TPS: Introduction, Overview of Toyota Production Systems – Focused Areas, Techniques: 5S, JIT, JIDOKA, KANBAN, KAIZEN, POKAYOKE, Toyota Production Systems.

Module -5 Total Quality Management(TQM) 9 Hours

Evolution of quality; Concept, Meaning and Features of TQM, Eight building blocks of TQM; TQM tools. Benchmarking: Concepts, Meaning, Benefits, Elements, Reasons for benchmarking, Process of benchmarking, FMEA; Quality Function Deployment (QFD) – House of Quality, QFD Process, Benefits, Taguchi Quality Loss Function, Quality Circles. Total Productive Maintenance (TPM) – Concept and need.

Module-6 Quality Systems 7 Hours

ISO: ISO role; Functions of ISO, Quality System Family Series ISO 9000; ISO 14000; ISO21000.
Six Sigma: Features of Six Sigma, Goals of Six Sigma, DMAIC, Six Sigma implementation.
Supply Chain and Operations: Supply Chain "KEIRETSU", Core Competency, Relationship of Operations and Supply Chain; Relationship of Purchasing and Supply Chain; Sources, Service Quality and Supply Chain.

Course Outcomes:

At the end of the course the student will be able to:

1. Acquire the knowledge about the concepts of production and operation management
2. Demonstrate the basic concepts of process mapping
3. Evaluate the importance of Lean Manufacturing
4. Develop strategies of Total quality management
5. Understand the roles of ISO standards and production system

Practical Component:

- Students should understand process management
- Students to visit an organization and study the quality management system
- Students has to understand production system
- Study the role of leader in operation management and prepare a Report
- Students need to understand the practicality of the ISO standards

CO-PO MAPPING

CO	PO				
	PO1	PO2	PO3	PO4	PO5
CO1	X				
CO2	X			X	
CO3	X			X	
CO4	X		X	X	X
CO5	X		X		X

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have 8 full questions carrying equal marks.
- Each full question is for 20 marks.
- Each full question will have sub question covering all the topics under a Module.
- The students will have to answer five full questions; selecting four full question from question number one to seven and question number eight is compulsory.
- 100 percent theory in the SEE.

Textbooks				
Sl No	**Title of the book**	**Name of the Author/s**	**Publisher Name**	**Edition and year**
1	Production and Operations Management	S. N. Chari.	Mc Graw Hill.	6/e
2	Operations Management Theory and Practical	B. Mahadevan	Pearson.	3/e
3	Operations Management	Jay Heizer Barry Render, Chuck Munson, Amit Sachan	Pearson.	12/e
4	Production and Operations Management	R. Panneerselvam.	PHI	3/e
Reference Books				
1	The Goal: Process of Improvement	Eliyahu M. Goldratt	North River Press	3/e
2	The Toyota Way	Jeffery Liker.		

MARKETING SPECIALISATION COURSES

SERVICES MARKETING			
Course Code	20MBAMM303	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Course Objectives

1. To acquaint the students with the characteristics of services and their marketing implications.
2. To discuss and conceptualize the service quality, productivity in services, role of personnel in service marketing and to manage changes in the environment.
3. To familiarize the students with the GAPS model and strategizing towards closing the GAPS for effective services marketing.

Module-1 Introduction to services **9 hours**

Reasons for the growth of services sector and its contribution; difference in goods and service marketing; characteristics of services; concept of service marketing triangle; service marketing mix; GAP models of service quality.

Consumer behaviour in services: Search, Experience and Credence property, consumer expectation of services, two levels of expectation, Zone of tolerance, Factors influencing customer expectation of services.

Customer perception of services-Factors influencing customer perception of service, Service encounters, Customer satisfaction, Strategies for influencing customer perception.

Module -2 Market Research for Customer Expectation **9 hours**

Key reasons for gap using marketing research to understand customer expectation, Types of service research, Building customer relationship through retention strategies –Relationship marketing, Evaluation Of customer relationships, Benefits of customer relationship, levels of retention strategies, Market segmentation-Basis & targeting in services.

Module -3 Customer defined service standards **9 hours**

"Hard" & "Soft" standards, challenges of matching supply & demand in capacity, four common types of constraints facing services, optimum v/s maximum use of capacity, strategies for matching capacity & demand.

Yield management-balancing capacity utilization, pricing. Waiting line strategies- four basic Waiting line strategies.

Leadership &Measurement system for market driven service performance-key reasons for GAP-2 service leadership- Creation of service vision and implementation, Service quality as profit strategy, Role of service quality In offensive and defensive marketing.

Module -4 Employee role in service designing and Delivery **7 hours**

Boundary spanning roles, Emotional labour, Source of conflict, Quality- productivity trade off, Strategies for closing GAP 3.

Customer's role in service delivery-Importance of customer & customer's role in service delivery, Strategies for enhancing-Customer participation, Delivery through intermediaries-Key intermediaries for service delivery, Intermediary control strategies.

Module -5 Role of services marketing communication **9 hours**

Role of services marketing communication- Key reasons for GAP 4 involving communication, four categories of strategies to match service promises with delivery.

Pricing of services- Role of price and value in provider GAP 4, Role of non-monitory cost, Price as an indicator of service quality –Approaches to pricing services, pricing strategies, SERVQUAL Model.

Mini Project – On measuring SERVQUAL

Module - 6 Physical Evidence in Services **7 hours**

Physical evidence in services: Importance of Physical Evidence, Elements of Physical Evidence, Physical Evidence Strategies, Guidelines for Physical Evidence.

Service scapes: Types of service scapes-Objective and Goals of services capes Role of services capes, Approaches for understanding service scapes effects, Frame work for understanding services capes & its effect on behaviour-Guidance for physical evidence strategies.

Course outcomes:

At the end of the course the student will be able to:

1. Develop an understanding about the various concepts and importance of Services Marketing.
2. Enhance knowledge about emerging issues and trends in the service sector.
3. Learn to implement service strategies to meet new challenges.

Practical Component:

- Ask students to choose a service industry of their choice at the beginning of the semester
- Ask them to do an in-depth study of the industry and give a presentation at the end of the every Module relating the concepts to the particular industry(GAPS).
- Students can prepare service blueprints for any service of their choice.
- Identify any existing services, locate loopholes in the design and suggest modifications.
- Visit a service industry and analyze the role of customers in service delivery.

CO-PO MAPPING

CO	PO				
	PO1	PO2	PO3	PO4	PO5
CO1	X				
CO2	X			X	
CO3	X		X		X

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have 8 full questions carrying equal marks.
- Each full question is for 20 marks.
- Each full question will have sub question covering all the topics under a Module.
- The students will have to answer five full questions; selecting four full question from question number one to seven and question number eight is compulsory.
- 100 percent theory in the SEE.

Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and
1	Services Marketing	Valarie A Zeithmal & Mary Jo	McGraw Hill	6/e 2018
2	Services Marketing	Christopher Lovelock	Pearson Education	2014
3	Services Marketing	Rajendra Nargundkar	McGraw Hill	2015
4	Marketing Research	Kumar	Sage Publications	4/e, 2018

Reference Books

1	Services Marketing	Parasuraman	Sage Publications	2018
2	Services Marketing	Hoffman & Bateson	Cengage Learning	2017
3	Services Marketing: Operation, Management and Strategy	Strategy-Kenneth E Clow& David L. Kurtz	Biztantra	2016

MARKETING RESEARCH & ANALYTICS			
Course Code	20MBAMM304	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Course Objectives

1. To provide an understanding of the basics of marketing research process.
2. To orient on the theoretical and practical aspects of marketing research.
3. Encourage the students to take up analytical thinking through research.
4. To highlight importance marketing research for enhancing marketing strategies.

Module-1 Marketing Research Dynamics **9 hours**

Meaning of Marketing research; when marketing research is unnecessary; Nature and Scope of Marketing Research; Marketing Research in the 21st Century (Indian Scenario); limitations of Marketing Research; threats to marketing research; Introduction to marketing intelligence: concept of marketing intelligence (MI), components, need for MI, Domains of MI. Ethics in marketing research. Design of consumer experiments using Conjoint Analysis. Case Study on Marketing Research Dynamics.

Module -2 Marketing Research Projects **7 hours**

Design and implementation of Marketing Research Projects, defining research questions, identifying respondents, sampling accuracy and sufficiency. Issues around studying human subjects.

Lab on socially acceptable responses- managing

Module -3 Decision Support System **9 hours**

Marketing Decision Support System-meaning, Use of Decision Support Systems in Marketing Research, Data base & Data warehousing. The three Vs: Volume, Velocity & Varity, The Fourth V: Value. Elements of data base, types of data base, using marketing data base for marketing intelligence, ways to gather consumer data.

Module -4 Applications of Marketing Research **9 hours**

Applications of Marketing Research: Introduction, Consumer Market Research, Business-to-Business Market Research, Product Research, Pricing Research, Motivational Research, Distribution Research, Advertising Research, Media research, Sales Analysis and Forecasting.

Live project & Assignment: Agriculture Marketing or B2B marketing

Module -5 Predictive analysis **9 hours**

Meaning of predictive analysis, how good are models at predictive behavior, benefits of predictive models and applications of predictive analysis, reaping the benefits, avoiding the pitfalls, importance of predictive model, process of predictive analytics. Predictive Analytics, Data Mining and Big Data_ Myths, Misconceptions and Methods by Steven Finlay.

Module - 6 Product Research **7 hours**

Product Research- Analysis of Diffusion of products, Adoption decisions, Product – services tradeoffs, evaluating prototypes, Luxury and Lifestyle products.

Live project: New Product adoption

Course outcomes:

The student should be able to:

1. Comprehend the objectives of Market research & its application in solving marketing problems.
2. Appreciate the use of different data collection methods, sampling design techniques, measurement methods to analyze the data.
3. Generalize and interpret the data with the help of various measurement techniques.
4. To understand the emergence of new trends in research.

Practical Component:

- Choose 5 successful products or services and identify the insight behind them through a field survey.
- Do a comprehensive essay on the difference between consumers vs. trade vs. Competition insights & how best to exploit them.
- Take 5 recent digital innovations like twitter or face book and identify the insights.
- Running case with real data Dell, Comprehensive critical thinking case Baskin-Robbins.
- Data Analysis case with real data IBM.

CO-PO MAPPING

CO	PO				
	PO1	PO2	PO3	PO4	PO5
CO1	X		X		
CO2	X	X		X	
CO3	X		X		X
CO4	X			X	X

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have 8 full questions carrying equal marks.
- Each full question is for 20 marks.
- Each full question will have sub question covering all the topics under a Module.
- The students will have to answer five full questions; selecting four full question from question number one to seven and question number eight is compulsory.
- 100 percent theory in the SEE.

Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Marketing Research- An Applied Orientation	Naresh K Malhotra & SatyaBhushan Dash	Pearson	7th Edition
2	Marketing Analytics Using Excel	.Ajithab Dash	Sage publications	2019
3	Essentials of Marketing Research	William G Zikmund et. al	Cengage Learning	7/e
4	Marketing Research	V Kumar	Sage Publications	1/e, 2015

Reference Books

1	Market Research: Text and cases	Rajendra Nargundkar	Mc Graw Hill	3rd Edition
2	The Effective Use of Market Research: How to drive and focus better business decisions	Robin J Birn	Viva	4th Edition
3	Marketing Research: Methodological Foundations	Gilbert A Churchill & Dawan Lacobucci		8th Edition

CONSUMER BEHAVIOUR			
Course Code	20MBAMM305	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Course Objectives

1. To understand the concept of consumer behaviour, decision making by consumers, behavioural variables and its influences on consumer behaviour.
2. To comprehend the social and cultural dimensions of consumer behaviour.
3. To provide an insight of the psychological and behavioural concepts of consumers.

Module-1 Introduction **7 hours**

Meaning of Consumer Behaviour; Difference between Consumer & Customer; Nature & characteristics of Indian Consumers; Consumerism: meaning; Consumer Movement in India; Rights & Responsibilities of consumers in India; Benefits of consumerism. Research on Consumer Behaviour; Consumer Behaviour and Society.

Module -2 Models of Consumer Behaviour **9 hours**

Input-Process-Output Model, Nicosia Model, Howard Sheth Model, Engel-Kollat-Blackwell Models of Consumer Behaviour, Internal Influences, External Influences.

Consumer Decision Making: Consumer Buying Decision Process, Levels of Consumer Decision Making – Four views of consumer decision making. On-line Decision Making: Meaning & Process/Stages.

Situational Influences- Nature of Situational Influence, Situational Characteristics and consumption behaviour.

Class Exercise: Conducting consumer experiments.

Module -3 Individual Influences on Consumer Behaviour and CRM Part –I **9 hours**

a) Motivation: Basics of Motivation, Needs, Goals, Positive & Negative Motivation, Rational Vs Emotional motives, Motivation Process, Arousal of motives, Selection of goals. Motivation Theories and Marketing Strategy - Maslow's Hierarchy of Needs, McGuire's Psychological Motives.

b) Personality: Basics of Personality, Theories of Personality and Marketing Strategy (Freudian Theory, Neo-Freudian Theory, Trait Theory), Applications of Personality concepts in Marketing, Personality and understanding consumer diversity, Brand Personality, Self and Self-Image.

c) Perception: Basics of Perception & Marketing implications, Elements of Perception, Dynamics of Perception, Influence of perception on CB, Consumer Imagery, Perceived price, Perceived quality, price/quality relationship, Perceived Risk, Types of risk, How to consumers' handle risk.

Module -4 Individual Influences on Consumer Behaviour and CRM Part –II **9 hours**

d)Learning: Elements of Consumer Learning, Marketing Applications of Behavioural Learning Theories, Classical Conditioning – Pavlovian Model, Neo-Pavlovian Model, Instrumental Conditioning.

e) Attitude: Basics of attitude, the nature of attitude, Models of Attitude and Marketing Implication, (Tri-component Model of attitude, Multi attribute attitude models. Elaboration Likelihood Model).

Persuasive Communication: Communications strategy, Target Audience, Media Strategy, Message strategies, Message structure and presentation

Module -5 External Influences on Consumer Behaviour **9 hours**

Social Class: Social Class Basics, What is Social Class? (Social class & Social status, the dynamics of status consumption, Features of Social Class, Five Social-Class Categories in India.

Culture: Basics, Meaning, Characteristics, Factors affecting culture, Role of customs, values and beliefs in Consumer Behaviour. Subculture: Meaning, Subculture division and consumption pattern in India, Types of subcultures. Cross Culture - Cross-cultural consumer analysis - Cross-cultural marketing strategy: Cross-cultural marketing problems in India, Strategies to overcome cross-cultural problems.

Groups: Meaning and Nature of Groups, Types Family: The changing structure of family, Family decision making and consumption related roles, Dynamics of husband-wife decision making, The family life cycle & marketing strategy, Traditional family life cycle & marketing implications, Reference Groups: Understanding the power & benefits of reference groups, Factors that affect reference group influence, Types of reference group, Reference Group Appeals.

Module - 6 Consumer Influence and Diffusion of Innovations **7 hours**

Opinion Leadership: Dynamics of opinion leadership process, Measurement of opinion leadership, Market Mavens, Opinion Leadership & Marketing Strategy, Creation of Opinion Leaders.

Diffusion of Innovations: Diffusion Process, Adoption Process: Stages, categories of adopters, Post Purchase Processes.

Customer Relationship Management- Meaning & Significance of CRM, Types of CRM Strategies for building relationship marketing, e-CRM, Meaning, Importance of e-CRM, Difference Between CRM & e-CRM
Case Study: Pillsbury Cookie Challenge.

Course outcomes:

At the end of the course the student will be able to:

1. Explain the background and concepts vital for understanding Consumer Behaviour.
2. Identify the role of variables that determines Consumer Behaviour in Social & cultural domain.
3. Identifying the psychological and behavioural practices adopted by organizations to enhance the Consumer Behaviour.

Practical Components:

- Students can go to malls and unorganized retail outlets and observe the behaviour of consumers of different demographic segments while buying different category of goods. The students need to present the findings / observations followed with a group discussion.
- Students have to prepare a questionnaire and conduct the survey on consumer buying behaviour and present the findings in the class.
- Find three advertisements that appeal to the need for power, affiliation and achievement. Discuss their effectiveness. Rewrite these for persons in different levels of Maslow's Hierarchy?
- Meet your friends and conduct a survey to find what are the important factors in their purchase of mobiles, shoes, bags etc.
- Conduct a study on advertisements regarding a specific product and find out how consumer deal with the information overload.

CO-PO MAPPING

CO	PO				
	PO1	PO2	PO3	PO4	PO5
CO1	X				
CO2	X		X	X	
CO3	X				X

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have 8 full questions carrying equal marks.
- Each full question is for 20 marks.
- Each full question will have sub question covering all the topics under a Module.
- The students will have to answer five full questions; selecting four full question from question number one to seven and question number eight is compulsory.
- 100 percent theory in the SEE.

Texbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Consumer Behaviour	Leon Schiffman, Leslie	Pearson	Latest Edition
2	Consumer Behaviour: A Managerial Perspective	Dr.Dheeraj Sharma, Jagdish N Sheth, Banwari Mittal	Cengage Learning	Latest Edition
3	Consumer Behaviour	Sethna	Sage Publications	4/e, 2018
4	Advertisement Brands & Consumer Behaviour-Case Book	Ramesh Kumar	Sage Publications	2017

Reference Books				
1	Consumer Behaviour in Indian Perspective	Suja Nair	Himalaya Publications	2015
2	Consumer Behaviour: Building Marketing Strategy	Dell, Hawking & others	Tata McGraw Hill	Latest Edition
3	Consumer Behaviour	Satish K Batra & S H H Kazmi	Excel Books	Latest Edition

RETAIL MANAGEMENT			
Course Code	20MBAMM306	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Course Objectives

1.To provide an understanding of the concepts, techniques and approaches in Sales Management
2. To emphasize on the Sales Manager's problems and dilemmas.
3.To develop skills for generating, evaluating and selecting sales strategies.
4.To develop an understanding of the contemporary retail management, issues, strategies and trends.
5.To highlight the importance of retailing and its role in the success of modern business.
6.To acclimatize with the insights of retailing, key activities and relationships.

Module-1 Sales Management **7 hours**

Meaning, Personal Selling, the sales management process Emerging Trends in Sales Management, Qualities and Responsibilities of a sales manager. Selling skills & selling strategies: selling and buying styles, selling situations, selling skills, selling process.

Module -2 Management of Sales Territory & Sales Quota **7 hours**

Sales territory, meaning, size, designing, sales quota, procedure for sales quota. Types of sales quota, Methods of setting quota. Recruitment and selection of sales force, Training of salesforce.

Module -3 Retail Management **10 hours**

Introduction and Perspectives on Retailing World of Retailing, Retail management, introduction, meaning, characteristics, emergence of organizations of retailing - Types of Retailers (Retail Formats) - Multichannel Retailing -Customer Buying Behaviour, role of retailing, trends in retailing, FDI in Retail - Problems of Indian Retailing - Current Scenario. **Assignment: History and current trends including Indian retail FDI Policy.**

Module-4 Setting up Retail organization **10 hours**

Size and space allocation, location strategy, factors Affecting the location of Retail, Retail location Research and Techniques, Objectives of Good store Design. Retail Market Strategy - Financial Strategy Human Resource Management, Information Systems and supply chain management & Logistics.

Store Layout and Space planning: Types of Layouts, role of Visual Merchandiser, Visual Merchandising Techniques, Controlling Costs and Reducing Inventories Loss, Exteriors, Interiors.

Store Management: Responsibilities of Store Manager, Store Security, Parking Space Problem at Retail Centers, Store Record and Accounting System, Coding System, Material Handling in Stores, Management of modern retails stores.

Assignment: ***Merchandise Planning and Category Management, Mall Management-key aspects***

Module -5 Retail Pricing **9 hours**

Retail Pricing: Factors influencing retail pricing, Retail pricing strategies, Retail promotion strategies

Relationship Marketing in Retailing: Management & Evaluation of Relationships in Retailing, Retail **Research in Retailing:** Importance of Research in Retailing, Trends in Retail Research, Areas of Retail Research. Customer Audits, Brand Management in retailing Retail Audit and ethics in Retailing Undertaking an audit, responding to a retail Audit, problems in conducting a retail audit

Retail Analytics Case Study: Customer Analytics at Big Basket.

Module – 6 Internationalization of Retailing **7 hours**

Evolution of International Retailing, Motives of International Retailing, International Retail Environment – Socio-Cultural, Economic, Political, Legal, Technological and issues in international retailing.

Course Outcomes:

1.Career development in the field of sales
2.Management of sales
3.Find out the contemporary retail management, issues, and strategies.
4.Evaluate the recent trends in retailing and its impact in the success of modern business.
5.Relate store management and visual merchandising practices for effective retailing.

Practical Component:

- Interview a salesperson in a retail store and write a brief report about what they like and dislike about their jobs, their salary, travelling allowances, sales quotas, why they chose a sales career, and what does it take to

succeed in this profession.

- Go to a kirana store and a supermarket and compare the following: a) store arrangement b) No of brands carried c) pricing policies – are discounts given? d) Service – personal or impersonal? Etc.
- Go to at least three kirana stores in your neighbourhood (around 2 kms) and discuss with them the importance of location, pricing, credit policy, etc. What percentages of goods are sold 'loose' in each locality and compare this with the approximate income range of the customers? What are the retailer's losses when a customer defaults in payment? Does he make up for it by increasing his prices to other customers?
- Ask your friends if they would buy certain goods like groceries, vegetables, socks, mobile, pens etc from the roadside vendor as against a regular shop. Group the products into low risk and high risk ones. Does this buying behavior also depend on the personality of the individual doing the buying? Or the one doing the selling?
- Student can make a presentation on any product or the services of student choice, covering selling strategies and one day work exposure towards merchandising in any big retail outlets of respective places where institute is operating. Rural colleges can send the students to the city nearby to observe the merchandising planning in retail outlets and to make a small report.

CO-PO MAPPING

CO	PO				
	PO1	PO2	PO3	PO4	PO5
CO1	X		X	X	
CO2	X		X	X	
CO3	X				X

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have 8 full questions carrying equal marks.
- Each full question is for 20 marks.
- Each full question will have sub question covering all the topics under a Module.
- The students will have to answer five full questions; selecting four full question from question number one to seven and question number eight is compulsory.
- 100 perecent theory in the SEE.

Texbooks

1	Sales & Distribution Management	Tapan K. Panda & Sunil Sahadev,	6/e, Oxford University Press	2012
2	Managing of Sales Force	Spiro Stanton Rich	TMH	2003.
3	Sales Management	Charles M. Futrell		2012
4	Retail Management	Levy &Weitz	McGraw Hill	Latest Edition
5	Retail Management	Chetan Bajaj	Oxford University	
3	Retail Management-A Global Perspective: Text and Cases	Dr.Harjit Singh	S.Chand	Reprint 2018

Reference Books

	Sales & Distribution Management	Gupta S. L	Excel Books	2010
2	Retail Marketing Management	Dravid Gilbert,	Pearson Education	Latest Edition
3	Retail Management: A Strategic Approach	Barry Berman, Joel R. Evans	Pearson Education	Latest Edition

FINANCE SPECIALISATION COURSES

INVESTMENT MANAGEMENT			
Course Code	20MBAFM303	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Course Objectives

1. To understand the capital market and various instruments for investment.
2. Learn valuation of equity, debt and mutual funds.
3. To learn theories of portfolio management.
4. To learn diversification of securities for risk return trade off in capital market.
5. To lean portfolio construction for retail investors, high net worth individuals, mutual funds.

Module -1 Introduction to Investment **7 hours**

Investment Avenues, Attributes, Investor V/s speculator, Features of a good Investment, Investment Process. Financial Instruments: Money Market Instruments, Capital Market Instruments, Derivatives.

Securities Market: Primary Market, Secondary Market. Stock Market Indicators- Indices of Indian Stock Exchanges (only Theory).

Module -2 **7 hours**

Return and Risk Concepts: Concept of return, individual security returns, rate of return, Concept of Risk, Causes of Risk, Types of Risk- Systematic risk- Market Price Risk, Interest Rate Risk, Purchasing Power Risk, Unsystematic Risk- Business risk, Financial Risk, Insolvency Risk, Risk-Return Relationship, Concept of diversifiable risk and non-diversifiable risk. Calculation of Return and Risk of Individual Security (Theory & Problems).

Module -3 Valuation of Securities **9 hours**

Bond features, Types of Bonds, Determinants of interest rates, Bond Valuation, Bond Duration, Bond Management Strategies. Preference Shares- Concept, Features, Valuation. Equity Shares- Concept, Valuation, Dividend Valuation Models, P/E Ratio valuation model. (Theory & Problems).

Module -4 **7 hours**

Macro-Economic and Industry Analysis: Fundamental analysis-EIC Frame Work, Economy Analysis, Industry Analysis, Company Analysis- Financial Statement Analysis.

Market Efficiency: Efficient Market Hypothesis, Forms of Market Efficiency, Empirical test for different forms of market efficiency.

Technical Analysis – Concept, Theories- Dow Theory, Eliot Wave theory. Charts-Types, Trends and Trend Reversal Patterns. Mathematical Indicators –Moving Average Convergence-Divergence, Relative Strength Index (Theory only).

Module -5 Modern Portfolio Theory **11 hours**

Markowitz Model- Diversification, Portfolio Return, Portfolio Risk, Efficient Frontier. Sharpe's Single Index Model, Capital Asset Pricing Model: Assumptions, CAPM Equation, Capital Market Line, Security Market Line, CML V/s SML. Sharpe's Optimum Portfolio Construction. Arbitrage Pricing Theory: Equation, Assumption, CAPM V/s APT (Theory & Problems).

Module-6 Portfolio Management Strategies and Performance Evaluation **9 hours**

Portfolio Management Strategies: Active and Passive Portfolio Management strategy. Portfolio Revision: Portfolio Revision Strategies – Objectives, Performance plans. **Mutual Funds**: Concept of Mutual Funds, Participants in Mutual Funds, Advantages of Investment in Mutual Fund, Measure of Mutual Fund Performance. **Portfolio performance Evaluation:** Measures of portfolio performance (Theory & Problems).

Course outcomes:

At the end of the course the student will be able to:

1. The student will understand the capital market and various Instruments for Investment.
2. The learner will be able to assess the risk and return associated with investments and methods to value securities.
3. The student will be able to analyse the Economy, Industry and Company framework for Investment Management.
4. The student will learn the theories of Portfolio management and also the tools and techniques for efficient portfolio management.

CO-PO MAPPING

Practical Components:

• Each student will be given a virtual cash of Rs.10 Lakhs and they will be asked to invest in equity shares based on fundamental analysis throughout the semester. At the end the best investment will be awarded based on the final net worth. Virtual on line trading account can be opened for the student and every week 2 hours can be allotted to invest, monitor and evaluate.

• Students should study the stock market pages from business press and calculate the risk and return of selected companies.

• Students can do a macro economy using GDP growth.

• Students' are expected to do Industry analysis for specific sectors.

• Students can do Company analysis for select companies using profitability and liquidity ratios.

• Practice technical analysis using Japanese candle sticks.

CO	PO				
	PO1	PO2	PO3	PO4	PO5
CO1	X				
CO2	X			X	X
CO3	X				X
CO4	X			X	

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have 8 full questions carrying equal marks.
- Each full question is for 20 marks.
- Each full question will have sub question covering all the topics under a Module.
- The students will have to answer five full questions; selecting four full question from question number one to seven and question number eight is compulsory.

40 percent theory and 60 percent problems in the SEE.

Textbook/ Textbooks

Sl. No.	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Investment Analysis and Portfolio management	Prasanna Chandra	Tata McGraw Hill Education	3/e, 2010
2	Investments	ZviBodie, Kane, Marcus & Mohanty	Tata McGraw Hill Education	8/e, 2010
3	Security Analysis & Portfolio Management	J Kevin	Tata McGraw Hill Education	2014
Reference Books				
1	Analysis of Investments & Management	Reilly & Brown	Cengage Publications,	10e/2017
2	Security Analysis & Portfolio Management	Punithavathy Ehavathy Pandian	Vikas Publications	2/e, 201/8
3	Investment management (Security Analysis and & Portfolio Management)	Bhalla V.K.	Vikas Publications	19/e, 2018

DIRECT TAXATION			
Course Code	20MBAFM304	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Course Objectives

1. To provide the students with a comprehensive understanding of basic concepts of Income tax
2. To understand the computation of taxable Income under different heads.
3. To know the deductions available while computing Income.
4. To understand corporate taxation system in India

Module-1 Income Tax Act, 1961 **7 hours**

Income Tax Act, 1961, Basic Concepts and definitions, Capital and revenue – receipts, expenditures, Basis of charge and scope of total income , Residential Status and Incidence of Tax, Incomes which do not form part of Total Income (Sec.10), Tax Planning, Tax Evasion and Tax Management. (Problems on residential Status of Individual assessee).

Module -2 Income from Salaries **9 hours**

Meaning of Salary, Allowances, Valuation & Taxability of Perquisites, Death cum Retirement benefits, Deductions against Salary. Income from House Property (Theory Only). (Problems on salary Income).

Module -3 Income from Business or Professions **9 hours**

Income under the head Profit and Gains of Business or Professions and its computation- basic method of accounting- scheme of business deductions/ allowance- deemed profits- maintenance of books, Depreciation. (Problems on computation of income from business/ profession of Individual assessee and Depreciation).

Module -4 Income under capital gain **9 hours**

Income under capital gain, basis of charge, transfer of capital asset, inclusion & exclusion from capital asset, capital gain, computation of capital gain, deductions from capital gains. Income from Other Sources (Theory Only). (Problems on computation of Income from capital gain).

Module -5 Permissible Deductions **9 hours**

Permissible deductions under section 80C to 80U, computation of tax liability of Individuals. Setoff and carry forward of losses (Theory only). (Problems on Computation of taxable Income and tax liability of Individuals).

Module -6 Computation of taxable income of a company **7 hours**

Computation of taxable income of a company with special reference to MAT. (Problems on MAT).

Course outcomes:

At the end of the course the student will be able to:

1. Understand the basics of taxation and process of computing residential status.
2. Calculate taxable income under different heads.
3. Understand deductions and calculation of tax liability of Individuals.
4. Know the corporate tax system.

Practical Components:

- Calculation of Taxable income and tax liability using Excel.
- Encouraging the students to register as tax return preparers.
- Students can be exposed to filing of tax returns of Individual assesses.

CO-PO MAPPING

CO	PO				
	PO1	PO2	PO3	PO4	PO5
CO1	X				
CO2	X			X	
CO3	X				
CO4	X				

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have 8 full questions carrying equal marks.
- Each full question is for 20 marks.
- Each full question will have sub question covering all the topics under a Module.
- The students will have to answer five full questions; selecting four full question from question number one to seven and question number eight is compulsory.
- 40 percent theory and 600 percent problems in the SEE

Textbooks

Sl. No.	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Direct Taxes Law and practice	Vinod Singhania and Kapil Singhania	Taxman Publications	2019/2020 Edition
2	Students Guide to Income Tax Vinod Singhania and Kapil Singhania	Vinod Singhania and Kapil Singhania	Taxman Publications	2019/2020 Edition
Reference Books				
1	Students Handbook on Taxation	T N Manoharan	Snow White Publications Pvt. Ltd	Jan 2020 Edition
2	Income Tax Law & Practice	B.B.Lal & N. Vashisht	Pearson	33e/2019
3	Income Tax	H.C.Mehrotra & S.P.Goyal	Sahithya Bhavan Publications	60 e/2019

BANKING & FINANCIAL SERVICES			
Course Code	20MBAFM305	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Course Objectives:

1. To understand the structure and functions of central and Commercial banking in India.
2. To learn the functions of various financial services in India.

Module-1 Structure of Banking in India **7 hours**

Structure of Banking in India: Functions of RBI, Monetary system, Sources of funds, Quantitative and qualitative measures of credit control. Banking sector reforms, Bank performance analysis and Future of Banking.(Theory)

Module -2 Commercial Banking **9 hours**

Commercial Banking: Structure, Functions - Primary & secondary function, Role of commercial banks in socio-economic development, Services rendered. Banking Technology- Concept of Universal Banking-Home banking– ATMs-Internet Banking– Mobile Banking-Core Banking Solutions–Debit, Credit and Smart Cards– Electronic Payment systems-MICR- Cheque Truncation-ECS- EFT – NEFT-RTGS. (Theory)

Module -3 Merchant Banking **9 hours**

Merchant Banking: Categories, Services offered, Issue management – Pre and Post issue management, Issue pricing, preparation of prospectus, Issue Management, Underwriting, Private Placement, Book Building Vs. Fixed price issues.(Theory)

Module -4 NBFCs; Micro-finance; Leasing & Hire Purchase Banking **9 hours**

A. NBFCs: An Overview -Types of NBFCs in India-Regulatory framework.
B. Micro-finance: Models, Services, Challenges.
C. Leasing & Hire Purchase: Concept, Types, Evaluation. Problems in Evaluation of Leasing & Hire Purchase. (Theory& Problems)

Module -5 Credit Rating; Venture Capital; Depository System & Securitisation of Debt **9 hours**

A. Credit Rating: Meaning, Process, Methodology, Agencies And Symbols.
B. Venture Capital: Concept, Features, Process. Stages, Performance of Venture Capital Funded Companies In India.(Theory)
C. Depository System: Objectives, Activities, NSDL& CDSL. Process of Clearing and Settlement.
D. Securitization of Debt: Meaning, process, Types, Benefits. (Theory)

Module-6 Mutual Funds **7 hours**

Meaning, Structure, Functions, Participants, Types of Funds, Types of Schemes, Performance of Mutual Funds, Regulations for Mutual Funds.

Course outcomes:

At the end of the course the student will be able to:

1. The Student will be acquainted to various Banking and Non-Banking financial services in India.
2. The Student will understand the activities of Merchant Banking and credit rating.
3. The Student will be equipped to understand micro financing and other financial services in India.
4. The Student will understand how to evaluate and compare leasing & hire purchase.

Practical Components:

- Study and compare the performance of Public and private sector banks.
- Issue management: Study the recent public issues.
- Factoring and forfeiting business in India.
- Venture capital funding and start up challenges.
- Status of securitization in India

CO-PO MAPPING

CO	PO				
	PO1	PO2	PO3	PO4	PO5
CO1	X				
CO2	X			X	
CO3	X				X
CO4	X			X	

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have 8 full questions carrying equal marks.
- Each full question is for 20 marks.
- Each full question will have sub question covering all the topics under a Module.
- The students will have to answer five full questions; selecting four full question from question number one to seven and question number eight is compulsory.
- 80 percent theory and 20 percent problems in the SEE.

Textbook/ Textbooks

Sl. No.	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Financial services	Khan M Y	McGraw Hill	6/e
2	Banking and Financial Services	Mukund Sharma	Himalaya Publishing House	2015
3	Financial Services in India: Concept and Application	Rajesh Kothari	Sage Publications	1/e, 2010
Reference Books				
1	Financial Markets and Services	Gordon & Natarajan	Himalaya Publishing House	7/, 2011
2	Merchant Banking & Financial	Vij & Dhavan	McGraw Hill	1/e, 2011
3	Investment Banking	Pratap G Subramanyam	Tata McGraw Hill	2012
4	Behavioural Finance	Sujata Kapoor & Jaya Mamta Prosad	Sage Publications	1/ e, 2019

ADVANCED FINANCIAL MANAGEMENT			
Course Code	20MBAFM306	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Course Objectives

1. To understand the concept capital structure and capital structure theories.
2. To assess the dividend policy of the firm.
3. To be aware of the management of working capital and its financing.
4. To understand the techniques of managing different components of working capital.

Module -1 Capital Structure Decisions **9 hours**

Capital structure & market value of a firm. Theories of capital structure – NI approach, NOI approach, Modigliani Miller approach, Traditional approach. Planning the capital structure: EBIT and EPS analysis. ROI & ROE analysis. (Theory and Problems).

Module -2 Dividend Policy **9 hours**

Dividend policy – Theories of dividend policy: relevance and irrelevance dividend decision. Walter's & Gordon's model, Modigliani & Miller approach. Dividend policies – stable dividend, stable payout and growth. Bonus shares and stock split corporate dividend behavior. (Theory and Problems).

Module -3 Working Capital Management Policy **9 hours**

Working capital management – Determination of level of current assets. Sources for financing working capital. Bank finance for working capital. (No problems on estimation of working capital). Working capital financing: Short term financing of working capital, long term financing of working capital. Working capital leverage. (Theory).

Module -4 Inventory Management **7 hours**

Inventory Management: Determinations of inventory control levels: ordering, reordering, danger level. EOQ model. Pricing of raw material. Monitoring and control of inventories, ABC Analysis. (Theory and problems)

Module -5 Receivables Management **7 hours**

Receivables Management – Credit management through credit policy variables, marginal analysis, Credit evaluation: Numerical credit scoring and Discriminate analysis. Control of accounts receivables, Problems on credit granting decision. (Theory and Problems)

Module-6 Cash Management **9 hours**

Cash Management – Forecasting cash flows – Cash budgets, long-term cash forecasting, monitoring collections and receivables, optimal cash balances – Baumol model, Miller-Orr model, Strategies for managing surplus fund. (Theory and Problems)

Course outcomes:

At the end of the course the student will be able to:

1. Get an overview of capital structure theories.
2. Understand and assess the dividend policy of the firm.
3. Realize the importance of management of working capital in an organization.
4. Be aware of the techniques of cash, inventory and receivables management

Practical Component:

• Study the working capital financing provided by a Bank and submit the report on the same.
• Study the annual report of any two companies and prepare a cash budget for next year.
• Study dividend policy of companies and its impact on shareholders' wealth.
• Study implications of bonus issues/stock splits of companies.

CO-PO MAPPING

CO	PO				
	PO1	**PO2**	**PO3**	**PO4**	**PO5**
CO1	X				
CO2	X			X	
CO3	X				
CO4	X				X

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have 8 full questions carrying equal marks.
- Each full question is for 20 marks.
- Each full question will have sub question covering all the topics under a Module.
- The students will have to answer five full questions; selecting four full question from question number one to seven and question number eight is compulsory.
- 40 percent theory and 60 percent problems in the SEE.

Textbooks

Sl. No.	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Financial Management	M.Y.Khan & P.K.Jain	TMH	6/e, 2011
2	Financial Management	Prasanna Chandra	TMH	8/e, 2011
3	Corporate Finance-Text and Cases	Vishwanath S.R.	Sage Publishing	3/e, 2019

Reference Books

1	Financial Management & Policy	Vanhorne	Pearson	12/e,
2	Financial Planning: Theory and Practice	Sid Mittra, Shailendra Kumar Rai, Anandi P Sahu & Harry Starn, Jr.	Sage Publishing	1/e, 2015
3	Financial Management-A	Rajesh Kothari	Sage Publishing	2/e, 2017

HUMAN RESOURCE SPECIALISATION COURSES

RECRUITMENT AND SELECTION			
Course Code	20MBAHR303	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Course Objectives

1. The student will be able to recite the theories and various steps involved in Recruitment and Selection
2. The student will be able to describe and explain in her/his own words, the relevance and importance of Recruitment and Selection in the Organization
3. The student will be able to apply and solve the workplace problems through Recruitment and Selection intervention
4. The student will be able to classify and categorize in differentiating between the best method to be adopted by organization related to Recruitment and Selection
5. The student will be able to compare and contrast different approaches of Recruitment and Selection framework for solving the complex issues and problems
6. The student will be able to design and develop an original framework and framework in dealing with the problems in the organization.

Module-1 Workforce Planning and Recruitment Analytics **9 hours**

Concept of Work, Organisation's Work and Jobs; Millennials at the work place; Key Characteristics of Millennials; Types of Millennial; The Evolution of Work Structure; Organising the Work; Strategic Job Redesign and Its Benefits; Strategic Issues in Recruitment; What make Bad Recruitment; Overview of the Hiring Process; Recruitment Metrics; Factors Affecting Recruitment; Recruitment Strategy: An Internal Approach; Recruitment Strategy: An External Approach; Legal and Ethical Considerations; Organisational Best Practices.

Module -2 Job Analysis, Job Description and Job Design **9 hours**

Identify the Job to Examine; Determine Appropriate Information Sources and Collect Job-Related Data; Job Description; Competency and Competency Ice Berg Model; Why Competency Based Recruitment; Sources of Recruitment; Different steps of job search; Motivational Job Specification; Creation of Functional Specification; Creation of Behavioural Specification; Employer branding; Social Media; Job Design.

Module -3 Job Evaluation **7 hours**

The Job Evaluation Process; Obtain Job KSAOs, Qualifications, Working Conditions, and Essential Duties; Examine Compensable Factors Using the Rating/Weighting Evaluation Method; Determine Overall Job Value; Hay Group—Pioneer in Job Evaluation; Determining Compensation using Job Evaluation Data; Legal and Ethical Considerations for Job Evaluation; Online Salary Survey.

Module -4 Selection and Interview Strategy **9 hours**

Interview Strategy and Process; Millennials shaping the Recruitment landscape in the organizations; Strategies for recruiting and selecting Generation Y into the workforce Developing Effective. Interviewers; Interviewing Techniques; Legal and Ethical Considerations in the Interview Process; The overall BEI Process; Assessment Centre's; Simulations.

Module -5 Testing and Assessment **9 hours**

Testing in Occupational Selection; Test related to Assessment of Knowledge, Skills, and Abilities; Personality Assessment; The Birkman method and MBTI® comparison; FIRO-B; Honesty and Integrity Assessment; Various Non-Interviewing Methods; Graphology; Skills Assessment; Games and Group Activity for Leadership Assessment; Administration of Tests and Assessments; Key Interviewer Skills.

Module – 6 Making the Hire; Assessment of Candidate and Job Fit **7 hours**

Unique Recruitment strategies; Biodata and Application Forms; Implications of Using Social Media Content in Hiring Decisions; Background Checks; Reference Checks; Pre-employment Testing; Making a Job Offer; Transitioning from Job Candidate to Employee; Induction; Placement.

Course outcomes:

At the end of the course the student will be able to:

1. Gain the practical insight of various principles and practices of recruitment and selection.
2. Acquire knowledge of latest conceptual framework used in recruitment and selection process and procedure applied in various industries.

3. Illustrate the application of recruitment and selection tools and techniques in various sectors.
4. Develop a greater understanding about strategies for workforce planning and assessment, analyse the hiring management system followed in various industries.

Practical Component:

- Design and Job Advertisement and Calculate the Cost; Paper Print mode; Social Media formalities.
- Meet a Manager (which ever stream), interact and design and JD for that role.
- Meet HR Manager / Officer, and ask Best 10 Interview Questions they ask during Candidate interaction.
- Visit HR department, and take part on shortlisting/ Scrutiny the CV.

CO-PO MAPPING

CO	PO				
	PO1	PO2	PO3	PO4	PO5
CO1	X				
CO2	X			X	
CO3	X				X
CO4	X		X	X	

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have 8 full questions carrying equal marks.
- Each full question is for 20 marks.
- Each full question will have sub question covering all the topics under a Module.
- The students will have to answer five full questions; selecting four full question from question number one to seven and question number eight is compulsory.
- 100 percent theory in the SEE.

Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	How to Recruit, Incentives and Retain Millennials.	Rohtak	Sage Publications	2019
2	Recruitment and Selection- Strategies for Workforce Planning & Assessment	Carrie A. Picardi	Sage Publication	2019
3	Human Resource Management	R. C. Sharma	Sage Publication	2019

Reference Books

1	Human Resource Management:	Amitabha Sengupta	Sage Publication	2018
2	Leadership: Theory and Practices	Peter G. Northouse	Sage Publication India Pvt. Ltd	7/e, 2016
3	Performance Management and	T. V Rao	Response Books	2004

HUMAN RESOURCE ANALYTICS			
Course Code	20MBAHR304	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Course Objectives

1. The student will be able to describe and Identify the application of HR Analytics in the Organisation
2. The student will be able to describe and explain in her/his own words, the relevance and importance of HR Analytics in the Organisation
3. The student will be able to apply and solve the workplace problems through application of HR Analytics in the Organisation
4. The student will be able to classify and categorise different models of HR Analytics in the Organisation
5. The student will be able to compare and contrast different approaches of HR Analytics in the Organisation
6. The student will be able to design and develop an original framework and model in dealing with the problems in the organisation.

Module-1 Introduction **7 hours**

Evolution of Business Analytics, Motivation for Studying Business Analytics, Emergence of Business Analytics, Understanding Business Analytics, Managing a Business Analytics Project, Advantages of Business Analytics, Making the Best Use of Business Analytics, Challenges to Business Analysts, Analytics in Different Domains of Business, Levels of Analytics Maturity.

Module -2 Rise of Human Resource(HR)Analytics **7 hours**

Meaning of HR Analytics; Pitfalls of HR Analytics; What is not HR Analytics; Evolution of HR Analytics, Levels of Analysis, Conducting HR Analytics, Who Are Applying HR Analytics, Future of HR Analytics, The Scope of Big Data in HR Analytics, Scope of Text Analytics in HR Analytics.

Module -3 Applications of HR Metrics and Creating HR Dashboards **9 hours**

HR Metrics, Types of HR Metrics, Staffing Metrics, Training and Development Metrics, Application-oriented Exercises : Dashboards: Few Key Excel Add-ins/Functions to Help Create Dashboards, Name Range, The Developer Tab, Form Controls, Important Excel Formulas Useful for Creating Dashboards, VLOOKUP, INDEX, SUMIF, AVERAGEIF and COUNTIF, Application of Excel Functions in Creating HR Dashboards, Storyboarding: Connecting the Dots and Integrating the Findings.

Module -4 Correlation and Regression for HR Analytics **9 hours**

Correlation Analysis, Output of Correlation Analysis, The Case of Outlier, Software for Statistical Analysis 1- GNU PSPP, Plotting Scatter Plot in PSPP, Conducting Correlation in PSPP , Software for Statistical Analysis 2: R and R Commander, The Advantage of Free OSS over Closed Software, Simple Linear Regression Analysis, Co-variation of the Cause and Effect, Temporal Precedence, Plausible Alternative Explanations, Assumptions of Regression Analysis, Interpretation of the Output of Simple Linear Regression Analysis, Conducting Simple Linear Regression Analysis in PSPP, Conducting Simple Linear Regression Analysis in R Commander, Multiple Regression Analysis, Interaction Effects.

Module -5 HR Analytics Applications using ANOVA **9 hours**

One-Sample T-test, Null and Alternate Hypotheses, One-Sample T-Test, Assumptions of One-Sample T-test , Conducting One-Sample T-Test in PSPP, Conducting One-Sample T-Test in R Commander, Interpreting the Output of One-Sample T-Test, Paired Sample T-Test, Conducting Paired-Sample T-Test in PSPP, Conducting Paired-Samples T-Test in R Commander, Independent-Sample T-Test, Conducting Independent-Sample T-Test in PSPP, Conducting Independent-Sample T-Test in R Commander, Analysis of Variance, Conducting Independent One-Way ANOVA in PSPP, Conducting Independent One-Way ANOVA in R Commander, Steps to Analyse the Output of ANOVA, Advanced Concepts.

Module – 6 HR Analytics Applications using Regression **9 hours**

Logistic Regression with Single Nominal Predictor, Assumptions of Logistic Regression Analysis Conducting Logistic Regression Analysis in PSPP, Conducting Logistic Regression Analysis in R Commander, The Output of Logistic Regression Analysis, Multiple Predictors, Conducting Logistic Regression Using Rattle Package, Advanced Concepts , Pros and Cons of Logistic Regression as a Supervised Learning Algorithm; Factor Analysis and Cluster Analysis: Factor Analysis, Assumptions of Factor Analysis, Considerations Before Conducting Factor Analysis; Conducting Factor Analysis in PSPP, Conducting Factor Analysis in R Commander, Interpretation of the Output of Factor Analysis, Cluster Analysis, Assumptions of Cluster Analysis, Conducting Cluster Analysis in PSPP, Conducting Cluster Analysis in R Commander, Conducting Cluster Analysis in Rattle, Interpreting the Output of Cluster Analysis, Advanced Concepts.

Course Outcomes:

At the end of the course the student will be able to:

1. Gain practical insight of HR Processes, HR analytics and predictive modelling used in HR functions.
2. Acquire conceptual knowledge of HRA frameworks, models and approaches.
3. Illustrate the application of datafication of HR, predictive analytics tools and techniques.
4. Analyse the employee data set, considering the various concepts and functions of HR, facilitating the decision making in business context.

Practical Component:

- To visit an Organisation and interact with Analyst who deals with HR function; Know how the data is used and worked.
- Prepare a dashboard and analysis various functions and interrelations of data.
- Work on Excel through real time data of any company and generate the output.

CO-PO MAPPING

CO	PO				
	PO1	PO2	PO3	PO4	PO5
CO1	X				X
CO2	X			X	
CO3	X	X		X	
CO4	X			X	

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have 8 full questions carrying equal marks.
- Each full question is for 20 marks.
- Each full question will have sub question covering all the topics under a Module.
- The students will have to answer five full questions; selecting four full question from question number one to seven and question number eight is compulsory.
- 100 percent theory in the SEE.

Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year

1	Practical Applications of HR Analytics	Pratyush, Banerjee; Jatin Pandey; Manish Gupta	Sage Texts, India	2019
2	HR Analytics- Understanding Theories and Applications	Bhattacharya, Dipak Kumar	Sage Texts, India	2017
3	Winning on HR Analytics- Leveraging Data for Competitive Advantage	Ramesh, Soundarajan and Kuldeep Singh	Sage Publication India Pvt. Ltd.	2016
Reference Books				
1	Applying Advanced Analytics to HR Management Decisions: Methods for Selection, Developing Incentives and Improving Collaboration	Sesil James, C	Pearson, New Jersey	2017
2	Predictive Analytics- Mastering the HR Matrix	Martin Edwards and Kirsten Edwards	Kogan Page	2019
3	Fundamentals of HR Analytics: A Manual on Becoming HR Analytical	Fermin Diez, Mark Bussin, Venessa Lee	Emerald Publishing Limited	2019

INDUSTRIAL RELATIONS AND LABOUR LAWS			
Course Code	20MBAHR305	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Course Objectives

1. The student will be able to describe and Identify the application of Labour Laws regulating Industrial Relations in Organisation
2. The student will be able to describe and explain in her/his own words, the relevance and importance of Labour Laws and Industrial Relations in Organisation
3. The student will be able to apply and solve the workplace problems through Labour Laws
4. The student will be able to classify and categorise different Laws and Codes
5. The student will be able to create and reconstruct Industrial Relations System to be adopted in the Organisation
6. The student will be able to appraise and judge the practical applicability of Labour Laws regulating Industrial Relations in Organisation

Module-1 Fundamental Aspects of Industrial Relations **9 hours**

Introduction, Nature of Industrial Relations, Approaches to Industrial Relations, Trade Unions: The Participants of Industrial Relation Activities, State and Employer/Management. The Participants of Industrial Relation Activities; **Evolution of Labour Legislation in India -** History of Labour Legislation in India, Objectives of Labour Legislation, Types of Labour Legislations in India, Constitutional Provisions for the Protection of Labour Workforce in India, Rights of Woman Workers; The Present Labour Laws and Codes

Module -2 Factories Act, 1948 **7 hours**

Introduction, Objectives, Scope and Important Definitions, Approval, Licensing and Registration of Factories, Health and Safety of Workers, Provisions Related to Working Conditions, Hazardous Processes, Employee Welfare and Working Hours, Employment of Young Persons and Women, Annual Leaves with Wages, Penalties and Contingence of Offences

Module -3 Social Security Act **9 hours**

The Employees' Compensation Act, 1923

Introduction, Objectives, Scope and Important Definitions of the Act, Eligibility, Rules for Workmen's Compensation, Amount and Distribution of Compensation, Notice, Claims and Other Important Provisions, Enforcement of Act and Provisions for Penalty

The Employees' State Insurance Act, 1948

Introduction, Objectives, Scope and Important Definitions, Administration of the Act, Finance and Audit, Contribution, Benefits, Obligations of Employers under the Act, Adjudication of Disputes, Claims and Penalties, Exemptions

The Maternity Benefit Act, 1961

Introduction, Objectives, Scope and Important Definitions, Provisions Related to Maternity, Benefits, Enforcement of the Act, Penalties and Offences, Miscellaneous Provisions of the Act

The Employees' Provident Funds and Miscellaneous Provisions Act, 1952

Introduction, Objectives, Scope and Important Definitions, Administration of the Schemes under the Act, Administration of the Act, Calculation of Money Due from Employers, Their Recovery and Employees', Provident Funds Appellate Tribunal, Enforcement of the Act, Penalties and Offences, Miscellaneous Provisions of the Act

The Payment of Gratuity Act, 1972

Introduction, Objectives, Scope and Important Definitions, Payment and Forfeiture of Gratuity and Exemption, Compulsory Insurance and Protection of Gratuity, Determination and Recovery of Gratuity, Enforcement of the Act, Penalties and Offences.

Module -4 Wages Act **9 hours**

The Payment of Wages Act, 1936

Introduction, Objectives, Scope and Important Definitions, Provisions for Payment of Wages, Deductions from Wages, Enforcement of the Act, Penalties and Offences, Miscellaneous, Provisions of the Act

The Minimum Wages Act, 1948

Introduction, Objectives, Scope and Important Definitions, Fixation and Revision of Wages, Payment of

Minimum Wages, Enforcement of the Act, Penalties and Offences, Miscellaneous, Provisions of the Act

The Payment of Bonus Act, 1965

Introduction, Objectives, Scope and Important Definitions of the Act, Eligibility, Disqualification and Amount of Bonus, Calculation of Bonus, Special and Miscellaneous Provisions, Dispute, Penalties and Offences

Module -5 Regulating Employer-Employee Relations Act **9 hours**

The Industrial Disputes Act, 1947

Introduction, Objectives, Scope and Important Definitions, Procedure for Settlement of Industrial Disputes and Authorities under the Act, (Chapter II), Notice of Change in Conditions of Service (Chapter II-A), References of Disputes to Boards, Courts or Tribunals and Voluntary References

(Chapter III) Award and Settlements, Strikes and Lockouts (Chapter V), Layoff and Retrenchment (Chapters V-A and V-B), Transfer and Closing Down of Undertakings, Special Provisions Related to Layoff, Retrenchment and Closure (Chapter V-B), Unfair Labour Practices (Chapter V-C), Miscellaneous Provisions of the Act (Chapter VII)

The Industrial Employment (Standing Orders) Act, 1946

Introduction, Objectives, Scope and Important Definitions of the Act, Procedure for Certification of Standing Orders, Other Provisions Relating to Standing Orders, Miscellaneous Provisions of the Act, Penalties and Offences

The Trade Unions Act, 1926

Introduction, Objectives, Scope and Important Definitions, Registration and Cancellation of Registration of Trade Unions, Rights and Duties of Registered Trade Unions, Amalgamation and Dissolution of Trade Union, Penalties

Module – 6 Contract Labour (Regulation and Abolition) Act, 1970 **7 hours**

Contract Labour (Regulation and Abolition) Act, 1970

Introduction, Objectives, Scope and Important Definitions, Registration of Establishments Employing Contract Labour, The Advisory Boards, Prohibition of Employment of Contract Labour, Appointment of Licensing Officer and Licensing of Contractors, Welfare and Health of Contract Labour, Offences by Companies

The Employment Exchanges (Compulsory Notification of Vacancies) Act, 1959

Introduction, Objectives, Scope and Important Definitions, Notification of Vacancies, Penalties Miscellaneous Provisions, The Employment Exchanges (Compulsory Notification of Vacancies)
Amendment Bill, 2013

Course outcomes:

At the end of the course the student will be able to:

1. Gain practical experience related to labour legislations in India across various sectors.
2. Acquire conceptual knowledge of Industrial relations and labour laws followed within industries.
3. Develop the greater understanding of IR concepts and its application in solving various issues in IR.
4. Apply the IR and labour laws concepts in various industries in India.

Practical Component:

- Visit Any Organisation and discuss the applicability of Laws at the workplace
- Meet HR Manager and discuss the statutory and non-statutory measure
- Visit Labour Dept, Government, and Interact with Labour Commissioner

CO-PO MAPPING

CO	PO				
	PO1	PO2	PO3	PO4	PO5
CO1	X				
CO2	X			X	
CO3	X		X		X
CO4	X		X		

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have 8 full questions carrying equal marks.
- Each full question is for 20 marks.
- Each full question will have sub question covering all the topics under a Module.
- The students will have to answer five full questions; selecting four full question from question number one to seven and question number eight is compulsory.
- 100 percent theory in the SEE.

Texbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Industrial Relations and Labour Laws for Managers	Parul Gupta	Sage Publication India Pvt. Ltd	2019
2	The SAGE Handbook of Industrial Relations	Paul Blyton, Edmund Heery, Nicolas Bacon, Jack Fiorito	SAGE Publications	2008
3	Labour and Industrial Laws	P. K. PADHI	Prentice Hall India Pvt., Limited	2017

Reference Books

1	Bare Acts, Ministry of Labour	GOI	GOI	2019
2	The Idea of Labour Law	Guy Davidov, Brian Langille	The Oxford University Press	2011
3	Labour and Industrial Laws	PADHI, P. K	PHI Learning Pvt. Ltd	2019

COMPENSATION MANAGEMENT AND REWARD SYSTEM			
Course Code	20MBAHR306	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Course Objectives

1. The student will be able to describe and Identify the application of Compensation Management in the Organisation
2. The student will be able to describe and explain in her/his own words, the relevance and importance of Compensation Management in the Organisation
3. The student will be able to apply and solve the workplace problems through application of Compensation Management
4. The student will be able to classify and categories different models and approaches of Compensation Management adopted in the Organisation
5. The student will be able to formulate and prepare Compensation Management to be adopted in the Organisation
6. The student will be able to design and develop an original framework and model in dealing with compensation problems in the organisation.

Module-1 Compensation **7 hours**

Compensation, Meaning of compensation, Total Compensation/Reward and Its Components and Types, Importance of the Total Compensation Approach, Wages/Salaries, Some Other Terms, Theories of Wages, Does Compensation Motivate Behaviour?, Compensation Philosophy, Compensation Strategy, Compensation Policy, Base of Compensation Management, The Psychological Contract, Compensation and Legal Issues in Compensation Management, Factors Affecting Employee Compensation/Wage Rates/Wage Structure/Levels of Pay.

Module -2 Compensation Management **7 hours**

Meaning of Compensation Management, Methods of Wage Payment, Essentials of a Satisfactory Wage System, National Wage Policy in India, Wage Policy at the Organisational Level, Wage Problems in India, Components/Functions of Compensation Management/W&S Admin, Divergent Systems and Institutions for Wage Fixation in India.

Module -3 Wage Determination Practices in India **9 hours**

Divergent Systems for Wage Determination in Practice in Indian Organisations

Introduction, Management's Strategy, Reward Policy, Reward Management Processes, Reward Management Procedures, Pay Reviews, Planning and Implementing Pay Reviews, Procedures for Grading Jobs and Pay, Rates Fixation, Controlling Payroll Costs, Evaluation of Reward Processes, Some Other Trends, Boardroom Pay; Divergent Systems and Institutions for Wage Fixation in Practice in India, Management Strategy; Fringe Benefits, Fringe Benefits and Current Practices, Internal Audit of Compensation and Benefits; Different types of Direct and Indirect compensation include: Base Pay / Base pay; Commissions; Overtime Pay; Bonuses, Profit Sharing, Merit Pay; Stock Options; Travel/Meal/Housing Allowance; Benefits including: dental, insurance, medical, vacation, leaves, retirement, taxes; Merit pay; Incentive Pay; Deferred Pay ; Pay for time; Recreational facilities.

Module -4 Contingent Pay, Pay for Performance, Competence **9 hours**

Competency-Based Pay, Skill-Based Pay, Team-Based Rewards, Gainsharing, Profit-Sharing Profit-Related Pay and Beyond Other Cash Payments and Allowances Overtime Payments Attendance Bonuses, Shift Pay, Clothing Allowances, Honoraria, Payments for Qualifications, Pay for Person, Pay for Excellence, Managerial Compensation and Rewards, Sales Force Incentive Programmes, Competency based Pay- Framework, Model and Challenges; Pay for Performance : Steps involved in the design for pay for performance - Intent ; Eligibility; Participation; Performance and Goal Criteria-Measurements ; Funding; Pay Outs and Timing; Benefits Impact & Administration; Evaluation.

Module -5 Administration & Controlling Salary Costs and Salary Review **9 hours**

Salary Survey data, Salary Costs, Salary Planning, Salary Budget, Salary Control, Salary Reviews, Guidelines for Salary Review Process, Responding to Negative Salary Review, Five Key Steps: Manager's Guide to Annual Salary Review, Fixing of Salary, Method of Paying Salary, Flexibility, Process of Wage and Salary Fixation.

Module - 6 Operating, Non-financial Benefits(Intrinsic and Relational Rewards) **9 hours**

on, Role of Non-financial Benefits/Rewards on Employee Motivation, Types of Non-financial Benefits/Rewards, Planning the Non-financial Benefits/Rewards, A Few Most Effective Non-financial Benefits/Rewards to Motivate Employees, Heineken's Refreshing Approach to Reward, Non-financial Metrics Intellectual Capital Assessment and Market Implications of Human Capital, Recognition, Praise, Learning and Development, Achievement, Value Addition in Personality Others.

Course outcomes:

At the end of the course the student will be able to:

1. Gain insights of various conceptual aspects of Compensation and Benefits to achieve organizational goals.
2. Determine the performance based compensation system for business excellence and solve various cases.
3. Designing the compensation strategies for attraction, motivation and retaining high quality workforce.
4. Understand the Legal & Administrative Issues in global compensation to prepare compensation plan, CTC, wage survey and calculate various bonus.

Practical Component:

- To understand the theoretical and practical aspects in the area of compensation and benefits.
- Exposure to MS-Excel or HRIS packages recommended.
- Acquire knowledge of compensation and reward system policies, processes and procedure.
- Apply the concepts of compensation administration and intrinsic and extrinsic reward system in national and global perspective.
- Analyse the divergent system and wage determination practices followed in various sectors.

CO-PO MAPPING

CO	PO				
	PO1	PO2	PO3	PO4	PO5
CO1	X				X
CO2	X	X	X		
CO3	X	X			
CO4	X			X	X

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have 8 full questions carrying equal marks.
- Each full question is for 20 marks.
- Each full question will have sub question covering all the topics under a Module.
- The students will have to answer five full questions; selecting four full question from question number one to seven and question number eight is compulsory.
- 100 percent theory in the SEE.

Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Compensation Management	R. C. Sharma, Sulabh Sharma	Sage Publication India Pvt. Ltd	2019
2	Compensation and Benefit Design	Biswas, Bashker, D	Pearson	2013
3	Managing Employees Performance and Rewards	Shields	Cambridge Press	2007

Reference Books				
1	Human Resource Information Systems: Basics, Applications, and Future Directions	Michael J. Kavanagh, Mohan Thite, Richard D. Johnson	Sage Publication India Pvt. Ltd	3/e, 2015
2	Competency-Based Human Resource Management	Anindya Basu Roy, Sumati Raym	Sage Publication India Pvt. Ltd	2019
3	Compensation and Reward Management	Singh, B D	Excel Books	2007

GUIDELINES FOR INTERNSHIP 20MBA IN 307
(BETWEEN 2ND AND 3RD SEMESTER MBA)

INTERNSHIP			
Course Code	20MBA IN 307	CIE Marks	40
Teaching Hours/Week (L:T:P)	0:0:8	SEE Marks	60
Credits	04	Exam Hours	00

OBJECTIVE
To expose the students to understand the working culture of the organization and apply theoretical concepts in real life situation at the work place for various functions of the organization.

STRUCTURE
The Internship shall consist of study of an organization for 4 credits for 4 weeks.

GENERAL GUIDELINES

- The Internship shall be for a period of 4 weeks immediately after the completion of 2nd Semester Examinations but before the commencement of the 3rd semester classes
- The Course code of the Internship shall be 20MBA IN 307 and shall be compulsory for all the students.
- No two students of an institute shall work on the same organization.
- The student shall seek the guidance of the internal guide on a continuous basis, and the guide shall give a certificate to the effect that the candidate has worked satisfactorily under his/her guidance. Student need to identify an external guide (Working in the organization) and seek guidance from him/her.

Submission of Report: Students shall submit one hard copy of the report to the college with hard bound color of royal blue and a soft copy in PDF file (Un-editable Format)

Evaluation:
Internal evaluation will be done by the internal guide.
Viva-Voce / Presentation: A viva-voce examination shall be conducted at the respective institution where a student is expected to give a presentation of his/ her work. The viva –voce examination will be conducted by the respective HOD or Senior Professor or Internal Guide of the department and an external evaluator drawn from industry. In case of non availability of industry professional, a senior professor or a faculty with more than 10 years of experience may be invited to conduct the viva-voce examination. Internship carries 100 marks consisting of 40 marks for Internship report (evaluated by internal guide) and 60 marks for viva-voce examination.

Contents of the Internship Report

- Cover page
- Certificate from the Organization (scanned copy)
- Certificate from the guide, HOD and Head of the Institution (scanned copy) indicating bonafide performance of Internship by the student.
- Declaration by the student (scanned copy)
- Acknowledgement
- Table of contents
- List of tables and graphs

Executive summary
Chapter 1: Introduction about the Organisation & Industry.
Chapter 2: Organization Profile

i. Back ground,
ii. Nature of business,
iii. Vision mission, quality policy
iv. Workflow model
v. Product/service profile
vi. Ownership pattern
vii. Achievements/awards if any
viii. Future growth and prospects

Chapter 3: Mckensy's 7S framework and Porter's Five Force Model with special reference to Organization under study.
Chapter 4: SWOT Analysis
Chapter 5: Analysis of financial statements

Chapter 6: Learning experience.
Bibliography
Annexure relevant to the Internship such as figures, graphs, photographs, Financial statements etc.,
Format of the Internship: Report shall be prepared using the word processor viz., MS Word, Times New Roman font sized 12, on a page layout of A4 size with 1" margin all sides (1.5" on left side due to binding) and 1.5line spacing. The Internship report shall not exceed 60 pages.

Rubrics for Internship 20MBAIN 307 Marks

SL. No		Particulars	Marks
1	CIE	Assessment by the Guide- Interaction with the student	20
2	CIE	Report Evaluation by the Guide	20
3	SEE	Viva-Voce Examination to be conducted by the Guide and an External examiner from the Industry/Institute	60
		Total	100

Mark sheet for Viva voce Examination (SEE)
Visvesvaraya Technological University
Name of the Institution
Name of the Department

Course Code and Course Title: 20MBA IN 307 Internship

SL. No	**Aspects**	**Marks**
1	Introduction	**5**
2	Understanding the Industry	**5**
3	Understanding the Corporate Functions/Company profile	**10**
4	Mckensy's 7S framework and Porter's Five Force Model	**10**
5	SWOT/SWOC analysis justification	**10**
6	Financial statement analysis	**10**
7	Learning experience	**10**
	Total	**60**

Marks Sheet for Viva Voce examination

SL No	**USN**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Total**
1									
2									
3									
4									
5									
	Total								

Signature of Internal Examiner
Name and Designation with affiliation

Signature of External Examiner
Name and Designation with affiliation

IV SEMESTER
MARKETING SPECIALISATION COURSES

B2B MARKETING MANAGEMENT			
Course Code	20MBAMM401	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	60
Credits	03	Exam Hours	03

Course Objectives

1. Make students have an understanding of B2B Marketing and its characteristics
2. To analyze the purchasing decisions of online customers
3. Analysing traditional marketing approach vis-a vis modern marketing approach using the B2B strategy
4. To enhance knowledge of emerging trends in integrated marketing communications.
5. Managing innovation in the B2B context and understand concept of Relationship portfolio and Key Account Management.

Module-1 B2B Marketing **7 hours**

B2B-Introduction, significance and concept of B2B Marketing. Business Markets, characteristics. Classification of Business Products and Markets.

Module -2 Purchasing Behaviour **7 hours**

Factors affecting purchasing decisions, purchasing orientation, Segmenting purchase categories. Purchase Process- variations. Buying situations and marketer actions. Online buying.
Traditional marketing approach- uncertainties of buyer and supplier/ marketer. Supplier uncertainties. Relationship variables. Impact of IT. Inter-firm Relationships and Networks. **Case Study**

Module -3 B2B strategy and Market Segmentation **7 hours**

Process, approach. Responsible strategy-CSR and sustainability, Customer value and strategy.
Researching B2B markets. Standard industrial classification.
B2B Market Segmentation- Significance of segmentation. Basis of segmentation. Challenges of segmentation in B2B markets. B2B positioning**. Case Study.**

Module -4 Market Communication **7 hours**

Brand expression, Communication mix and customer acquisition process. Relationship Communication, sales responsibilities. The relationship communication process, call preparation, selling to low-priority and high-priority customers. Value selling and consequences- order fulfilment-relationship building**. Case Study.**

Module -5 Relationship Portfolio & Key Account Management **7 hours**

Principles of Portfolio management, identifying key accounts, Classification criteria. Relationship life-cycle, declassification, managing loyalty. **Case Study**.
Assignment: Implementing KAM

Module – 6 B2B product Offerings and Price Setting **5 hours**

Elements of B2B offering, strategic tools for managing product offerings, managing innovation in the B2B context.
Price setting in B2B markets- 3 C's of pricing-cost, customer and competition-Pricing- strategy, price positioning, role of sales force in pricing, bid pricing, internet auctions, ethical aspects of B2B pricing.
Case Study

Course outcomes:

At the end of the course the student will be able to:

1. Understand significance of B2B marketing .
2. Ability to create an integrated marketing communications plan which includes promotional strategies.
3. Effectively use marketing communication for customer acquisition
4. Define and apply knowledge of various aspects of managerial decision making related to marketing communications strategy and tactics.

Practical Component:

- Interview a salesperson and write a brief report about what they like and dislike about their jobs, their salary, travelling allowances, sales quotas, why chose sales career, and what does it take to succeed in this profession.
- Ask your friends if they would buy certain goods like groceries, vegetables, socks, mobile, pens etc from the roadside vendor as against a regular shop. Group the products into low risk and high risk ones. Does this buying behaviour also depend on the personality of the individual doing the buying? Or the one doing the selling?
- Students can make a presentation on any product or the services of student choice, covering selling strategies

and one day work exposure towards merchandising in any big retail outlets of respective places where the institute if operating.

- Rural colleges can send the students to the city nearby to observe the merchandising planning in retail outlets and to make a small report.
- Roles and functions of sales manager and sales people are different in every organization Sales people view the roles of sales managers in their own way and vice versa. You are the sales manager of a company. You make an analysis of what you feel should be roles of a sales manager and a salesperson for maximizing sales of the organization.
- Your company is active in internet trading. A current issue in internet trading is : how to make internet selling safe. Different methods have been suggested for safety or security of internet trading. You have to analyze different methods and recommend a method for your company.

CO-PO MAPPING

CO	PO				
	PO1	PO2	PO3	PO4	PO5
CO1	X				
CO2	X	X	X		
CO3	X	X	X		X
CO4	X		X	X	X

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have 8 full questions carrying equal marks.
- Each full question is for 20 marks.
- Each full question will have sub question covering all the topics under a Module.
- The students will have to answer five full questions; selecting four full question from question number one to seven and question number eight is compulsory.
- 100 percent theory in the SEE

Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Business to Business Marketing	Ross Brennan, Louise Canning & Raymond McDowell	Sage Publications	3e -2014
2	B2B Marketing Strategy: Differentiate, Develop and Deliver Lasting Customer Engagement	Heidi Taylor	Kogan Page	1/e, 2017

Reference Books

1	Innovative B2B Marketing: New Models, Processes and Theory	Simon Hall	Kogan Page	1/e, 2017
2	Product and Brand Management	Michael Baker and Stuart Hart	Pearson	4/e, 2014

LOGISTICS AND SUPPLY CHAIN MANAGEMENT			
Course Code	20MBAMM402	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	60
Credits	03	Exam Hours	03

Course Objectives

1. To understand the basic concepts, processes and key elements of a supply chain.
2. To understand the elements and scope of logistics in supply chain management
3. To provide insights for establishing efficient, effective, and sustainable supply chains.
4. To comprehend the role of warehouse management
5. To gain knowledge about Inventory Management
6. To provide insights into International Logistics
7. To explain the role of technology in supply chain planning, visibility, and execution.

Module-1 Supply Chain **7 hours**

Concept, significance and key challenges. Scope of SCM- historical perspective, essential features, decision phases – process view, supply chain framework, key issues in SCM and benefits.

Definition and scope of Logistics. Elements of Logistics, types, incremental value delivery through Logistics management. Innovations in Supply Chain. Estimating customer demand, forecasting in Supply Chain.

Case Study.

Module -2 Warehouse Management System **7 hours**

Warehousing – scope, primary functions. Efficient Warehouse Management. Types of Warehouse. Warehouse Layout Design, criteria. Warehouse Management System,

Distribution Management, Designing the distribution network, role of distribution, factors influencing distribution, design options, distribution networks in practice, network design in the supply chain, factors affecting the network design decisions. HUB & SPOKE vs Distributed Warehouses. **Case Study**

Module -3 Inventory Management **7 hours**

Concept, various costs associated with inventory, EOQ, buffer stock, lead time reduction, reorder point / re-order level fixation, ABC analysis, SDE/VED Analysis. Goals, need, impact of inventory management on business performance. Types of Inventory, Alternative approach for classification of inventories, components of inventory decisions, inventory cost management, business response to stock out, replenishment of inventory, material requirements planning.

Dealing with demand uncertainty in Supply Chain- managing uncertainty in Supply Chain, (Bullwhip Effect) ,Impact of uncertainties. **Case Study**

Module -4 Transportation **5 hours**

Role, functions, mode of transportation and criteria of decision. Transportation Infrastructure. Factors impacting road transport cost, hazards in transportation, State of Ocean Transport, global alliances.

Packaging Issues in Transportation, role of containerisation. **Case Study**

Module -5 Logistics Management **7 hours**

Logistics of part of SCM, logistics costs, logistics, sub-systems, inbound and out bound logistics bullwhip effects in logistics, distribution and warehousing management. Demand Management and Customer Service: Demand Management, CPFRP, customer service, expected cost of stock outs.

Recent Issues in SCM: Role of computer/ IT in supply chain management, CRM Vs SCM, Benchmarking concept, features and implementation, outsourcing – basic concepts, value addition in SCM.

Case Study

Module - 6 International Logistics **7 hours**

Logistics and Environment, Methods and tools facilitating International Logistics, challenges, Integrated Supply Chain and Logistics Value Chain, Supply Chain Security Initiatives in the USA, Logistics Industry in India.

Sourcing Decisions in Global SCM- Logistics, trends, Key issues in Global sourcing, Factors influencing Outsourcing. Performance Management in Supply Chain introduction. **Case Study**

Course outcomes:

The student should be able to:

1. Demonstrate knowledge of the functions of logistics and supply chain management.
2. To relate concepts and activities of the supply chain to actual organizations.
3. Highlight the role of technology in logistics and supply chain management.
4. Evaluate cases for effective supply chain management and its implementation.

Practical Components:

- Students are expected to choose any four Indian Organizations and study their supply chain in terms of drivers of the Supply chain and submit a report.
- Students should visit different logistics companies and understand the services provided by them and submit a report.
- Students should identify any product/service and study the type of distribution system used and understand the reason for using that particular type and present it in the class.
- Students should identify the various types of IT applications employed by Indian Organizations in their Supply chain

CO-PO MAPPING

CO	PO				
	PO1	PO2	PO3	PO4	PO5
CO1	X				
CO2	X		X	X	
CO3	X				X
CO4	X			X	

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have 8 full questions carrying equal marks.
- Each full question is for 20 marks.
- Each full question will have sub question covering all the topics under a Module.
- The students will have to answer five full questions; selecting four full question from question number one to seven and question number eight is compulsory.
- 100 percent theory in SEE

Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	A Logistic approach to Supply Chain Management	Coyle, Bardi, Longley	Cengage Learning	Latest edition
2	Integrated Supply Chain and Logistics Management	Rajat K. Baisya	Sage	2020
3	Supply Chain Management- Text and Cases	Janat Shah	Pearson	Latest edition
4	Supply Chain Management- Strategy, Planning and Operation	Sunil Chopra, Peter Meindl, D.V.Kalra	Pearson	Latest edition
5	Marketing Channels	Anne Coughlan, Anderson, Stern and El-Ansary		

Reference Books

1	The Box	Marc Levinson		
2	Essentials of Supply Chain Management	Michaael H Hugos		
3	Logistics and Supply Chain	Martin Christopher	FT Publishing	5th Editon
4	Supply chain Logistics Management	Donald J Bowersox,	Mc Graw Hill	4th Edition

DIGITAL MARKETING MANAGEMENT			
Course Code	20MBAMM403	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	60
Credits	03	Exam Hours	03

Course Objectives

1. To understand the important concepts related to e-marketing
2. To learn the use of different electronic media for designing marketing activities.
3. To acquaint the students with the latest techniques of e-marketing.

Module-1 Introduction to Digital Marketing **7 hours**

Concept of Digital Marketing, Origin, traditional versus Digital Marketing. Digital Marketing Strategy- The P-O-E-M Framework, Segmenting and customising Messages, Digital Landscape. Digital advertising Market in India. Skills required in Digital Marketing, Digital Marketing Plan

Module -2 Display Advertising **7 hours**

Concept of Display Advertising, types of display ads, buying models, display plan
Targeting- contextual targeting placement targeting, remarketing, interest categories, geographc and language tagging, demographics, mobile, other targeting methods. Programmatic digital advertising, You Tube Advertising.

Module -3 Search Engine Advertising **7 hours**

Understanding Ad Placement, Understanding Ad Ranks, Creating First Ad Campaign, Performance Reports.
Social Media Marketing: Building a successful Strategy
Live Project: Create a digital marketing plan

Module -4 Social Media Marketing **7 hours**

Face Book Marketing: Facebook for business & facebook insights
LinkedIn Marketing: LinkedIn Strategy, LinkedIn Analytics
Twitter Marketing: Building Content Strategy, twitter usage , Twitter Analytics
Instagram & Snanpchat: Objectives of Instagram, Hashtags. What is Snanpchat. Digital Public Relations

Module -5 Mobile Marketing **7 hours**

Mobile Usage, Mobile Advertising- Mobile Advertising Models, advantages of Mobile advertising, Mobile Marketing Toolkit, Mobile Marketing features- Location based services, Social marketing on mobile, QR Codes, Augmented Reality, Gamification.**Tracking mobile campaigns-** Mobile Analytics.
Live Project: Create a mobile advertising project..

Module – 6 Search Engine Optimization **5 hours**

Search Engine Optimization: How search engines work, concept of search engine optimisation (SEO), On Page Optimisation, Off Page Optimisation, Social media Reach, Maintenance- SEO tactics, Google Search Engine, Web Analytics- Key Metrics- concepts only

Course outcomes:

At the end of the course the student will be able to:

1. Recognize appropriate e-marketing objectives.
2. Appreciate the e-commerce framework and technology.
3. Illustrate the use of search engine marketing, online advertising and marketing strategies.
4. Develop social media strategy's to solve business problems.

Practical Components:

- Students will learn to create a digital marketing plan.
- Students will learn to create a mobile advertising project.

CO-PO MAPPING

CO	PO				
	PO1	PO2	PO3	PO4	PO5
CO1	X				
CO2	X	X			
CO3	X		X	X	
CO4	X		X		X

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have 8 full questions carrying equal marks.
- Each full question is for 20 marks.
- Each full question will have sub question covering all the topics under a Module.
- The students will have to answer five full questions; selecting four full question from question number one to seven and question number eight is compulsory.
- 100 percent theory in the SEE.

Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Digital Marketing	Seema Gupta	McGraw Hill Education	2017
2	Markeing 4.0: Moving from Traditinal to Digital	Philip Kotler, Hermawan Kartajaya, Iwan Setiawan	Wiley	2017
3	Fundamentals of Digital Marketing	Puneet Bhatia	Pearson	2/e, 2014
4	Social Media Marketing	Tracy L Tuten, Michael R Solomon	Sage Publications	3/e, 2020

Reference Books

1	Digital Marketing	Swaminathan T N, Karthik Kumar	Cengage Learning India Pvt. Ltd	2019
2	Digital Marketing	Hanlon	Sage Publications	2/e, 2017
3	Digital Marketing	Ian Dodson	Wiley	2016

STRATEGIC BRAND MANAGEMENT			
Course Code	20MBAMM404	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	60
Credits	03	Exam Hours	03

Course Objectives

1. To appreciate the relationship between corporate strategy and Brand Management.
2. To explore the various issues related to Brand Management, brand association, brand identity, brand architecture, leveraging brand assets, brand portfolio management.
3. To develop familiarity and competence with the strategies and tactics involved in building, leveraging and defending strong brands in different sectors.

Module-1 Brand Management **7 hours**

Concept, Meaning of Brand, Evolution of Brands, Functions of Brand to consumer, Role of Brand-Advantages of Brand, Product Vs Brand. **Branding-** Meaning, Creation of Brands through goods, services, people, Organisation, Retail stores, places, online, entertainment, ideas, challenges to Brand builders.
Brand Management-Meaning & Definition. Strategic Brand Management Process-Meaning, Steps in Brand Management Process Strong Indian Brands.

Module -2 Customer Based Brand Equity(CBBE) **5 hours**

Meaning, Model of CBBE, Brand Equity: Meaning, Sources, Steps in Building Brands, Brand building blocks Resonance, Judgments, Feelings, performance, imagery, salience-Brand Building Implications, David Aaker's Brand Equity Mo del. Brand Identity & Positioning: Meaning of Brand identity, Need for Identity & Positioning, Dimensions of brand identity, Brand identity prism, Brand positioning – Meaning, Point of parity & Point of difference, positioning guidelines Brand Value: Definition, Core Brand values, Brand mantras, Internal branding,

Module -3 Choosing Brand Elements to Build Brand Equity **7 hours**

Criteria for choosing brand elements, options & tactics for brand elements-Brand name, Naming guidelines, Naming procedure, Awareness, Brand Associations, Logos & Symbols & their benefits, Characters & Benefits, Slogans & Benefits, Packaging. Leveraging Brand Knowledge: Meaning of Brand Knowledge,
Dimensions of Brand Knowledge, Meaning of Leveraging Secondary Brand Knowledge & Conceptualizing the leverage process.

Module -4 Brand Value chain **7 hours**

Designing Brand Tracking studies, Establishing brand Equity Management Systems. 58 Methods for measuring Brand Equity-Quantitative Techniques & Quantitative Techniques, Comparative methods-Brand based comparisons, marketing based comparisons Conjoint Analysis, Holistic methods. Managing Brand Equity: Brand Reinforcement, Brand Revitalization, Brand Crisis

Module -5 Designing and sustaining branding strategies **7 hours**

Brand hierarchy, Branding strategy, Brand extension and brand transfer, Managing Brands overtime. Brand Architecture and brand consolidation. Brand Imitations: Meaning of Brand Imitation, Kinds of imitations, Factors affecting Brand Imitation, Imitation Vs Later market entry, First movers advantages, Free rider effects, Benefits for later entrants, Imitation Strategies.
Assignment: Measuring Brand Strength

Module – 6 Making Brands go Global **7 hours**

Making Brands go Global: Geographic extension, sources of opportunities for global brand, single name to global brand, consumers & globalization, conditions favouring marketing, barriers to globalization, managerial blockages, organization for a global brand, pathways to globalization. Luxury Brand Management: Luxury definition and relativity, luxury goods and luxury brands, basic psychological phenomena associated with luxury purchase, luxury marketing mix, luxury retail, International luxury markets: historical leaders and emerging countries.

Course outcomes:

At the end of the course the student will be able to:

1. Comprehend & correlate all the management functions which are happening around with fundamental concepts and principles of management.
2. Understand the overview of management, theory of management and practical applications of the same.
3. Effectively use their skills for self-grooming, working in groups and to achieve organizational goals .

4.Demonstrate their acumen in applying managerial and behavioral concept in real world/situation.
5.Understand and demonstrate their exposure on recent trends in management

Practical Component:

- Go to a supermarket and find the brand elements in various brands of soaps, mobiles, jeans, and other product.
- If you would start an MBA College, what would the positioning be with POP's and POD's?
- Pick up your college, analyse its positioning and how would you reposition it?
- Pick a multiproduct company and as completely as possible analyze its brand portfolio and brand extensions?
- Consider some groups like Tata's , Birla's, Infosys etc – what is their branding strategy.
- Students are supposed to assess the product life cycle and appraise alternative approaches to luxury brand management.
- Students can select any two popular brands and identify and examine the criteria for success in the luxury brand industry.

CO-PO MAPPING

CO	PO				
	PO1	PO2	PO3	PO4	PO5
CO1	X				
CO2	X				
CO3	X		X		X
CO4	X		X		X
CO5	X		X	X	

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have 8 full questions carrying equal marks.
- Each full question is for 20 marks.
- Each full question will have sub question covering all the topics under a Module.
- The students will have to answer five full questions; selecting four full question from question number one to seven and question number eight is compulsory.
- 100 percent theory in the SEE.

Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Strategic Brand Management, Building Measuring & Managing	Kevin Lane Keller	Pearson Education	Latest Edition
2	Brand Management -The Indian Context	Y L R Moorthi	Vikas Publication	Latest Edition
3	Strategic Brand Management	Jean, Noel, Kapferer	Kogan Page India	Latest Edition

4	M B Parameswaran	Brand Building and Advertising Concepts and Cases	Tata McGraw Hill Publication	Latest Edition
Reference Books				
1	Compendium Brand Management	Chunnawalla	HPH,	Latest Edition
2	Strategic Brand Management	Richard Elliott & Larry Perclu	Oxford Press	Latest Edition
3	Creating powerful brands	Chernatony	Elsevier	Latest Edition
4	Brand Management for B2B	Shard Sharin	Sage Publications	1/e, 2015

AGRI BUSINESS MARKETING			
Course Code	20MBAMM405	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	60
Credits	03	Exam Hours	03

Course Objectives

1. To provide a conceptual understanding on the Rural Marketing with special reference to Indian context.
2. To create awareness about the applicability of the concepts, techniques and processes of marketing in rural context.
3. To familiarize with the special problems related to sales in rural markets.

Module-1 Introduction to Indian Rural Marketing **7 hours**

Scope of rural marketing, concepts, classification of rural markets, rural vs. urban markets. Rural marketing environment: Population, occupation pattern, income generation, location of rural population, expenditure pattern, literacy level, land distribution, land use pattern, irrigation, development programs, infrastructure facilities, rural credit institutions, rural retail outlets, print media in rural areas, rural areas requirement, rural demand and rural market index, problems in rural marketing.

Module -2 Rural Consumer behaviour **7 hours**

Consumer buying behaviour models, Factors affecting Consumer Behaviour, Social factors, Technological Factors, Economic Factors, Political Factors, Characteristics of Rural consumer-Age and Stages of the Life cycle, Occupation and Income, Economic circumstances, Lifestyle, Personality and Brand Belief, Information Search and pre-purchase Evaluation, Rise of Consumerism, Consumer Buying Process, Opinion Leadership Process, Diffusion of Innovation, Brand Loyalty. 60 Researching Rural Market: Sensitizing rural market, Research design-reference frame, Research approach, Diffusion of innovation, Development studies, PRA approach, The need for PRA, Sampling, Operational aspects of data collection.

Module -3 Rural Marketing of FMCG's **7 hours**

Rural Marketing of FMCG's: Indian FMCG industry, characteristics of Indian FMCG sector, Challenges in the FMCG industry, Rural Marketing of FMCG's: Select case studies Rural Marketing of Consumer durables: Issues related to consumer durables in the rural market, Rural Marketing of Consumer durables: Select case studies Rural marketing of financial services: Marketing objectives and approaches, Evolution of rural banking after independence, Challenges in marketing for banking services in rural, opportunities for banking in rural areas, marketing strategies for banking services.

Module -4 Marketing of agricultural inputs **5 hours**

Indian tractor industry: A brief overview, Challenges for Indian tractor industry, factors suggesting better future prospects for tractor industry, marketing strategies for tractor industry Fertilizer industry in India: Marketing of fertilizer industry, classification of fertilizer industry, Challenges for marketing of fertilizer industry, marketing strategies for fertilizer industry.

Module -5 Marketing of agricultural products **7 hours**

Profiling of Indian agricultural produces marketing, challenges in marketing of agricultural produce, Strategies to promote marketing of agricultural produce. Corporate sector in agri-business: Reasons for increased interest of corporate sector in agribusiness, opportunities in the agri-business, benefits of corporate driven agri-business system involvement of corporate sector in agri-business.

Module - 6 Distribution and Communication Strategy **7 hours**

Distribution Strategy: Introduction Accessing Rural Markets, Coverage Status in Rural Markets, Channels of Distribution, Evolution of Rural Distribution Systems- Wholesaling, Rural Retail System, Vans, Rural Mobile Traders: The last Mile Distribution, Haats/Shandies, Public Distribution System, Co-operative Societies Behaviour of the Channel, Prevalent Rural Distribution Models- Distribution Models of FMCG Companies, Distribution Model of Durable Companies, Distribution of fake products, Emerging Distribution Models-Corporate –SHG Linkage, Satellite Distribution, Syndicated Distribution, ITC's Distribution Model, Petrol pumps and Extension counters.

Communication strategy: Challenges in Rural Communication, A view of Communication Process, Developing Effective- Profiling the Target Audience, Determining communication objectives, designing the message, selecting the communication channels, deciding the promotion mix, Creating advertisement for rural audiences

rural media- Mass media, Non-Conventional Media, Personalized media, Rural Media: The importance of the two-step flow of communication Media Typology, The Media Model, Media innovation, Influence of Consumer Behaviour on Communication strategies.

Live Project: Visit a Rural santhe in village setting (Producer market) and submit a report

Course outcomes:

At the end of the course the student will be able to:

1. Highlight the characteristics of Indian rural markets and describe the differences between rural and the urban economy.
2. Analyze the roadblocks of Indian rural market and advocate solutions for the problems of rural markets.
3. Emphasize the different strategies adopted by Indian companies for rural markets.
4. Apply the strategies to be adopted for influencing the rural consumers.

Practical Components:

- Visit to the various Micro Finance Institutes, who extend their services in catering rural market.
- Visit to a village and understand the market structure and also understand the functioning part of the rural markets.
- Students should come up with new product designing with the rural marketing mix 4 As (Awareness, Acceptability, Adaptability and Affordability).
- Students can do a survey on corporate farming and its effect on income of the rural farmer.

CO-PO MAPPING

CO	PO				
	PO1	PO2	PO3	PO4	PO5
CO1	X	X			
CO2	X			X	
CO3	X		X		X
CO4	X		X		X

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have 8 full questions carrying equal marks.
- Each full question is for 20 marks.
- Each full question will have sub question covering all the topics under a Module.
- The students will have to answer five full questions; selecting four full question from question number one to seven and question number eight is compulsory.
- 100 percent theory in SEE.

Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Rural Marketing	Pradeep Kashyap&	Biztantra.	2108
2	Rural marketing: Challenges and OpportModuleies	Dinesh Kumar & Punam Gupta	SAGE	2017
3	Rural Marketing	Gopal Swamy T. P	Vikas Publishing	2108

Reference Books

1	Rural Marketing	Dogra &KarminderGhuman	TMH	2018
2	Rural Marketing	Sanal Kumar Velayudhan	Response Publication	2014
3	Agricultural Marketing In India	Acharya	Oxford I B H.	2015

INTERNATIONAL MARKETING MANAGEMENT			
Course Code	20MBAMM406	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	60
Credits	03	Exam Hours	03

Course Objectives

1. To introduce students to the international marketing management process, design and theories
2. To develop skills relating to international trade.
3. To familiarize the steps involved in import export documentation.

Module -1 Introduction to International Marketing **5 hours**

Scope, Challenges, Reasons and Motivations, Concepts to the management of international marketing function, differences between international marketing and domestic marketing – transition from domestic to international markets - World Trade and India's foreign trade: an overview.

Module -2 International Trade Theories and Market research **5 hours**

International Trade Theories- Absolute cost-comparative Cost- H-O Theorem- New Trade Theories- Porter's Diamond Theory- Managerial Implications. Developing a global vision through market research : Breadth and scope of international marketing research , problems in availability and use of secondary data, problems in gathering primary data , multi cultural research – a special problem , research on internet – a new opportunity , estimating market demand, responsibility for conducting marketing research, communicating with decision makers. Identifying foreign markets – classification based on demand , based on the stage of development ,other basis for division of world markets.

Module -3 Planning and organization **7 hours**

Planning and organization: Global perspective – global gateways – global marketing management – an old debate and a new view – planning for global markets – alternative market entry strategies – organizing for global competition. Global marketing environment – cultural Environment Political and Legal Environment, Economic Environment- Modes of entry in to foreign business.

Module -4 International Product Policy for Consumers **9 hours**

: Quality – green marketing and product development, products and culture – analyzing product components for adaptation – products for consumers in global markets, product development, product adaptation, product standardization, Cross country segmentation, Product life cycle in International Marketing, International Packaging.

Product and services for businesses. Demand in global business to business markets- Quality and global standards – business services – tradeshows crucial part of business to business marketing – relationship markets in business to business context.

Module -5 International Pricing, Promotion and distribution decision **9 hours**

Pricing decision: global pricing frame work, pricing basics, marginal cost pricing and its importance. Transfer pricing, counter trade, systems pricing, pricing and positioning price quotation-INCO terms.

Promotion decision: International Advertising, Sales promotion in International, direct mailing, personal selling, exhibition – generic promotion in international marketing.

Global Distribution decision - Introduction, distribution as competitive advantage, rationalizing local channels, global channel design, Channel alternatives – Importance of Channel decision – Factors influencing the Channel decision – Channel Selection decision.

Assignment: Identifying a International luxury product and relate it to either pricing or promotion or distribution

Module – 6 Import –Export procedure and documentation **5 hours**

Import policy – procedure and Documentation - balance of trade and payments , Institutional infrastructure for exports promotions in India-India's trade policy- export assistance- exports documentation and procedures including different stages of documentations.

International Retailing.

International expansion of retailers – International retailing defined – retail format – variations in different markets – general merchandise at Retailing – issues in international retailing.

Course outcomes:

At the end of the course the student will be able to:

1. Understand the differences between domestic marketing and international marketing.
2. Understand the concept of international pricing and distribution decision.
3. Acquire the knowledge of import export documentation.

Practical Components:

- Studying organizational structures of any 10 companies and classifying them into different types of organizations which are studied in Module 2 and justifying why such structures are chosen by those organizations.
- Preparing the leadership profiles of any 5 business leaders and studying their leadership qualities and behaviors with respects to the trait, behavioural and contingency theories studied.
- Identifying any five job profiles and listing the various types, abilities required for those jobs and also the personality traits/attributes required for the jobs identified.

CO-PO MAPPING

CO	PO				
	PO1	PO2	PO3	PO4	PO5
CO1	X				
CO2	X		X	X	
CO3	X				X

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have 8 full questions carrying equal marks.
- Each full question is for 20 marks.
- Each full question will have sub question covering all the topics under a Module.
- The students will have to answer five full questions; selecting four full question from question number one to seven and question number eight is compulsory.
- 100 percent theory in SEE.

Recommended Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	International Marketing	Catero, Graham	TataMcGrawHill	Latest Edition
2	International Marketing	Varshney, Bhattacharya	S.Chand	Latest Edition
3	Global marketing management	Warren J.Keegan	Pearson	Latest Edition
4	International Marketing Management: Text and Cases	U C Mathur	SAGE	2008

Reference Books

1	International marketing: analysis and strategy	Sak Onkvisit, Johnshaw	Biztantra	Latest Edition
2	International marketing	Rakesh mohan Joshi	Oxford	Latest Edition
3	International marketing	Michael Czinkota, Illka A. Ronkainen	Cenage Learning	Latest Edition

FINANCE SPECIALISATION COURSES

RISK MANAGEMENT AND INSURANCE			
Course Code	20MBAFM401	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	60
Credits	03	Exam Hours	03

Course Objectives

1. To provide an understanding of different types of risk.
2. To provide an understanding of the risk identification and measurement.
3. To give an overview of role of Life Insurance in risk management.
4. To provide an understanding of general insurance contract.

Module -1 Introduction to Risk Management **5 hours**

and Risk Identification: Risk-Risk and Uncertainty-Types of Risk-Burden of Risk-Sources of Risk-Methods of handling Risk-Degree of Risk-Management of Risk. Risk Identification-Business Risk Exposures-Individual Exposures-Exposures of Physical Assets -Exposures of Financial Assets -Exposures of Human Assets - Exposures to Legal Liability - Exposure to Work-Related Injury. (Theory).

Module -2 Risk Measurement **7 hours**

Evaluating the Frequency and Severity of Losses-Risk Control-Risk Financing Techniques-Risk Management Decision Methods-Pooling Arrangements and Diversification of Risk. Advanced Issues in Risk Management: The Changing Scope of Risk Management-Insurance Market Dynamics-Loss Forecasting-Financial Analysis in Risk Management -- Decision Making Other Risk Management Tools. (Theory).

Module -3 Introduction to Insurance **7 hours**

Risk and Insurance- Definition and Basic Characteristics of Insurance-Requirements of an Insurable Risk-Adverse Selection and Insurance-Insurance vs. Gambling Insurance vs. Hedging Types of Insurance-Essentials of Insurance Contracts. Indian Insurance Industry -Historical Framework of Insurance, Insurance sector Reforms in India. IRDA-Duties and powers of IRDA-IRDA Act 1999. (Theory).

Module -4 Life Insurance **7 hours**

Basics of Life Insurance-Growth of Actuarial Science-Features of Life Insurance-Life Insurance Contract-Life Insurance Documents-Insurance Premium Calculations. Life Insurance Classification-Classification on the Basis –Duration-Premium Payment Participation in Profit-Number of Persons Assured-Payment of Policy Amount-Money Back Policies-Module Linked Plans. Annuities-Need of Annuity Contracts, Annuity V/s Life Insurance, Classification of Annuities. (Theory).

Module -5 General Insurance **7 hours**

Laws Related to General Insurance-General Insurance Contract-General Insurance Corporation (GIC). Health Insurance-Individual Medical Expense Insurance – Long Term Care Coverage – Disability Income Insurance – Medi-claim Policy – Group Medi-claim Policy – Personal Accident Policy – Child Welfare Policy-Employee Group Insurance – Features of Group Health Insurance – Group Availability Plan. Fire Insurance-Essentials of Fire Insurance Contracts, Types of Fire Insurance Policies, Fire Insurance Coverage. Marine Insurance-Types of Marine Insurance – Marine Insurance principles Important Clauses in Marine Insurance– Marine Insurance Policies –Marine Risks-Clauses in Marine Policy. Motor Vehicles Insurance-Need for Motor Insurance, Types of Motor Insurance, Factors to be considered for Premium Fixing. (Theory).

Module-6 Management of Insurance Companies **7 hours**

Functions and Organization of Insurers- Types of Insurance Organization, Organizational Structure of Insurance Companies-Functions of Insurers. Underwriting-Principles of Underwriting, Underwriting in Life Insurance, Underwriting in nonlife Insurance. Claims Management-Claim Settlement in General Insurance-Claim Settlement in Life Insurance. (Theory).

Course outcomes:

At the end of the course the student will be able to:

1. Understand various types of risks.
2. Assess the process of identifying and measuring the risk.
3. Acquaint with the functioning of life Insurance in risk management.
4. Understand general insurance contract.

Practical Component:

- Should visit insurance companies and undertand the types of policies
- Undesatnd how insurance premium are fixed
- Interact with insurance agents and understand the ground reality of insurance investors.
- Undesatnd how different insurance companies settles the accident claims/death claims
- Undesatnd the functioning and organisation structure of insurances companies.
- Compile and analyse General and Life insurance policies offered by Indian insurance companies (one public sector and one private sector)
- Visit policy bazaar portal and study the different types of insurance policies offered by the Indian insurance companies.
- Analyse the Systematic and unsystematic risk of any two companies
- Analyse the types of Risk in different sectors of India due to Covid- 19 Pandemic

CO-PO MAPPING

CO	PO				
	PO1	PO2	PO3	PO4	PO5
CO1	X				
CO2	X		X	X	
CO3	X	X			
CO4	X				

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have 8 full questions carrying equal marks.
- Each full question is for 20 marks.
- Each full question will have sub question covering all the topics under a Module.
- The students will have to answer five full questions; selecting four full question from question number one to seven and question number eight is compulsory.
- 100 percent theory in the SEE.

Textbooks

Sl. No.	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Principles of Risk Management and Insurance	George E Rejda	Pearson	12/e, 2009
2	Insurance and Risk Management	P.K. Gupta	Himalaya	1/e, 2010
Reference Books				
1	Principles and Practice of Insurance	P. Periasamy	Himalaya Publishing House	2/e, 2009
2	Introduction to Risk Management and Insurance	Dorfman, Mark S.	Prentice Hall India	10/e, 2008
3	Risk Management and Insurance	Scott E. Harrington, Gregory R Niehaus	TMH	2/e, 2007

FINANCIAL DERIVATIVES			
Course Code	20MBAFM402	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	60
Credits	03	Exam Hours	03

Course Objectives

1. To understand various concepts and terminologies used in various financial derivatives.
2. To explain and critically evaluate various financial derivatives such as forwards, futures, options, financial swaps, credit derivatives etc.
3. To apply various financial derivatives in hedging risk and analyse it.

Module-1 Financial Derivatives **5 hours**

Meaning, benefits, types (both exchange traded and OTC traded) and features of financial derivatives-Factors causing growth of derivatives-functions of derivatives market-Derivative market players (Hedgers, speculators and arbitragers)-Derivatives market in India. (Theory).

Module -2 Futures and Forwards **7 hours**

Futures and Forwards: Meaning, features and types of futures/forwards-Futures vs Forwards-Mechanics of buying and selling futures/forwards-Hedging through futures/forwards-Marking-to-market process-contract specifications of stock, index and commodity futures–valuation of futures/forwards using cost of carry model-Arbitrage process-Interest Rate Futures & options. (Numerical problems on MTM and valuation of futures/forwards). (Theory and Problems).

Module -3 Option Contracts **7 hours**

Option Contracts: Meaning, features and types of option contracts-Options vs futures/forwards-Mechanics of buying and selling option contracts-contract specifications of stock, index and commodity options-Option pricing-factors affecting option pricing-Valuation of option contracts using Black Scholes model and Binomial model-Put-call parity theory-Option Greeks-Option Trading strategies-Interest rate options-Exotic options. (Numerical problems on all aspects except exotic options). (Theory and Problems).

Module -4 Financial Swaps **7 hours**

Meaning, features and advantages of financial swaps-Types of financial swaps (Interest rate swap, currency swap, equity swap and commodity swap)-Mechanics of interest rate swaps– Triangular swap (Numerical problems only on interest rate swap including triangular swap)-valuation of interest rate swaps- Only theory. (Theory and Problems).

Module -5 Commodity Derivative Market **7 hours**

Commodity Derivative Market: Meaning of commodity derivatives-Commodity derivative exchanges (with commodities traded) in India-Trading and settlement system of commodity derivatives-SEBI Guidelines for commodity market-commodities traded. (Theory).

Module -6 Credit Derivatives and VaR **7 hours**

Credit Derivatives-Total Return Swap (TRS)-Credit Default Swap (CDS)-Types of CDS-Asset Backed Securities (ABS)-Collateralised Debt Obligation (CDO)-Sub-Prime Crisis-2007-Credit Spread Options-Probability of Default- Forward Rate Agreement (FRA)-Interest Rate Caps/Floors/Collars-Types of Interest Rates-Zero Rate-Forward Rate-Value-at-Risk-Meaning, VaR Models-Stress testing and back testing. (Numerical problems only on VaR, Zero Rate and Forward rate). (Theory and Problems).

Course outcomes:

At the end of the course the student will be able to:

- Understand the mechanism of forwards/futures, options, financial swaps, various credit derivatives and VaR with their features, merits and demerits.
- Assess the application of forwards/futures, options, financial swaps, various credit derivatives and VaR using numerical problems.
- Application of financial derivatives in risk management.
- Critically evaluate various financial derivatives.

Practical Component:

- Visit the website of FEDAI and understand the regulations for Commodity Exchanges
- Visit the MCX/NCDEX and understand the their trading and settlement
- Visit the banks and understand the their foreign exchange transactions.
- Undesatnd how different types of qoutations helpful to the participants in Forex

- Undesatnd what is the implication of financial derivatives.
- Compile and analyze few Futures, Forward Option contract documents
- Visit MCX portal and study its trading and settlement process
- Study the different types of option and Future contracts traded on NSE

CO-PO MAPPING

CO	PO				
	PO1	PO2	PO3	PO4	PO5
CO1	X				
CO2	X			X	
CO3	X			X	
CO4	X			X	

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have 8 full questions carrying equal marks.
- Each full question is for 20 marks.
- Each full question will have sub question covering all the topics under a Module.
- The students will have to answer five full questions; selecting four full question from question number one to seven and question number eight is compulsory.
- 40 percent theory and 60 percent problems in SEE.

Textbooks

Sl. No.	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Options, Futures & Other Derivatives	John C. Hull	Pearson Education	
2	Financial Derivatives-Text and Cases	Prakash Yaragol	Vikas Publishing House Pvt. Ltd.	1/e, 2019
Reference Books				
1	Options & Futures	Vohra & Bagri	TMH	2/e
2	Derivatives-Principles and Practice	Sundaram & Das	McGraw Hill	
3	Derivatives and Risk Management	Rajiv Srivastava	Oxford University	2010

INDIRECT TAXATION			
Course Code	20MBAFM403	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	60
Credits	03	Exam Hours	03

Course Objectives:

1. To provide an overview of GST in India
2. To provide an understanding of levy and collection of GST
3. To give an overview of customs duty in India
4. To provide an understanding of valuation for customs duty

Module-1 Introduction to Goods and Services Tax (GST) **7 hours**

Goods and Services Tax Act & Rules, Need for GST in India, Dual GST Model - Central Goods and Services Tax Act, 2017 (CGST) State Goods and Services Tax Act, 2017 (SGST) Union Territory Goods and Services Tax Act, 2017 (UTGST) Integrated Goods and Services Tax Act, 2017 (IGST) Goods and Services Tax Network (GSTN), GST Council Guiding principle and Functions of the GST Council. (Theory).

Module -2 Levy and Collection of Tax **7 hours**

Scope of Supply, Composite and Mixed Supplies, Levy and Collection, Composition Levy, Exemptions Person Liable to pay GST, Exemption from tax. (Simple problems on calculation of value of taxable supply and GST Levy). (Theory and Problems).

Module -3 Time and Value of Supply **7 hours**

Time of Supply, Change in Rate of Tax in respect of Supply of Goods or Services, Place of Supply and Value of Supply. (Simple problems on Time of supply, place of supply and value of supply) (Theory and Problems).

Module -4 Input Tax Credit **7 hours**

Introduction and Eligibility to avail Input Tax Credit (ITC). Registration under GST: Persons not liable for Registration, Compulsory Registration in Certain Cases, Procedure for Registration, Deemed Registration. Returns under GST: Furnishing of Returns, First Return, Revision of Returns and Penalty/Late Fee. (Theory).

Module -5 Customs Duty **7 hours**

Concept, Meaning of Customs Duty, Circumstances of Levy of Customs Duties and Types of Duties and Exemption from Customs Duty. Valuation under customs: Valuation of Imported Goods and Valuation of Export Goods.. (Problems on Valuation of Imported Goods). (Theory and Problems).

Module -6 Import and Export Procedure for Customs **5 hours**

Introduction to Baggage and General Free Allowance. Provisional Assessment of Duty, Due Dates for Payment of Duty, Penalties under Customs, Seizure of Goods, Confiscation of Goods. (Theory).

Course outcomes:

At the end of the course the student will be able to:

1. Have clarity about GST system in India
2. Understanding of levy and collection of GST in India
3. Have an overview of customs duty in India
4. Understanding of valuation for customs duty.

Practical Component:

- Compile and analyze documents pertaining to Registration under GST and Returns under GST
- How to file Online GST Returns
- How to Generate GSTR 1 & GSTR 3B, E way Bill and How to calculate and avail Input Tax Credit(ITC)
- Conduct a survey among local business community about compliance with GST regime.
- Encourage students to register for online GST Certification Course – Suggested.

CO-PO MAPPING

CO	PO				
	PO1	PO2	PO3	PO4	PO5
CO1	X				
CO2	X				
CO3	X				
CO4	X				X

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have 8 full questions carrying equal marks.
- Each full question is for 20 marks.
- Each full question will have sub question covering all the topics under a Module.
- The students will have to answer five full questions; selecting four full question from question number one to seven and question number eight is compulsory.
- 40 percent theory and 60 percent problems in the SEE

Textbooks

Sl. No.	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Indirect Taxes Law and practices	V S Datey	Taxmann's	*Latest Edition*
2	GST & Customs Law (University Edition)	K.M Bansal	Taxmann's	*Latest Edition*
Reference Books				
1	Principles of GST & Customs Law	V.S. Datey and Dr. Krishnan Sachdeva	Taxmann's	*Latest Edition*
2	Goods & Services Tax (GST) in India	B. Viswanathan	UBS Publishers	*Latest Edition*
3	Indirect Taxation	Raj K Agrawal & Shivangi Agrawal	Bharat Law House Pvt. Ltd	*Latest Edition*

MERGERS, ACQUISITIONS & CORPORATE RESTRUCTURING			
Course Code	20MBAFM404	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	60
Credits	03	Exam Hours	03

Course Objectives:

1. To understand various concepts and terminologies used in mergers and acquisition.
2. To explain and critically evaluate M&A with its different classifications, strategies, theories, synergy etc.
3. To apply and analyse financial evaluation and accounting aspects of M&A.

Module-1 Mergers and Acquisitions(M & A) 5 hours

Introduction of M & A: Meaning-types of mergers–Merger Motives-Theories of Mergers-Mergers and industry life cycle, Reasons for failures of M & A-synergy-types of synergy–value creation in M&A-SWOT analysis-BCG matrix. (Theory).

Module -2 Merger Process 7 hours

Procedure for effecting M & A-Five-stage model–Due diligence–Types, process and challenges of due diligence-HR aspects of M & A–Tips for successful mergers-Process of merger integration. (Theory).

Module -3 Financial Evaluation of M & A 7 hours

Merger as a capital budgeting-Business valuation approaches-asset based, market based and income based approaches-Exchange Ratio (Swap Ratio)-Methods of determining exchange rate. (Theory and Problems).

Module -4 Accounting aspects of Amalgamation 7 hours

: Types of amalgamations (Amalgamation in the nature of merger and amalgamation in the nature of purchase)-Methods of Accounting-Pooling of interest method and Purchase method)–Calculation of purchase consideration-Journal entries in the books of transferor & transferee company-Ledger accounts in the books of transferor and transferee companies. (Theory and Problems).

Module -5 Acquisitions/Takeovers 7 hours

Meaning and types of acquisition/takeovers (Friendly and Hostile takeovers)-Anti-takeover strategies-Anti-takeover amendments-Legal aspects of M & A-Combination and Competition Act-2002Competition Commission of India (CCI)-The SEBI Substantial Acquisition of Shares and Takeover (Takeover code-2011). (Theory).

Module -6 Corporate Restructuring 7 hours

Meaning, significance and forms of restructuring–sell-off, spin-off, divestitures, demerger, Equity Carve Out (ECO), Leveraged Buy Outs (LBO), Management Buy Out (MBO), Master Limited Partnership (MLP), Limited Liability Partnership (LLP) and joint ventures. (Theory).

Course outcomes:

At the end of the course the student will be able to:

1. Understand M&A with its different classifications, strategies, theories, synergy etc.
2. Conduct financial evaluation of M&A
3. Analyse the results after evaluation
4. Critically evaluate different types of M&A, takeover and antitakeover strategies

Practical Component:

- Choose any two latest M & A deal, announced/completed in the Indian corporate sector in 2019-20; Compile complete details of the deal;
- Study the deal in the light of the following:
  1. Nature of the deal: merger, amalgamation, acquisition, takeover, OR any program of corporate restructuring Valuation/Financials involved in the deal
  2. Synergies/benefits likely to emerge from the deal
  3. Challenges/Impact/Problems-associated with the deal.

CO-PO MAPPING

CO	PO				
	PO1	PO2	PO3	PO4	PO5
CO1	X				
CO2	X			X	
CO3	X			X	
CO4	X			X	

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have 8 full questions carrying equal marks.
- Each full question is for 20 marks.
- Each full question will have sub question covering all the topics under a Module.
- The students will have to answer five full questions; selecting four full question from question number one to seven and question number eight is compulsory.
- 60 percent theory and 40 percent problems in the SEE.

Textbooks

Sl. No.	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Mergers Acquisitions & Corporate Restructuring - Strategies & Practices	Rabi Narayan Kar and Minakshi	Taxmann's	3/e, 2017
2	Mergers and Acquisitions	Sheeba Kapil and Kanwal N. Kapil	Wiley	2/e, 2017
3	Mergers, Acquisitions and Corporate Restructuring: Text and Cases	Chandrashekar, Krishnamurti & Vishwanath S	Sage Publications	2/e, 2018
Reference Books				
1	Mergers, Acquisitions and Takeovers	H.R.Machiraju	New Age International Publishers	1/e, 2010
2	Mergers et.al.-Issues, Implications, and Case Law in Corporate Restructuring	Ramanujam S.	Tata McGraw Hill Publishing House	2000
3	Takeovers, Restructuring and Corporate Governance	Weston, Mitchell and Mulherin	Pearson Education	4/e , 2003.

CORPORATE VALUATION			
Course Code	20MBAFM405	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	60
Credits	03	Exam Hours	03

Course Objectives:

1. Identify the purpose of corporate valuation and to obtain an overview of the basic corporate valuation process
2. To familiarize the students with the standard techniques of corporate valuation.
3. To develop analytical skills and communication strategies for discussing corporate valuation.
4. To understand the valuation in the contexts of IPOs, M&As, Bankruptcy cases

Module -1 Corporate Valuation Overview **7 hours**

Approaches to Valuation-Features of the valuation process: Enterprise DCF Model-Analysing historical performance-Estimating the cost of Capital-Forecasting performance-Estimating the continuing value-Calculating and interpreting the results-Other DCF models: Equity DCF Model: Dividend discount model, free cash flow to Equity (FCFE) model-Adjusted present value model-Economic profit model-Applicability and Limitations of DCF analysis (Theory and problems).

Module -2 Non-DCF Approaches to Valuation **7 hours**

Book value approach, Adjusted book value approach, Stock and debt approach (numerical problems in each of these methods).Market efficiency and valuation. Call option based valuation (theory only because Numerical problems on Black and Scholes –Binomial methods are considered in Derivatives).Relative valuation-Steps involved in Relative valuation-Equity valuation multiples-Enterprise valuation multiples-Choice of multiple-Best practices using multiples-Assessment of relative evaluation. (Theory and problems).

Module -3 Advanced Issues in Valuation **7 hours**

Valuation of companies of different kinds-valuation in different contexts-Loose ends of valuation-Valuation of intangible assets: Patents, trademarks, copyrights and licenses; Franchises; Brands, WACCVs Flow to equity method. (Theory and problems).

Module -4 Strategic Financing Decisions **7 hours**

Strategic financing decisions: Valuation and financing Decisions in ideal capital markets, Capital structure and value in a perfect world, Information asymmetry, Share buyback and valuation. (Theory).

Module -5 Leverage decisions **7 hours**

, Agency costs of Debt, financial distress, Bankruptcy. Role of Government, securities Markets and financial institutions in IPO valuations and M&As. (Theory).

Module-6 Value Based Management **5 hours**

Value Based Management- Methods and Key premises of VBM-Marakon approach-Alcar approach-Mckinsey approach-Stern Stewart approach-BCG approach-Lessons from the experiences of VBM adopters. (Theory).

Course outcomes:

At the end of the course the student will be able to:

1. Understand corporate valuation and valuation process
2. Familiarize with the standard techniques of corporate valuation
3. Develop analytical skills relevant for corporate valuation and value based management
4. Critically evaluate IPOs, M&As, Bankruptacy cases

Practicaul Component:

- Obtain last three years' balance sheet of any TWO firms (from different sector) that has debt and equity.
- Find out the free cash flow to the firm (FCFF) and free cash flow to the equity (FCFE) for the last three years.
- Determine if there is any growth in the cash flows to the firm and to the equity holders.
- Find beta of the firm and Compute cost of equity and WACC.
- Finally find the value of the firm and interpret the findings.
- Discuss few case studies on Value-based management followed in Indian corporates.
- Study the IPO valuation by Indian financial institutions.

CO-PO MAPPING

CO	PO				
	PO1	PO2	PO3	PO4	PO5
CO1	X				
CO2	X				
CO3	X			X	
CO4	X			X	

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have 8 full questions carrying equal marks.
- Each full question is for 20 marks.
- Each full question will have sub question covering all the topics under a Module.
- The students will have to answer five full questions; selecting four full question from question number one to seven and question number eight is compulsory.
- 60 percent theory and 40 percent problems in the SEE.

Textbooks

Sl. No.	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Corporate Valuation and Value Creation	Prasanna Chandra	Tata McGraw Hill	2011
2	Damodaran on Valuation	Aswath Damodaran	John Wiley and Sons	2/e, 2006
Reference Books				
1	Corporate Valuation: A Guide for Managers and Investors	Philip R Daves, Michael C. Ehrhardt, and Ron E. Shrieves	Cengage Learning	2003
2	Corporate Valuation	David Frykman, Jakob Tolleryd	Prentice Hall	2003
3	The Valuation Handbook: Valuation Techniques from Today's Top Practitioners	Rawley Thomas, Benton E. Gup	John Wiley & Sons	2010

INTERNATIONAL FINANCIAL MANAGEMENT			
Course Code	20MBAFM406	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	60
Credits	03	Exam Hours	03

Course Objectives:

1. To understand the International Financial Environment and the Foreign Exchange market.
2. To learn hedging and Forex risk management.
3. To learn the Firm's Exposure to risk in International environment and various theories associated with it**.**

Module -1 International Financial Environment **7 hours**

Importance, rewards & risk of international finance- Goals of MNC- International Business methods. Balance of Payments (BoP), Fundamentals of BoP, Accounting components of BOP, Equilibrium & Disequilibrium, International Monetary System: Evolution, Gold Standard, Bretton Woods system, the flexible exchange rate regime, the current exchange rate arrangements, the Economic and Monetary Union (EMU).(Only Theory).

Module -2 Foreign Exchange Market **7 hours**

Function and Structure of the Forex markets, Foreign exchange market participants, Types of transactions and Settlements Dates, Exchange rate quotations, Determination of Exchange rates in Spot markets. Exchange rates determinations in Forward markets. Exchange rate behaviour-Cross Rates- - Bid – Ask – Spread (Theory & Problems).

Module -3 Foreign Exchange Risk Management **7 hours**

Hedging against foreign exchange exposure – Forward Market- Futures Market- Options Market- Currency Swaps-Interest Rate Swap- problems on both two-way and three-way swaps. (Theory & Problems).

Module -4 International Financial Markets and Instruments **5 hours**

: Foreign Portfolio Investment. International Bond & Equity market. GDR, ADR, International Financial Instruments: Foreign Bonds & Eurobonds, Global Bonds. Floating rate Notes, Zero coupon Bonds, International Money Markets, International Banking services –Correspondent Bank, Representative offices, Foreign Branches. Forward Rate Agreements. (Only Theory).

Module -5 Forecasting Foreign Exchange rate **7 hours**

International Parity Relationships, Measuring exchange rate movements-Exchange rate equilibrium –Factors effecting foreign exchange rate- Forecasting foreign exchange rates. Interest Rate Parity, Purchasing Power Parity &International Fisher effects, Arbitrage, Types of Arbitrage – Locational, Triangular and Covered Interest Arbitrage. (Theory & Problems).

Module-6 Foreign Exchange exposure **7 hours**

Foreign Exchange exposure: Management of Transaction exposure-Management of Translation exposure-Management of Economic exposure-Management of political Exposure- Management of Interest rate exposure.
International Capital Budgeting: Concept, Evaluation of a project.
(Theory & Problems).

Course outcomes:

At the end of the course the student will be able to:

1. The student will have an understanding of the International Financial Environment.
2. The student will learn about the foreign exchange market, participants and transactions.
3. The student will be able to use derivatives in foreign exchange risk management.
4. The student will be able to evaluate the Firm's Exposure to risk in International environment and various theories associated with it.

Practical Components:

- Visit the foreign exchange department of a bank, study the operations and submit a report
- Track and analyze the rupee exchange value against Dollar and Euro in spot and forward markets for one week and record the observations.
- Study the different types of swaps used in Foreign Exchange Market
- Visit the foreign exchange department of a bank, study the operations and submit a report
- Track and analyze the rupee exchange value against Dollar and Euro in spot and forward markets for one week and record the observations

CO-PO MAPPING

CO	PO				
	PO1	PO2	PO3	PO4	PO5
CO1	X				
CO2	X			X	X
CO3	X			X	
CO4	X		X		X

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have 8 full questions carrying equal marks.
- Each full question is for 20 marks.
- Each full question will have sub question covering all the topics under a Module.
- The students will have to answer five full questions; selecting four full question from question number one to seven and question number eight is compulsory.
- 40 percent theory and 60 percent problems in the SEE.

Textbooks

Sl. No.	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	International Corporate Finance	Jeff madura	Cengage Learning	10/e 2012
2	International Finance Management	Eun & Resnick	Tata McGraw Hill	4/e, 2014
3	Financing International Trade: Banking Theories and Applications	Gargi Sanati	Sage Publication	1/e, 2017
Reference Books				
1	International Financial Management	Apte P. G	Tata McGraw Hill	6/e, 2011
2	International Financial Management	MadhuVij	Excel Books	2010
3	International Financial Management	Thummuluri Siddaiah	Pearson India	1/e, 2009

HUMAN RESOURCE SPECIALISATION COURSES

ORGANISATIONAL LEADERSHIP			
Course Code	20MBAHR401	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	60
Credits	03	Exam Hours	03

Course Objectives

1. The student will be able to describe and Identify the application of Leadership styles and practices followed in the Organisation
2. The student will be able to describe and explain in her/his own words, the relevance and importance of various Leadership practices and style followed in the Organisation
3. The student will be able to apply and solve the workplace problems through Leadership practices
4. The student will be able to classify and categories different Leadership practices and styles followed in the Organisation
5. The student will be able to create and reconstruct Leadership required to manage the Human Resources in the Organisation
6. The student will be able to appraise and judge the practical applicability of Leadership practices followed in the Organisation

Module-1 Introduction **5 hours**

Concept of Leadership, Ways of Conceptualizing Leadership, Definition and Components, Leadership Described, Trait Versus Process Leadership, Assigned Versus Emergent Leadership. Leadership and Power, Leadership and Coercion, Leadership and Management.

Module -2 Model of Leadership - Part A **7 hours**

Trait Approach

Description, Intelligence, Self-Confidence, Determination, Integrity, Sociability, Five-Factor Personality Model and Leadership, Emotional Intelligence, How Does the Trait Approach Work?
Strengths, Criticisms, Application, Case Studies, Leadership Instrument

Skills Approach

Description, Three-Skill Approach, Technical Skill, Human Skill, Conceptual Skill, Summary of the Three-Skill Approach, Skills Model, Competencies, Individual Attributes, Leadership, Outcomes, Career Experiences, Environmental Influences, Summary of the Skills Model, How Does the Skills Approach Work? Strengths, Criticisms, Application, Case Studies, Leadership Instrument

Behavioral Approach

Description, The Ohio State Studies, The University of Michigan Studies, Blake and Mouton's Managerial (Leadership) Grid, Authority–Compliance (9,1), Country-Club Management (1,9) Impoverished Management (1,1), Middle-of-the-Road Management (5,5), Team Management (9,9), Paternalism/Maternalism, Opportunism, How Does the Behavioral Approach Work? Strengths, Criticisms, Application, Case Studies, Leadership Instrument

Situational Approach

Description, Leadership Styles, Development Levels, How Does the Situational Approach Work? Strengths, Criticisms, Application, Case Studies, Leadership Instrument

Module -3 Model of Leadership - Part B **7 hours**

Path–Goal Theory

Description, Leader Behaviors, Directive Leadership, Supportive Leadership, Participative Leadership, Achievement-Oriented Leadership, Follower Characteristics, Task Characteristics How Does Path–Goal Theory Work? Strengths, Criticisms, Application, Case Studies, Leadership Instrument

Leader–Member Exchange Theory

Description, Early Studies, Later Studies, Leadership Making, How Does LMX Theory Work? Strengths, Criticisms, Application, Case Studies, Leadership Instrument

Transformational Leadership

Description, Transformational Leadership Defined, Transformational Leadership and Charisma, A Model of Transformational Leadership, Transformational Leadership Factors, Transactional Leadership Factors, Non-leadership Factor, Other Transformational Perspectives Bennis and Nanus, Kouzes and Posner, How Does the Transformational Approach Work? Strengths, Criticisms, Application, Case Studies, Leadership Instrument

Authentic Leadership

Description, Authentic Leadership Defined, Approaches to Authentic Leadership, Practical Approach, Theoretical Approach, How Does Authentic Leadership Theory Work? Strengths, Criticisms, Application, Case Studies, Leadership Instrument

Psychodynamic Approach

Description, The Clinical Paradigm, History of the Psychodynamic Approach, Key Concepts and Dynamics Within the Psychodynamic Approach,

1. Focus on the Inner Theatre
2. Focus on the Leader-Follower Relationships

Social Defense Mechanisms, Mirroring and Idealizing, Identification With the Aggressor

3. Focus on the Shadow Side of Leadership Narcissism

How Does the Psychodynamic Approach Work? Strengths, Criticisms, Application, Case Studies, Leadership Instrument

Module -4 Leadership Instrument **7 hours**

Description, Culture Defined, Related Concepts, Ethnocentrism, Prejudice, Dimensions of Culture, Uncertainty Avoidance, Power Distance, Institutional Collectivism, In-Group, Collectivism, Gender Egalitarianism, Assertiveness, Future Orientation, Performance Orientation, Humane Orientation, Clusters of World Cultures, Characteristics of Clusters, Anglo, Confucian Asia, Eastern Europe, Germanic Europe, Latin America, Latin Europe, Middle East, Nordic Europe, Southern Asia, Sub-Saharan Africa, Leadership Behavior and Culture, Clusters, Eastern Europe Leadership Profile, Latin America Leadership Profile, Latin Europe Leadership Profile, Confucian Asia Leadership Profile, Nordic Europe Leadership Profile, Anglo Leadership Profile, Sub-Saharan Africa Leadership Profile, Southern Asia Leadership Profile, Germanic Europe Leadership Profile, Middle East Leadership Profile, Universally Desirable and Undesirable Leadership Attributes, Strengths, Criticisms, Application, Case Studies on Leadership Instrument

Module -5 Ethical Leadership **7 hours**

Description, Ethics Defined ;Level 1. Preconventional Morality ;Level 2. Conventional Morality;
Level 3. Postconventional Morality; Ethical Theories, Centrality of Ethics to Leadership, Heifetz's Perspective on Ethical Leadership; Burns's Perspective on Ethical Leadership, The Dark Side of Leadership, Principles of Ethical Leadership, Ethical Leaders Respect Others, Ethical Leaders Serve Others, Ethical Leaders Are Just, Ethical Leaders Are Honest, Ethical Leaders Build CommModuley, Strengths, Criticisms, Application, Case Studies, Leadership Instrument.

Module – 6 Leadership Practices **7 hours**

Select Case of Successful Leadership Practices; TATA Group; Reliance; Infosys; WIPRO; and Organisations which are listed as Fortune Companies. Survey Report analysis of NHRD; NIPM; CII; FICCI; Conference Board; CCL - Centre of Creative Leadership.

Course Outcomes:

1. Understand the fundamental concepts and principles, theories of Organizational Leadership.
2. Analyze the organizational leadership style, approaches and traits, its impact on the followers by using leadership theories and instruments.
3. Developing better insight in understanding the leadership traits that influence them to work effectively in group.
4. Demonstrate their ability to apply of their knowledge in organizational leadership.

Practical Components:

- Meet any Leader- Organisation or Academic and ask 10 questions related to Leadership. Than analysis the type of leadership style adopted.
- Meet 4-5 Leaders from different roles and compare - contrast the different style son leadership.
- Meet Gender specific leaders and try analysing who makes the best leader in which type of set-up.

Note: Faculty can either identify the organizations/ leaders/job profile or students can be allowed to choose the same.

CO-PO MAPPING

CO	PO				
	PO1	PO2	PO3	PO4	PO5
CO1	X				
CO2	X		X	X	X
CO3	X		X	X	
CO4	X		X		X

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have 8 full questions carrying equal marks.
- Each full question is for 20 marks.
- Each full question will have sub question covering all the topics under a Module.
- The students will have to answer five full questions; selecting four full question from question number one to seven and question number eight is compulsory.
- 100 percent theory in the SEE.

Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Leadership: Theory and Practices Leadership for Organisations	Peter G. Northouse	Sage Publication	7/e, 2016
2	Management: Leading People and Organisations in the 21st Century	Gary Dessler	Prentice Hall	2001
3	Charismatic Leadership in Organisations	Jay A. Conger, Rabindra N. Kanungo	Sage Publications	1998

Reference Books

1	Leadership: Theory and Practice	Peter G. Northouse	Sage	2010
2	Management: Leading People and Organisations in the 21st Century	Gary Dessler	Prentice Hall	2001
3	The Leadership Code: Five Rules to Lead	Dave Ulrich, Norm Smallwood, Kate Sweetman	Harvard Business Pres	2008
4	Leadership for Organisations	David A. Waldman, Charles O'Reilly	Sage Publications	2019

PERSONAL GROWTH AND INTERPERSONAL EFFECTIVENESS			
Course Code	20MBAHR402	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	60
Credits	03	Exam Hours	03

Course Objectives

1. The student will be able to describe and Identify the application of various PG and IE framework
2. The student will be able to describe and explain in her/his own words, the relevance and importance of various PG and IE to be adopted in the Organisation
3. The student will be able to apply and improve the workplace effectiveness through various PG and IE
4. The student will be able to classify and categorise different PG and IE practices and to be followed in the Organisation
5. The student will be able to create and reconstruct Leadership required to manage the Human Resources in the Organisation
6. The student will be able to appraise and judge the practical applicability of various PG and IE practices to be followed in the Organisation

Module-1 Dynamics of Personal Growth **4 hours**

Dynamics of Personal Growth Meaning, nature and scope of personal growth. Self-awareness and self-esteem, life roles, social roles and organisational roles, role clarity and role boundaries. Ego states- Id, ego and super ego and defense mechanism. Developing a self-improvement plan.

Module -2 Interpersonal Trust **4 hours**

Openness, confidentiality, blind spot and unknown part of personality. Self-disclosure, seeking feedback, self-reflection and practicing new behaviors. Discovering facets of interpersonal trust through Johari Window.

Module -3 Understanding Human Personality and Neuro Functioning **7 hours**

Personality theories, Carl Jung's theory of personality types and Myers Briggs Type Indicator test (MBTI), Trait theories- Guilford Peogut, PF 16 and Type A and B, Emotional intelligence. **Basic functions of mind:** Creativity and innovation. Blocks to creativity. Creativity processes and tools- convergent and divergent thinking. Six thinking Hats, Neuro Linguistic Programming.

Module -4 Attitudes, Beliefs, Values and their impact on Behaviour **7 hours**

Personal change meaning, nature and requisites. Social adjustments and habit formation. Locus of control. Habits of personal effectiveness. Seven habits of highly effective people.

Module -5 **9 hours**

Interpersonal relations and personal growth: Interpersonal needs for openness, inclusion and control. Discovering the interpersonal orientation through FIRO-B. Conflict resolution and negotiation, time management and honouring the commitments

Module – 6 Transactional Analysis **9 hours**

Ego states, types of transactions and time structuring. Life position, scripts and games; T-group sensitivity training, encounter groups, appreciative enquiry and group relations conference (students may go through three days personal growth lab for experiential learning)

Course Outcomes:

1. Have in-depth understanding the various personality traits which promotes personal growth.
2. Analyze the concepts of human personality, behaviour and functioning of mind
3. Learn and apply the psychometrics tests in understanding the personality traits.
4. Develop the greater insight of self, and others through various theories and prepare the developmental plan for interpersonal effectiveness.

Practical Components:

- Students are expected to conduct an in-depth study about various personality traits & TA and submit a detailed report.
- Students must undergo psychometric test like MBTI, FIRO-B, Big Five etc, conduct SWOT analysis and prepare a personal growth plan based on the results
- Ask the individual students to seek multisource feedback about their interpersonal effectiveness from peers, teachers, and parents; understand and reflect the feedback and prepare a development plan for interpersonal

effectiveness.

- Discuss a Johari Window case in the class to identify how it can help each individual student to promote his/ her personal growth.
- Organize a workshop on MBTI for the students to know their type and to understand the type dynamics.
- Organize a Neuro linguistic programming workshop for the participation of all HR students.

CO-PO MAPPING

CO	PO				
	PO1	PO2	PO3	PO4	PO5
CO1	X		X		
CO2	X		X	X	X
CO3	X	X	X		
CO4	X	X	X		X

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have 8 full questions carrying equal marks.
- Each full question is for 20 marks.
- Each full question will have sub question covering all the topics under a Module.
- The students will have to answer five full questions; selecting four full question from question number one to seven and question number eight is compulsory.
- 100 percent theory in the SEE.

Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Organisational Behaviour: Human Behaviour at work	John W. Newstrom and Keith Davis	Tata McGraw Hill	11/e, 2003
2	Human Relations in organisations	Robert N. Lussier	Mc- Graw Hill Education	6/e
3	Development of Management Skills	Whetten & Cameron	PHI	7/e
4	Competency Mapping Assessment and Growth	Naik G. P	IIHRM	2010

Reference Books

1	Understanding OB	Udai Pareek	Oxford University Press	
2	Theories of Personality	Calvin S Hall	Wiley India Pvt. Ltd	4/e
3	Seven habits of highly effective people	Stephen R Covey	Pocket Books.	
4	Training in interpersonal Skills	Stephen Robbins	Pearson Education	

INTERNATIONAL HUMAN RESOURCES MANAGEMENT			
Course Code	20MBAHR403	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	60
Credits	03	Exam Hours	03

Course Objectives

1. The student will be able to describe and Identify the application of IHRM in managing and developing an Organisation
2. The student will be able to describe and explain in her/his own words, the relevance and importance of IHRM in managing and developing an Organisation
3. The student will be able to apply and solve the workplace problems involving International issues
4. The student will be able to classify and categorise different Laws related to IHRM
5. The student will be able to create and reconstruct HRM System to be adopted in the Organisation related to International employees
6. The student will be able to appraise and judge the practical applicability of various strategy and approaches in managing International Organisation

Module-1 Introduction **7 hours**

Meaning and Definition IHRM: Evolution, Challenges, Objectives, IHRM Versus Single Nation-centric HRM IHRM: Approaches Emergence of Global HR Manager IHRM;Culture and Cross-Cultural Management-Introduction, Studies on culture in management Positivist views: 'Culture and values' Interpretive views: 'Culture and meanings' Critical views: 'Culture and power"; Comparative Human Resource Management - Globalisation and HRM, The importance of context, Differences in HRM practice; Approaches to International Human Resource Management - Review of IHRM approaches, The concept of HRM, Are IHRM models applicable to other contexts? What factors affect HRM approaches internationally? What are the implications of change for IHRM approaches?

Module -2 IHRM Policies and Practices - Part A **7 hours**

Managing Knowledge in Multinational Firms: Introduction, Different types of knowledge, Factors influencing knowledge sharing How to stimulate knowledge sharing Gaining access to external knowledge, Knowledge retention From the management of knowledge to innovation

Training and Development: Developing Global Leaders and Expatriates

Training and Development: Domestic Versus International Organisations International Training Management: Basic Concepts and Models Leadership Training and Development in International Organisations Technology in International Training Management.

Module -3 IHRM Policies and Practices - Part B **7 hours**

Global Performance Management

Introduction, Key components of PMSs Factors affecting PMSs Culture and PMSs, PMSs in six leading economies: China, India, Japan, South Korea, UK and USA, PMS for expatriates

Total Rewards in the International Context

Recap: differentiating between PCNs, TCNs and HCNs Introduction: the current state of total rewards Complexities faced by IHR managers, International total rewards objectives for the MNC Newer forms of international assignments, Key components of global total rewards programs. Approaches to international compensation Repatriation issues, International trends in global total rewards.

Module -4 International Assignments And Employment Practices **5 hours**

Introduction Staffing policies, Motives for international transfers, Alternative forms of international assignments. The international assignment process Dimensions of international assignment success

Multinational Companies and the Host Country Environment Introduction, Varieties of host country environments, Sustainability of divergent, employment arrangements Understanding how MNCs act in diverse host country, environments Host country effects on IHRM practices of MNC subsidiaries

Module -5 Employment Practices **7 hours**

Regulation and Multinational Corporations: The Changing Context of Global Employment Relations

Importance of regulation and political context, Political agendas to de-regulate, Political and institutional drivers of de-regulation, Problems with de-regulation in a global context. Human Resource Management in Cross-Border Mergers and Acquisitions. Cultural differences and cross-border M&A performance, Managing cross-border integration: the HRM implications.

Module – 6 Diversity Management and CSR **7 hours**

Equal opportunities, Diversity Management, Work–life balance: practices and discourses; International Culture Management: Model Organisational Culture and Innovation, Models of Culture, Hofstede's Four, Cultural Dimensions, Trompenaar's Seven Cultural Dimensions, Globe's Nine Cultural Dimensions, Edgar Schein's Model of Culture Deal and Kennedy's Culture Model, Schneider's Culture Model, Cameron and Quinn's Model of Culture Charles Handy's Model of Culture Denison's Model of Culture, Profile of Organisational Culture in International Organizations Managing International Culture. Corporate Social Responsibility and Sustainability through Ethical HRM practices. Ethics and corporate social responsibility International labour standards.

Course Outcomes:

1. Gain conceptual knowledge and practical experience in understanding the HR concepts globally.
2. Comprehend and correlate the strategic approaches to HR aspects amongst PCN's, TCN's and HCN's.
3. Develop knowledge and apply the concepts of HR in global perspective
4. Have a better insight of HR concepts, policies and practices by critically analysing the impact of contemporary issues globally.

Practical Components:

- A visit to Organisation and interact with HR Manager and list out the roles played by HR manager.
- Meet Recruitment Manager and ask- 10 questions one asks during Interview.
- Meet Training and Development Manager and list out various training given to employees; basis of training program; Need analysis.
- Visit any Service Organisation and observe HR functions; List them.

CO-PO MAPPING

CO	PO				
	PO1	PO2	PO3	PO4	PO5
CO1	X		X		X
CO2	X		X		X
CO3	X	X	X		
CO4	X		X	X	X

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have 8 full questions carrying equal marks.
- Each full question is for 20 marks.
- Each full question will have sub question covering all the topics under a Module.
- The students will have to answer five full questions; selecting four full question from question number one to seven and question number eight is compulsory.
- 100 percent theory in the SEE.

Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	International Human Resource Management	Srinivas R. Kandula	Sage Publication India Pvt. Ltd.	2018
2	International Human Resource Management	Anne-Wil Harzing, Ashly H. Pinnington	Sage Publication India Pvt. Ltd.	4/e, 2015
3	Diversity at Work	Arthur P Brief	Cambridge University Press	2008

Reference Books				
1	Strategic Human Resource Management: An International Perspective	Gary Rees, Paul E. Smith	Sage Publication India Pvt. Ltd.	2014
2	Global Talent Management: An Integrated Approach	Sonal Minocha and Dean Hristov	Sage Publication India Pvt. Ltd.	2019
3	International Human Resource Management	Anne-Wil Harzing, Ashly Pinnington	Sage Publication India Pvt. Ltd.	2011

ORGANISATIONAL CHANGE AND DEVELOPMENT			
Course Code	20MBAHR404	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	60
Credits	03	Exam Hours	03

Course Objectives

1. The student will be able to describe and Identify the application of various OC/D framework
2. The student will be able to describe and explain in her/his own words, the relevance and importance of various OC/D intervention to be adopted in the Organisation
3. The student will be able to apply and improve the workplace effectiveness through various OC/D Intervention
4. The student will be able to classify and categorise different OC/D practices and intervention followed in the Organisation
5. The student will be able to create and reconstruct OC/D intervention and process required to manage the Organisation
6. The student will be able to appraise and judge the practical applicability of various OC/D intervention, process and practices to be followed in the Organisation

Module-1 Changing Organisations 5 **hours**

Nature of 21st Century Organisation, Defining Organisational Change, The Roots of Organisation Change, Environmental Forces, Driving Change Today, The Implications of Worldwide Trends for Change Management, Four Types of Organisational Change, Planned Changes and Intended Results, Organisation Change Roles, Change Initiators, Change Implementers, Change Facilitators, Change Recipients, The Requirements for Becoming a Successful Change Leader, Application of Lewin's Model of Change, OD Practitioners.

Module -2 Building and Energising the Need for Change **7 hours**

Organisations as Systems, Levels and Characteristics of Organisational Change, Models of Organisational Change, Systems Theory and Social Construction Approaches, Developing a Knowledge for the Need for Change, Seek Out and Make Sense of Internal - External Data, The Organisations' Readiness for Change, Creating Awareness of the Need for Change, Factors That Block People From Recognising the Need for Change, Creating a Powerful Vision for Change, The Difference Between an Organisational Vision and a Change Vision.

Module -3 Measuring Change: Designing Effective Control Systems **7 hours**

Using Control Processes to Facilitate Change, Selecting and Deploying Measures, Use Measures that Lead to Challenging but Achievable Goals, Use Measures and Controls that are Perceived as Fair and Appropriate, Ensure Accurate Data, Control Systems and Change Management, Controls During Design and Early Stages of the Change Project, Measurement Tools to use in Change Process, Strategy Maps, The Balanced Scorecard, Risk Exposure Calculator, Organisational Change Agent, Orienting Yourself to Organisation Change, Data Gathering, Diagnosis and Feedback.

Module -4 Models of Change **7 hours**

Kurt Lewin's Three-step Model (1950–1952), Six-box Model of Marvin Weisbord, The McKinsey 7-S Model, Huse's Model of Planned Organizational Change, Action Research Model, David Nadler and Michael Tushman Model , Porras and Silvers Model (1991), The Burke–Litwin Causal Model, John Kotter's Eight-step Theory , Organizational Intelligence Model (2004), Managing Change with ADKAR Model, Integrated Model of Change , Comparison and Critical Analysis of Change Models Plan the Work, Selecting the Correct Path, Engage Others in Action Planning, Working the Plan Ethically and Adaptively, Developing a Communication Plan, Key Principles in Communicating for Change, Transition Management. Ensure Alignment in Your Action Planning, Action Planning Tools: 1) To-Do Lists; 2) Responsibility Charting; 3) Contingency Planning; 4) Surveys and Survey Feedback;5) Project Planning and Critical Path Methods;6) Force Field and Stakeholder Analysis; 7) Leverage Analysis and 8) Other Change-Management Tools.

Module -5 Organisation Development(OD) **7 hours**

Concept of O D, History of O D, OD in India, OD Activities, Values, Beliefs and Assumptions of OD, Laboratory Training and T-Groups Action Research and Survey Feedback, Employee Involvement, Organisational Culture, Reengineering Organisational Learning, Organisational Effectiveness and Employee Engagement, Defining Values, Values Important to the OD Practitioner, Core Values of O D, Changes to OD Values, Values Statement of O D, Ethical Issues of OD.

Module – 6 OD Practitioner and Consulting Process **7 hours**

Changing Workforce Demographics, Changing Nature of Work, The Consulting Relationship and Types of Consulting, Consulting Model, OD Practitioners, The Organisation Development Consulting Profession, The OD Consulting Process and Action Research, Data Gathering - Data Gathering Methods and Process, Ethical Issues With Data Gathering, Diagnosis and Feedback, assessment, Ethical Issues With Diagnosis and Giving Feedback, OD Intervention-Team Interventions, Quality, Performance Management, Communication in OD process, Coaching, Mentoring, 360 Feedback, Career Planning and Development. Merger and Acquisition, Organisational Health, OD Association in India.

Course Outcomes:

1. Gain conceptual insight of change management models, OD processes and interventions.
2. Develop the understanding of OD to apply OD aspects in private and public sectors in India.
3. Analyse the tools and techniques available to implement changes in the organization environment
4. Handle the OD interventions by analysing the role of OD consultant.

Practical Components:

- A visit to Organisation and interact with OD and Change Manager and list out the roles played by OD/C manager.
- Meet and Interact with OD and Change Manager and ask- 10 questions related to Change and Development issues
- Meet OD and Change Manager and list out various OC/D Intervention practised and how they impact the Organisational Growth
- Visit Organisation and Interact with Employees in the organisation and discuss Culture Impact on Change process and how it can be managed.

CO-PO MAPPING

CO	PO				
	PO1	PO2	PO3	PO4	PO5
CO1	X				X
CO2	X		X	X	X
CO3	X		X	X	
CO4	X		X	X	

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have 8 full questions carrying equal marks.
- Each full question is for 20 marks.
- Each full question will have sub question covering all the topics under a Module.
- The students will have to answer five full questions; selecting four full question from question number one to seven and question number eight is compulsory.
- 100 percent theory in the SEE.

Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Change Management and Organisational Development	Ratan Raina	SAGE Texts	2018
2	Organisational Change- An Action-Oriented Toolkit	Gene Deszca, Cynthia Ingols, Tupper F. Cawsey	SAGE Publications, Inc	2019

3	Organisation Development: The process of Leading Organisational Change	Donald L. Anderson	Sage Publication India Pvt. Ltd.	2/e, 2012
Reference Books				
1	Organisation Development	Donald L. Anderson	SAGE South Asia	2013
2	Toolkit for Organisational Change	T. F. Cawsey, Gene Deszca	SAGE Text	2007
3	Organisation Development and Organisational Change	Donald L. Anderson and Tupper F. Cawsey	SAGE Publications	1/e, 2014

HUMAN RECOURSE AUDIT			
Course Code	20MBAHR405	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	60
Credits	03	Exam Hours	03

Course Objectives

1. The student will be able to describe and Identify the application of various HR Audit methodology
2. The student will be able to describe and explain in her/his own words, the relevance and importance of various HR Audit approach adopted in the Organisation
3. The student will be able to apply and improve the workplace effectiveness through various HR Audit approach, practices and interventions
4. The student will be able to classify and categories different HR Audit approach and practices followed in the Organisation
5. The student will be able to create and reconstruct HR Audit framework and Model required to manage the Human Resources in the Organisation
6. The student will be able to appraise and judge the practical applicability of various HR Audit approach and practices to be followed in the Organisation

Module-1 Human Resource Development(HRD) 5 hours

H R D -Strategies and Systems; HR as Strategic Partner ; Need for HR Accounting and HR Auditing; Good Industrial Relation Index; Components of HRD Audit; HR Policies and Practices; Elements of good HRD; Role of HR Manager in HRD

Module -2 Human Resource(HR) Audit 7 hours

The Audit System; Need; Advantage and Challenges; Basic concepts and components; Understanding the concept of HR Audit; Identifying goal of HR Audit; Forming Audit team; Approaches to measuring HR; Audit Strategies; HR Systems; HR Competencies; Benefits of HR Audit; Process; Preparation of Audit Report; Methodology of Conducting Audit; Documents for HR Audit; Competency required for HR Audit.

Module -3 Areas for HR Audit 7 hours

Audit of HR Planning; Training and Development; Industrial Relations; Managerial compliance and Corporate strategies; Culture; Quality; Communication; Competencies; Decision Making; Engagement; Relational Audit; Task; Systems; HRIS System; Measuring impact of HR policies on the corporate goals; Creating HR Dashboard and Metric.

Module -4 HR Audit process 7 hours

Audit Methodology- Planning questions; Interview; Observation; Questionnaire; Collecting Audit data; Analysing and interpreting data; Assessing organisation ability to change; Action Plan; Audit Report; Developing Credibility of HR Dept; Internal - External Audit; Attitude Survey; Job Satisfaction Survey; Approaches to HR Audit - (i) Cooperative approach, (ii) Outside authority approach, (iii) Statistical approach, (iv) Compliance approach and (v) Management by objectives (MBO)

Module -5 HR Scorecard approach 7 hours

Measuring Business Impact; Components of HR scorecard ;How to use HR Scorecard for Audit ; Measuring HR effectiveness through HR Scorecard; Balanced scorecard; HR Research; HRD Audit as OD Intervention.

Module – 6 HR Audit for Legal Compliance 7 hours

Using scorecard approach in formulating workplace policies; Recruitment and Selection: Formulating FIR Audit for Start-up companies; HR Audit in practice: Cases in manufacturing industry, Service industry; Extracts of an Illustrative Audit Report.

Course Outcomes:

1. Gain conceptual knowledge and practical experience in understanding the HR Audit.
2. Comprehend and correlate the strategic approaches to HR Audit aspects
3. Develop knowledge and apply the concepts of HR Audit in the organisation
4. Have a better insight of HR Audit concepts, policies and practices by critically analysing the impact of contemporary issues in the organisation.

Practical Components:

- A visit to Organisation and interact with HR Manager/ list out Audit Methodology followed.
- Can design an HR Audit for an Small Scale Organisation.
- Can have Video recording of Attitude and Job Satisfaction Survey of Employees and how Audit can be improved.
- Visit any Service Organisation and observe HR Audit process; List them, and critically can give feedback for further improvement.

CO-PO MAPPING

CO	PO				
	PO1	PO2	PO3	PO4	PO5
CO1	X		X		X
CO2	X		X		
CO3	X		X	X	X
CO4	X		X	X	X

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have 8 full questions carrying equal marks.
- Each full question is for 20 marks.
- Each full question will have sub question covering all the topics under a Module.
- The students will have to answer five full questions; selecting four full question from question number one to seven and question number eight is compulsory.
- 100 percent theory in the SEE.

Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	HRD Audit: Evaluating the Human Resource Function for Business Improvement	TV Rao	Sage Response	2/e, 2014
2	HR Audit	Durdana Ovais Rajni Gyanchandani	Everest Publishing House	2017
3	The HR Scorecard: Linking People, Strategy and Performance		Harvard Business Review Press	1/e, 2001

Reference Books

1	Auditing Your Human Resources Department: A Step-by-Step Guide to Assessing the Key Areas of Your Program	John Mcconnell	AMACOM	2/e, 2011
2	HRD Score Card 2500: Based on HRD Audit	TV Rao	Sage Response	1/e, 2005
3	7 Easy Steps to Conduct a Human Resources Audit and Protect Your Company!	Vanessa Nelson	Lulu Publication	2016

MANAGEMENT CONSULTING FOR BUSINESS EXCELLENCE			
Course Code	20MBAHR406	CIE Marks	40
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	60
Credits	03	Exam Hours	03

Course Objectives

1. To prepare professionals for a career in Management Consulting
2. To impart basic understanding of the requirements of the profession
3. To equip professionals with knowledge, skills and attitude desirable for a career in Management Consulting
4. How to Scale the business and transform it into established firm
5. To prepare professionals working in industry, service sector, development sector and Not for Profit Organisations for Internal Consulting Roles

Module-1 Introduction **7 hours**

Management Consultancy in India- Indian Management Consulting Scenario, Concept, Nature, Dynamics, Opportunity Modules, Challenges, Consultancy as Profession, Strategic planning process for long-term success through Consultancy; Proactive client relationships for repeat business; Organisational Study and Consultancy- Align organisational vision and strategy; Changing Business Models and Business Strategy; Consultancy Agenda; Economics of Consulting; Client development, Client engagement, Basic and Advanced tools, techniques and frameworks used by management consultants- simulation analysis, decomposition analysis, feasibility analysis and sensitivity analysis/ rankings, scenario analysis, representative element analysis, decision tree, Theory of constraints, Critical chain; issue tree, bottom-up approach, top-down approach, backward reasoning, 80/20 rule, benchmarking, cost drivers, opportunity tree; Ethics of Consulting; Pre requisite needed for Consultancy as Profession.

Module -2 Consultancy Areas - Part A **5 hours**

Corporate Governance: Role of Management Consultants Play; Consulting Experience in Brand Management; Experience in M and A Consulting; E-Governance and its Relevance to India; Information Technology Consulting: Bytes of Reality; Management Consultancy in Infrastructure Projects; Implications for Management Consultants.

Module -3 Consultancy Areas - Part B **7 hours**

Project Finance: New Investment, Diversification and Growth; Mentoring In Entrepreneurship; Strengthening Contribution of NGOs in Social Development: Consultancy in Communication Research; Developing strategy for financial restructuring; Management consulting in investment banking, legal, real estate, accounting, financial services, advertising, IT consulting, engineering consulting, HR consulting, R&D, education, architecture, AI, Block chain; Customer relations' management.

Module -4 Consulting Services **7 hours**

Consulting Services to design and implement policies, systems and processes in functional and cross-functional areas of business. Project Feasibility studies and appraisal; Performance measurement and evaluation of public and corporate sectors; Designing project planning, monitoring and control systems; Designing and implementing manufacturing execution system; Designing and implementing supply chain models; Total quality management; System analysis and design; Enterprise Resource Planning (ERP); Information Technology strategies and architectures; Business Process Reengineering (BPR); E-Governance; Strategic restructuring through alliances and Joint ventures.

Module -5 Careers and Firms in Consultancy **7 hours**

Career in Consulting - Future Jobs; Top consulting firms McKinsey, BCG, Bain and AT Kearney, PwC, EY, Accenture, Career Growth for Management Consultants area like- Strategy Consulting; Operations Consulting; Financial Advisory Consulting; Risk & Compliance Consulting; Business Coach; Industry-Specific Consulting like steel, FMCG, supply-chain, public sector, etc.; Legal Management Consultancy; Skills and Competency- Research and analysis, Industry analysis, Project preparation, Strategic and design thinking, Technology, Communication skills, Presentation, Business negotiations, ability to think logically and structure, current affairs in the industry and general news around the world, problem solving, business-analytics skills, writing proposals, managing projects, prising strategy, initiating relationship, growing client organisation relationship, corporate valuation and integration, sharp knowledge and strong networking skills, global culture.

Module – 6 HR Consultancy **7 hours**

Creating Winning People Strategy; Strategy Maps; Structure, Process and Governance; HR Service Delivery Design; Consulting in Executive Search and Building a Management Team; HR Audit; HR Annual Survey; HR Systems Design; HR Process Re-engineering; Creating HPWS- High Performance Work System and Culture; Developing leadership, Succession, Empowering line managers to take on HR role, 360 degree feedback, Assessment and development Centre's, Value and culture building, Human potential utilisation, Manpower planning; Development and Improvement of performance appraisal system; talent management, Organisational restructuring, Developing heterogeneous HR policies, Managing Gen Y and Gen Z employees, Attrition control and employee retention management, Work-life balance, Executive coaching, Performance management, Employee engagement, Integration and assimilation of new recruits, Expectation management, T and D, Stress management, healthy living and building future.

Course Outcomes:

1. Gain the practical insight of various principles and practices of Consultant and Consultancy
2. Acquire knowledge of latest conceptual framework used by Consultant and Consultancy process and procedure applied in various sectors
3. Illustrate the application of Consultant and Consultancy tools and techniques in various sectors.
4. Develop a greater understanding about strategies adopted/undertaken by Consultant and Consultancy.

Practical Components:

- Visit management consulting firm and identify opportunities and challenges of the firm.
- Help consulting firm to increase profitability by making an SWOT analysis.
- Design strategies for Lifetime Fitness to enter foreign markets.

CO-PO MAPPING

CO	PO				
	PO1	PO2	PO3	PO4	PO5
CO1	X		X		X
CO2	X		X		
CO3	X		X		X
CO4	X		X	X	X

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have 8 full questions carrying equal marks.
- Each full question is for 20 marks.
- Each full question will have sub question covering all the topics under a Module.
- The students will have to answer five full questions; selecting four full question from question number one to seven and question number eight is compulsory.
- 100 percent theory in the SEE.

Texbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Management Consulting in India-Practice and Experiences for Business Excellence	U. K. Srivastava; Pramila Srivastava	SAGE Response	2012
2	An Introduction to Management Consultancy	Marc Baaij	SAGE Publications Ltd	2013
3	Management Consultancy Insights and Real Consultancy Projects	Book by Graham Manville	Routledge	2018

Reference Books				
1	The McKinsey way	Ethan M. Rasiel	KOBO	1999
2	The Boston Consulting Group on Strategy: Classic Concepts and New Perspectives	Carl W. Stern, Michael S. Deimler	John WILEY and Sons	2006
3	Competitive Strategy: Techniques for Analyzing Industries and Competitors	Michael E. Porter	The Free Press	1980

RUBRICS FOR CONTINUOUS INTERNAL EVALUATION (CIE) FOR 40 MARKS

Particulars	Marks	Procedure
Internal Assessment Test	50+50= 100/4=25	Average of two best performances out of three internal assessments tests shall be considered.
Seminar/Presentation	05	Document for the same must be maintained
Subject Viva-Voce/ Oral Examination	05	Document for the same must be maintained
Assignment/ Quiz	05	Document for the same must be maintained
Note: Course Instructor may introduce/use any activity other than the above three activities to award 15 marks. The activities used by the course instructor must be measurable and documented for inspection by VTU.		

QUESTION PAPER PATTERN FOR SEE

Q.No.1 to7 PART -A	Marks
a	3 marks
b.	7 marks
c.	10 marks
Total (4/7) 4X20	80 marks
PART-B Case-Compulsory	20 marks

Note: For III Sem SEE 20% marks allocated to application oriented questions from practical Components.

GUIDELINES FOR 6 WEEK PROJECT WORK 20MBAPR407
(BETWEEN 3RD AND 4TH SEMESTER MBA)

PROJECT REPORT			
Course Code	20MBAPR407	CIE Marks	40
Teaching Hours/Week (L:T:P)	0:0:12	SEE Marks	60
Credits	06	Exam Hours	00

Objective

To expose the students to understand the working of the organization/company / industry and take up an in-depth study of an issue / problem in the area of specialization.

General Guidelines

- The project work shall be for a period of 6 weeks immediately after the completion of 3rd SEE but before the commencement of the 4th semester classes.
- The Course code of the project report shall be 20MBAPR407 and shall be compulsory for all the students opting for all specializations.
- The University shall receive 2 copies of project reports prior to the commencement of the 4th semester examination. Copies of the project report should be sent to the concerned Regional Office with intimation to the Registrar (Evaluation).
- By keeping the business trend in the present scenario, university has given an option to the students to select the research problem either from business organization or they can carry out the project on freelance basis subject to the approval of department committee.
- It is the total responsibility of the internal guide to monitor the freelance project.
- In case, business problem selected from a Company, no two students of an institute shall work on the same problem in the same organization.
- The student shall seek the guidance of the internal guide on a continuous basis, and the guide shall give a certificate to the effect that the candidate has worked satisfactorily under his/her guidance.
- On completion of the project work, student shall prepare a report with the following format.
- The Project report shall be prepared using word processor viz. MS Word with New Times Roman, 12 font size.
- All the reports shall be printed in the A4 size 1" margin on all the sides.
- The report shall be hard bound facing sheet of royal blue color indicating the title of college and month & year of admission (spiral binding not permitted).
- A certificate by the guide, HOD and Head of the institution indicating the bonafide performance of the project by the student to be enclosed.
- An undertaking by the student to the effect that the work is independently carried out by him/her.
- The certificate from the organization if applicable (if its Freelance project, certificate is not required and Internal guide can issue a certificate for successful completion).
- Acknowledgement
- Executive Summary .

Schedule to be followed before commencement of Project

Activity	Timeline	Remarks
Identifying the organization Problem identification	First week	Student individually identifies an organization OR identifies problem for his/her study, according to his/her interest.
Problem statement Research Design	Second week	His/ Her interests are discussed with project guides. Discussion with Internal Guide to decide on suitable design for the research
Synopsis Preparation	Third week	Preparation of Synopsis* & formulating the objectives
Presentation of Synopsis	Fourth Week	The student will present the synopsis with the detailed execution plan to the Internal Guide and HOD who will review and may: a. Approve b. Approve with modification or c. Reject for fresh synopsis
Approval Status	Fifth & Sixth week	The approval status is submitted to HOD who will officially give concurrence for the execution of the Project

Synopsis: Three page hard copy to be submitted to the HOD with the signatures of the Guide and the student

Page 1	Title, Contact Address of student- with details of Internal and External Guide (if applicable).
Page 2	Short introduction with objectives and summary (300 words). Review of Articles / Literature about the topic with source of information.
Page 3	Time Activity Chart.

Schedule to be followed during Project work

Activity	Time Line	Remarks
Understanding Structure, Culture and functions of the organization /identifying of business problem from the Industry from the literature study	First week of Project	Student should understand products/services and the problems of the organization.
Preparation of Research design and Research instrument for data collection	2nd week of Project	Discussion with the guide for finalization of research design and instrument in his/her domain and present the same to the guide. (First Presentation).
Data collection	3rd week of Project	Date collected to be edited, coded, tabulated and presented to the guide for suggestions for analysis. (Second Presentation).
Analysis and finalization of report	4th & 5th week of project	Students must use appropriate and latest statistical tools and techniques for analyzing the data. (It is must to use of Statistical Package whose result should be shown in the report) (Third Presentation).
Submission of Report	6th week of Project	Final Report should be submitted to the University before one week of the commencement of theory examination.

Project Report Evaluation:

- Internal evaluation will be done by the internal guide.
- External valuation shall be done by a faculty member of other institute drawn from VTU affiliated institute with minimum of 10 years experience.
- Viva-Voce / Presentation: A viva-voce examination shall be conducted at the respective Institution where a student is expected to give a presentation of his/ her work.
- The viva –voce examination will be conducted by the respective HOD / Senior Professor of the department and an expert drawn from the VTU affiliated institutes with minimum of 10 years of experience as appointed by the University.
- Project work carries 100 marks consisting of 40 marks for internal marks by the internal guide, average of 30 marks from both internal and external evaluation and 30 marks for viva-voce examination. Minimum passing marks of the Project work is 50% in each of the components such as Internal Marks, report evaluation and viva-voce examination.
- Format of the project report shall be prepared using the word processor viz., MS Word, Times New Roman font sized 12, on a page layout of A4 size with 1inch margin all sides (1.5inch on left side) and 1.5 line spacing. The Project report shall not exceed 100 pages.
- Submission of Report: Students should submit the Project Report in electronic data form only, in PDF file (Un-editable Format) to the Institute. The Institute in turn shall submit all the CD's of their students along with a consolidated master list as per specialization containing USN, Name of the student, and Title of the Report to Registrar Evaluation) one week before the commencement of the Theory Examinations or as per notification given for this purpose.
- Plagiarism: Plagiarism is considered as academically fraudulent, and an offence against University academic discipline. The University considers plagiarism to be a major offence, and subject to the corrective procedures. It is compulsory for the student to get the plagiarism check done before submission of the project report. Plagiarism of up to 25% is allowed in the project work and report should consist 75% of original content/work.
- Publication of Research Findings: Students are expected to present their research findings in Seminars/ Conferences/ Technical/ Management Fests or publish their research work in Journals in association with their Internal Guide. Appropriate Weightage should be given to this in the internal evaluation as well as in the viva voce examination of the project report.

Contents of the Project Report

- Cover page
- Certificate from the Organization (scanned copy if applicable)
- Certificate from the guide, HOD and Head of the Institution (scanned copy) indicating bonafide performance of Project by the student
- Declaration by the student (scanned copy)
- Acknowledgement
- Table of contents
- List of tables and graphs
- Executive summary

Chapter 1: Introduction

Introduction, Industry profile and company profile: Promoters, vision, Mission & Quality Policy. Products / services profile areas of operation, infrastructure facilities, competitor's information, SWOT Analysis, Future growth and prospects and Financial Statement

Chapter 2: Conceptual background and Literature review

Theoretical background of the study, Literature review with research gap (with minimum 20 literature reviews).

Chapter 3: Research Design

Statement of the problem, Need for the study, Objectives, Scope of the study, Research methodology, Hypotheses, Limitations, Chapter scheme.

Chapter 4: Analysis and Interpretation

Analysis and interpretation of the data- collected with relevant tables and graphs. Results obtained by the using statistical tools must be included.

Chapter 5: Findings, Conclusion and Suggestions

Summary of findings, Conclusion and Suggestions / Recommendations

Bibliography: Books, Articles names, etc. to be mentioned as per APA style.

Annexures: Relevant to the project such as figures, graphs, photographs etc.,

Rubrics for Project Work (Common to core and Dual Specializations)

Sl.No	Particulars	Marks Allotted
1	Internal Assessment by the Guide- Based on three Presentations by Students	**40**
2	Report Evaluation by the Guide & External Examiner Average of the marks awarded by the two Examiners shall be the final evaluation marks for the Dissertation.	**30**
3	Viva-Voce Examination to be conducted by the Guide and an External examiner from the Industry/ Institute (Joint Evaluation)	**30**
Total		**100**

Rubrics for Project Evaluation and Viva voce Examination

A. Internal Assessment by the Guide- Based on three Presentations by Students

SL No	Aspects	Marks Allotted
1	First Presentation	5
2	Second Presentation	5
3	Third Presentation	5
4	Introduction and Methodology	5
5	Industry and Company Profile	5
6	Theoretical background of study	5
7	Data analysis and interpretation	5
8	Summary of findings, suggestions and conclusion	5
	Total	40

B. Report Evaluation by the Guide & External Examiner. Average of the marks awarded by the two Examiners shall be the final evaluation marks for the Dissertation.

SL No	Aspects	Marks Allotted
1	Introduction & Relevance of the project	5
2	Conceptual background and literature review	5
3	Research design	5
4	Analysis and interpretation	10
5	Summary of findings, suggestions and conclusion	5
	Total	**30**

C. Viva-Voce Examination to be conducted by the HOD/ Guide and an External examiner from the Industry/ Institute (Joint Evaluation)

SL No	Aspects	Marks Allotted
1	Presentation skills	5
2	Communication skills	5
3	Subject knowledge	5
4	Objectives of the study and Methodology	5
5	Analysis using statistical tools and statistical packages	5
6	Findings and appropriate suggestions	5
	Total	**30**

Formats for Project Report and Evaluation

- Format of Cover Page
- Format of certificate by Company/Institution or from both
- Format of Declaration Page
- Format of Contents
- Format of List of Tables and Charts
- Format of Bibliography
- Format for Internal Evaluation, External Evaluation and Viva voce

(Title of the Report)

Submitted by

(Student Name)
(USN)

Submitted to
VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELGAVI
In partial fulfillment of the requirements for the award of the degree of

MASTER OF BUSINESS ADMINISTRATION

Under the guidance of

INTERNAL GUIDE	**EXTERNAL GUIDE**
(Name & Designation)	**(Name & Designation)**

(Institute Logo)

Department of MBA
(Institute Name with Address)
(Month & Year of submission)

CERTIFICATE

This is to certify that (Name of the Student) bearing USN (xxxx), is a bonafide student of Master of Business Administration course of the Institute (Batch), affiliated to Visvesvaraya Technological University, Belgaum. Project report on "(Title of Report)"is prepared by Him/her under the guidance of (Name of the Guide), in partial fulfillment of the requirements for the award of the degree of Master of Business Administration of Visvesvaraya Technological University, Belagavi Karnataka.

Signature of Internal Guide **Signature of HOD** **Signature of Principal**

DECLARATION

I, (Student Name), hereby declare that the Project report entitled "(Title)" with reference to ―(Organization with place) prepared by me under the guidance of (Guide Name), faculty of M.B.A Department, (Institute name) and external assistance by (External Guide Name, Designation and Organization). I also declare that this Project work is towards the partial fulfillment of the university Regulations for the award of degree of Master of Business Administration by Visvesvaraya Technological University, Belgaum. I have undergone a summer project for a period of Twelve weeks. I further declare that this Project is based on the original study undertaken by me and has not been submitted for the award of any degree/diploma from any other University / Institution.

Place: **Signature of the Student**

Date:

Table of Contents

List of Tables

List of Figures/ Charts/ Graphs

Sl.No	Particulars	Page No's.
1	Graph showing ABC Analysis	XXXXX
2	Graph showing FSN Analysis	XXXXX
3	Graph showing EOQ	XXXXX
4	Graph showing stock of Raw materials	XXXXX

BIBLIOGRAPHY

BOOKS:
Name of the Author, Title of the Book, Name of the Publisher, Edition, year of Publication.
ARTICLES:
Name of the Author, Title of the article, Name of the Journal, Volume/Issue Number, Year, Page Number (pp).
WEBLIOGRAPHY
Name of the Author, Title of the article. Retrieved on dd/mm/yyyy from URL.

MARKS SHEET FORMATS

1. Internal Assessment by the Guide- Based on three Presentations by Students

Visvesvaraya Technological University
Marks Sheet for MBA Project Work (20MBAPR407)

Name of the College: **College Code:**
Internal Marks Allocation for Project Work (20MBAPR407)

SL No	Aspects	Marks Allotted
1	First Presentation	5
2	Second Presentation	5
3	Third Presentation	5
4	Introduction and Methodology	5
5	Industry and Company Profile	5
6	Theoretical background of study	5
7	Data analysis and interpretation	5
8	Summary of findings, suggestions and conclusion	5
	Total	**40**

Marks Sheet

Sl. No	USN	1	2	3	4	5	6	7	8	Total
1										
2										
3										
4										
5										

Signature of the Internal Guide with Name, Address & Date

Note:

1. Total Internal Evaluation Marks of the Project report should be sent along with the other subject internal marks and the above marks sheet should be maintained by the Department/Institution for verification on demand.
2. Total Internal Evaluation Marks of the Project report should be uploaded to VTU by the Internal guide after thorough evaluation of the project report and the copy of the mark sheet downloaded after the entry must be maintained in the department as well as sent to VTU along with the remuneration bill.

2. Report Evaluation by the Guide & External Examiner. Average of the marks awarded by the two Examiners shall be the final evaluation marks for the Dissertation.

Visvesvaraya Technological University
Marks Sheet for MBA Project Work (20MBAPR407)

Name of the College: **College Code:**
External Evaluation Marks Allocation for Project Work (20MBAPR407)

SL No	Aspects	Marks Allotted
1	Introduction & Relevance of the project	5
2	Conceptual background and literature review	5
3	Research design	5
4	Analysis and interpretation	10
5	Summary of findings, suggestions and conclusion	5
	Total	**30**

Marks Sheet

Sl. No	USN	1	2	3	4	5	Total
1							
2							
3							
4							
5							

Signature of External Examiner with affiliation

Note:
1. Total External Evaluation Marks of the Project report should be uploaded to VTU by the External examiner appointed by VTU after thorough evaluation of the project report and the copy of the mark sheet downloaded after the entry must be sent to VTU along with the remuneration bill.
3. Viva-Voce Examination to be conducted by the HOD/ Guide and an External examiner from the Industry/ Institute (Joint Evaluation)

Visvesvaraya Technological University
Marks Sheet for MBA Project Work (20MBAPR407)

Name of the College: **College Code:**
Viva voce Marks Allocation for Project Work (20MBAPR407)

(Viva voce conducted by HOD/Internal Guide and an Expert from VTU.)

SL No	Aspects	Marks Allotted
1	Presentation skills	5
2	Communication skills	5
3	Subject knowledge	5
4	Objectives of the study and Methodology	5
5	Analysis using statistical tools and statistical packages	5
6	Findings and appropriate suggestions	5
	Total	**30**

Marks Sheet

Sl. No	USN	1	2	3	4	5	6	Total
1								
2								
3								
4								
5								

Signature of Internal Exam **Signature of External Examiner with affiliation**

Note: Marks may be finalized based on the joint evaluation by internal examiner and External examiner.

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI

B.E. in Information Science and Engineering

Scheme of Teaching and Examinations2021

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

(Effective from the academic year 2021 - 22)

III SEMESTER

Sl. No	Course and Course Code	Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
				Theory Lecture	Tutorial	Practical/ Drawing	Self -Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	T	P	S					
1	BSC 21MAT31	Transform Calculus, Fourier Series and Numerical Techniques	Maths	3	0	0		03	50	50	100	3
2	IPCC 21CS32	Data Structures and Applications	Any CS Board Department	3	0	2		03	50	50	100	4
3	IPCC 21CS33	Analog and Digital Electronics		3	0	2		03	50	50	100	4
4	PCC 21CS34	Computer Organization and Architecture		3	0	0		03	50	50	100	3
5	PCC 21CSL35	Object Oriented Programming with JAVA Laboratory		0	0	2		03	50	50	100	1
6	UHV 21UH36	Social Connect and Responsibility	Any Department	0	0	1		01	50	50	100	1
7	HSMC 21KSK37/47	Samskrutika Kannada	TD and PSB: HSMC	1	0	0		01	50	50	100	1
	HSMC 21KBK37/47	Balake Kannada										
	OR											
	HSMC 21CIP37/47	Constitution of India and Professional Ethics										
8	AEC 21CS38X/21 CSL38X	Ability Enhancement Course - III	TD: Concerned department PSB: Concerned Board	If offered as Theory Course: 1	0	0		01	50	50	100	1
				If offered as lab. course: 0	0	2		02				
								Total	**400**	**400**	**800**	**18**

9	**Scheduled activities for III to VIII semesters**	NMDC 21NS83	National Service Scheme (NSS)	NSS	All students have to register for any one of the course namely National Service Scheme, Physical Education (PE)(Sports and Athletics) and Yoga with the concerned coordinator of the course during the first week of III semester. The activities shall be carried out from (for 5 semesters) between III semester to VIII semester. SEE in the above courses shall be conducted during VIII semester examinations and the accumulated CIE marks shall be added to the SEE marks. Successful completion of the registered course is mandatory for the award of the degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the colander prepared for the NSS, PE and Yoga activities.
		NMDC 21PE83	Physical Education (PE) (Sports and Athletics)	PE	
		NMDC 21YO83	Yoga	Yoga	

Course prescribed to lateral entry Diploma holders admitted to III semester B.E./B.Tech programs

1	NCMC 21MATDIP31	Additional Mathematics - I	Maths	02	02	--	--	---	100	---	100	0

Note: BSC: Basic Science Course, **IPCC:** Integrated Professional Core Course, **PCC:** Professional Core Course, **INT** –Internship, **HSMC:** Humanity and Social Science & Management Courses, **AEC**–Ability Enhancement Courses. **UHV:** Universal Human Value Course.
L –Lecture, **T –** Tutorial, P- Practical/ Drawing, **S –** Self Study Component, **CIE:** Continuous Internal Evaluation, **SEE:** Semester End Examination. **TD-**Teaching Department, **PSB**: Paper Setting department

21KSK37/47 Samskrutika Kannada is for students who speak, read and write Kannada and **21KBK37/47** Balake Kannada is for non-Kannada speaking, reading, and writing students.

Integrated Professional Core Course (IPCC): Refers to Professional Theory Core Course Integrated with Practical's of the same course. Credit for IPCC can be 04 and its Teaching–Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper. For more details, the regulation governing the Degree of Bachelor of Engineering /Technology (BE/B.Tech.) 2021-22 may be referred.

21INT49 Inter/Intra Institutional Internship: All the students admitted to engineering programs under the lateral entry category shall have to undergo a mandatory 21INT49 Inter/Intra Institutional Internship of 03 weeks during the intervening period of III and IV semesters. The internship shall be slated for CIE only and will not have SEE. The letter grade earned through CIE shall be included in the IV semester grade card. The internship shall be considered as a head of passing and shall be considered for vertical progression and for the award of degree. Those, who do not take up / complete the internship shall be declared fail and shall have to complete during subsequently after satisfying the internship requirements. The faculty coordinator or mentor shall monitor the students' internship progress and interact with them for the successful completion of the internship.

Non–credit mandatory courses (NCMC):

(A) Additional Mathematics I and II:

(1) These courses are prescribed for III and IV semesters respectively to lateral entry Diploma holders admitted to III semester of B.E./B.Tech., programs. They shall attend the classes during the respective semesters to complete all the formalities of the course and appear for the Continuous Internal Evaluation (CIE). In case, any student fails to register for the said course/fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have secured an F grade. In such a case, the student has to fulfill the course requirements during subsequent semester/s to earn the qualifying CIE marks. These courses are slated for CIE only and has no SEE.

(2) Additional Mathematics I and II shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses shall be mandatory for the award of degree.

(3) Successful completion of the courses Additional Mathematics I and II shall be indicated as satisfactory in the grade card. Non-completion of the courses Additional Mathematics I and II shall be indicated as Unsatisfactory.

(B) National Service Scheme/Physical Education (Sport and Athletics)/ Yoga:

(1) Securing 40 % or more in CIE,35 % or more marks in SEE and 40 % or more in the sum total of CIE + SEE leads to successful completion of the registered course.

(2) In case, students fail to secure 35 % marks in SEE, they have to appear for SEE during the subsequent examinations conducted by the University.

(3) In case, any student fails to register for NSS, PE or Yoga/fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have not completed the requirements of the course. In such a case, the student has to fulfill the course requirements during subsequent semester/s to earn the qualifying CIE marks.

(4) Successful completion of the course shall be indicated as satisfactory in the grade card. Non-completion of the course shall be indicated as Unsatisfactory.

(5) These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses shall be mandatory for the award of degree.

Ability Enhancement Course - III			
21CSL381	Mastering Office	21CS383	
21CS382	C++ Programming	21CS384	

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI

B.E. in Information Science and Engineering

Scheme of Teaching and Examinations 2021

Outcome-Based Education (OBE) and Choice Based Credit System (CBCS)

(Effective from the academic year 2021 - 22)

IV SEMESTER

Sl. No	Course and Course Code	Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
				Theory Lecture	Tutorial	Practical/ Drawing	Self -Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	T	P	S					
1	BSC 21CS41	Mathematical Foundations for Computing	Maths	2	2	0		03	50	50	100	3
2	IPCC 21CS42	Design and Analysis of Algorithms	Any CS Board Department	3	0	2		03	50	50	100	4
3	IPCC 21CS43	Microcontroller and Embedded System		3	0	2		03	50	50	100	4
4	PCC 21CS44	Operating System		2	2	0		03	50	50	100	3
5	AEC 21BE45	Biology For Engineers	BT, CHE, PHY	2	0	0		02	50	50	100	2
6	PCC 21CSL46	Python Programming Laboratory	Any CS Board Department	0	0	2		03	50	50	100	1
7	HSMC 21KSK37/47	Samskrutika Kannada	HSMC	1	0	0		01	50	50	100	1
	HSMC 21KBK37/47	Balake Kannada										
	OR											
	HSMC 21CIP37/47	Constitution of India & Professional Ethics										
8	AEC 21CS48X/21CS48LX	Ability Enhancement Course- IV	TD and PSB: Concerned department	If offered as theory Course: 1	0	0		01	50	50	100	1
				If offered as lab. course: 0	0	2		02				
9	UHV 21UH49	Universal Human Values	Any Department	1	0	0		01	50	50	100	1
10	INT 21INT49	Inter/Intra Institutional Internship	Evaluation By the appropriate authorities	Completed during the intervening period of II and III semesters by students admitted to first year of BE./B.Tech and during the intervening period of III and IV semesters by Lateral entry students admitted to III semester.				3	100	--	100	2
								Total	**550**	**450**	**1000**	**22**

Course prescribed to lateral entry Diploma holders admitted to III semester of Engineering programs

1	NCMC 21MATDIP41	Additional Mathematics - II	Maths	02	02	--	--	--	100	--	100	0

Note: BSC: Basic Science Course, IPCC: Integrated Professional Core Course, PCC: Professional Core Course, AEC –Ability Enhancement Courses, HSMC: Humanity and Social Science and Management Courses, UHV- Universal Human Value Courses.

L –Lecture, T – Tutorial, P- Practical/ Drawing, S – Self Study Component, CIE: Continuous Internal Evaluation, SEE: Semester End Examination.

21KSK37/47 Samskrutika Kannada is for students who speak, read and write Kannada and 21KBK37/47 Balake Kannada is for non-Kannada speaking, reading, and writing students.

Integrated Professional Core Course (IPCC): Refers to Professional Theory Core Course Integrated with Practical's of the same course. Credit for IPCC can be 04 and its Teaching – Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from practical part of IPCC shall be included in the SEE question paper. For more details the regulation governing the Degree of Bachelor of Engineering /Technology (BE/B.Tech.) 2021-22 may be referred.

Non – credit mandatory course (NCMC):

Additional Mathematics - II:

(1) Lateral entry Diploma holders admitted to III semester of B.E./B.Tech., shall attend the classes during the IV semester to complete all the formalities of the course and appear for the Continuous Internal Evaluation (CIE). In case, any student fails to register for the said course/fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have secured an F grade. In such a case, the student has to fulfil the course requirements during subsequent semester/s to earn the qualifying CIE marks. These courses are slated for CIE only and has no SEE.

(2) Additional Mathematics I and II shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses shall be mandatory for the award of degree.

(3) Successful completion of the course Additional Mathematics II shall be indicated as satisfactory in the grade card. Non-completion of the courses Additional Mathematics II shall be indicated as Unsatisfactory.

Ability Enhancement Course - IV

21CSL481	Web Programming	21CSL483	R Programming
21CS482	Unix Shell Programming	21CS484	

Internship of 04 weeks during the intervening period of IV and V semesters; 21INT68 Innovation/ Entrepreneurship/ Societal based Internship.

(1) All the students shall have to undergo a mandatory internship of 04 weeks during the intervening period of IV and V semesters. The internship shall be slated for CIE only and will not have SEE. The letter grade earned through CIE shall be included in the VI semester grade card. The internship shall be considered as a head of passing and shall be considered for vertical progression and for the award of degree. Those, who do not take up / complete the internship shall be considered under F (fail) grade and shall have to complete during subsequently after satisfying the internship requirements.

(2) Innovation/ Entrepreneurship Internship shall be carried out at industry, State and Central Government /Non-government organizations (NGOs), micro, small and medium enterprise (MSME), Innovation centers or Incubation centers. Innovation need not be a single major breakthrough; it can also be a series of small or incremental changes. Innovation of any kind can also happen outside of the business world.

Entrepreneurship internships offers a chance to gain hands on experience in the world of entrepreneurship and helps to learn what it takes to run a small entrepreneurial business by performing intern duties with an established company. This experience can then be applied to future business endeavours. Start-ups and small companies are a preferred place to learn the business tack ticks for future entrepreneurs as learning how a small business operates will serve the intern well when he/she manages his/her own company. Entrepreneurship acts as a catalyst to open the minds to creativity and innovation. Entrepreneurship internship can be from several sectors, including technology, small and medium-sized, and the service sector.

(3) Societal or social internship.

Urbanization is increasing on a global scale; and yet, half the world's population still resides in rural areas and is devoid of many things that urban population enjoy. Rural internship, is a work-based activity in which students will have a chance to solve/reduce the problems of the rural place for better living.

As proposed under the AICTE rural internship programme, activities under Societal or social internship, particularly in rural areas, shall be considered for 40 points under AICTE activity point programme.

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V SEMESTER

Sl. No	Course and Course Code	Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
				Theory Lecture	Tutorial	Practical/ Drawing	Self -Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	T	P	S					
1	BSC 21CS51	Automata Theory and compiler Design	Any CS Board Department	3	0	0		03	50	50	100	3
2	IPCC 21CS52	Computer Networks		3	0	2		03	50	50	100	4
3	PCC 21CS53	Database Management Systems		3	0	0		03	50	50	100	3
4	PCC 21CS54	Artificial Intelligence and Machine Learning		3	0	0		03	50	50	100	3
5	PCC 21CSL55	Database Management Systems Laboratory with Mini Project		0	0	2		03	50	50	100	1
6	AEC 21XX56	Research Methodology & Intellectual Property Rights	TD: Any Department PSB: As identified by university	2	0	0		02	50	50	100	2
7	HSMC 21CIV57	Environmental Studies	TD: Civil/ Environmental /Chemistry/ Biotech. PSB: Civil Engg	1	0	0		1	50	50	100	1
8	AEC 21CS58X/21 CSL58X	Ability Enhancement Course-V	Concerned Board	If offered as Theory courses				01	50	50	100	1
				1	0	0						
				If offered as lab. courses				02				
				0	0	2						
								Total	**400**	**400**	**800**	**18**

Ability Enhancement Course - IV

21CSL581	Angular JS and Node JS	21CS583	
21CS582	C# and .Net Framework	21CS584	

Note: BSC: Basic Science Course, PCC: Professional Core Course, IPCC: Integrated Professional Core Course, AEC –Ability Enhancement Course INT – Internship, HSMC: Humanity and Social Science & Management Courses.
L –Lecture, T – Tutorial, P- Practical/ Drawing, S – Self Study Component, CIE: Continuous Internal Evaluation, SEE: Semester End Examination.

Integrated Professional Core Course (IPCC): refers to Professional Theory Core Course Integrated with Practical of the same course. Credit for IPCC can be 04 and its Teaching – Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). Theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by CIE only and there shall be no SEE. For more details the regulation governing the Degree of Bachelor of Engineering /Technology (BE/B.Tech.) 2021-22 may be referred.

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VI SEMESTER

Sl. No	Course and Course Code	Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
				Theory Lecture	Tutorial	Practical/ Drawing	Self -Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	T	P	S					
1	HSMC 21CS61	Software Engineering and Project Management	Any CS Board Department	2	2	0		03	50	50	100	3
2	IPCC 21CS62	Fullstack Development		3	0	2		03	50	50	100	4
3	PCC 21IS63	Software Testing		3	0	0		03	50	50	100	3
4	PEC 21XX64x	Professional Elective Course-I		3	0	0		03	50	50	100	3
5	OEC 21XX65x	Open Elective Course-I	Concerned Department	3	0	0		03	50	50	100	3
6	PCC 21ISL66	Software Testing Laboratory	Any CS Board Department	0	0	2		03	50	50	100	1
7	MP 21ISMP67	Mini Project		Two contact hours /week for interaction between the faculty and students.				--	100	--	100	2
8	INT 21INT68	Innovation/Entrepreneurship /Societal Internship	Completed during the intervening period of IV and V semesters.					--	100	--	100	3
								Total	**500**	**300**	**800**	**22**

Professional Elective - I

21CS641	Agile Technology	21IS643	Data Mining and Data warehousing
21CS642	Advanced JAVA Programming	21CS644	Data science and Visualization

Open Electives – I offered by the Department to other Department students

21CS651	Introduction to Data Structures	21CS653	Introduction to Cyber Security
21CS652	Introduction to Database Management Systems	21CS654	Programming in JAVA

Note: HSMC: Humanity and Social Science & Management Courses, **IPCC:** Integrated Professional Core Course, **PCC:** Professional Core Course, **PEC:** Professional Elective Courses, OEC–Open Elective Course, **MP** –Mini Project, INT –Internship.
L –Lecture, T – Tutorial, P - Practical / Drawing, S – Self Study Component, CIE: Continuous Internal Evaluation, SEE: Semester End Examination.

Integrated Professional Core Course (IPCC): Refers to Professional Theory Core Course Integrated with Practical of the same course. Credit for IPCC can be 04 and its Teaching – Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by CIE only and there shall be no SEE. For more details, the regulation governing the Degree of Bachelor of Engineering /Technology (BE/B.Tech) 2021-22 may be referred.

Professional Elective Courses (PEC):
A professional elective (PEC) course is intended to enhance the depth and breadth of educational experience in the Engineering and Technology curriculum. Multidisciplinary courses that are added supplement the latest trend and advanced technology in the selected stream of engineering. Each group will provide an option to select one course out of five courses. The minimum students' strength for offering professional electives is 10. However, this conditional shall not be applicable to cases where the admission to the programme is less than 10.

Open Elective Courses:
Students belonging to a particular stream of Engineering and Technology are not entitled for the open electives offered by their parent Department. However, they can opt an elective offered by other Departments, provided they satisfy the prerequisite condition if any. Registration to open electives shall be documented under the guidance of the Program Coordinator/ Advisor/Mentor.
Selection of an open elective shall **not be allowed** if,

(i) The candidate has studied the same course during the previous semesters of the program.
(ii) The syllabus content of open electives is similar to that of the Departmental core courses or professional electives.
(iii) A similar course, under any category, is prescribed in the higher semesters of the program.

In case, any college is desirous of offering a course (not included in the Open Elective List of the University) from streams such as Law, Business (MBA), Medicine, Arts, Commerce, etc., can seek permission, at least one month before the commencement of the semester, from the University by

submitting a copy of the syllabus along with the details of expertise available to teach the same in the college.
The minimum students' strength for offering open electives is 10. However, this conditional shall not be applicable to cases where the admission to the programme is less than 10.

Mini-project work: Mini Project is a laboratory-oriented course which will provide a platform to students to enhance their practical knowledge and skills by the development of small systems/applications.
Based on the ability/abilities of the student/s and recommendations of the mentor, a single discipline or a multidisciplinary Mini- project can be assigned to an individual student or to a group having not more than 4 students.
CIE procedure for Mini-project:
(i) Single discipline: The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two faculty members of the Department, one of them being the Guide. The CIE marks awarded for the Mini-project work shall be based on the evaluation of project report, project presentation skill, and question and answer session in the ratio of 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.
(ii) Interdisciplinary: Continuous Internal Evaluation shall be group-wise at the college level with the participation of all the guides of the project.
The CIE marks awarded for the Mini-project, shall be based on the evaluation of project report, project presentation skill, and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.
No SEE component for Mini-Project.

VII semester Classwork and Research Internship /Industry Internship (21INT82)

Swapping Facility
Institutions can swap VII and VIII Semester Scheme of Teaching and Examinations to accommodate research internship/ industry internship after the VI semester**.**
(2) Credits earned for the courses of VII and VIII Semester Scheme of Teaching and Examinations shall be counted against the corresponding semesters whether VII or VIII semester is completed during the beginning of IV year or later part of IV year of the program.
Elucidation:
At the beginning of IV year of the programme i.e., after VI semester, VII semester classwork and VIII semester Research Internship /Industrial Internship shall be permitted to be operated simultaneously by the University so that students have ample opportunity for internship. In other words, a good percentage of the class shall attend VII semester classwork and similar percentage of others shall attend to Research Internship or Industrial Internship.
Research/Industrial Internship shall be carried out at an Industry, NGO, MSME, Innovation centre, Incubation centre, Start-up, Centers of Excellence (CoE), Study Centre established in the parent institute and /or at reputed research organizations / institutes. The internship can also be rural internship.
The mandatory Research internship /Industry internship is for 24 weeks. The internship shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not take up/complete the internship shall be declared fail and shall have to complete during the subsequent University examination after satisfying the internship requirements.

INT21INT82 Research Internship/ Industry Internship/Rural Internship
Research internship: A research internship is intended to offer the flavour of current research going on in the research field. It helps students get familiarized with the field and imparts the skill required for carrying out research.
Industry internship: Is an extended period of work experience undertaken by students to supplement their degree for professional development. It also helps them learn to overcome unexpected obstacles and successfully navigate organizations, perspectives, and cultures. Dealing with contingencies helps students recognize, appreciate, and adapt to organizational realities by tempering their knowledge with practical constraints.
Rural internship: A long-term goal, as proposed under the AICTE rural internship programme, shall be counted as rural internship activity.
The student can take up Interdisciplinary Research Internship or Industry Internship.
The faculty coordinator or mentor has to monitor the students' internship progress and interact with them to guide for the successful completion of the internship.
The students are permitted to carry out the internship anywhere in India or abroad. University shall not bear any expenses incurred in respect of internship.

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Swappable VII and VIII SEMESTER

VII SEMESTER

Sl. No	Course and Course Code	Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
				Theory Lecture	Tutorial	Practical/ Drawing	Self -Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	T	P	S					
1	PCC 21IS71	Cryptography and Network Security	Any CS Board Department	3	0	0		3	50	50	100	3
2	PCC 21CS72	Cloud Computing		2	0	0		3	50	50	100	2
3	PEC 21XX73X	Professional elective Course-II		3	0	0		3	50	50	100	3
4	PEC 21XX74X	Professional elective Course-III		3	0	0		3	50	50	100	3
5	OEC 21XX75X	Open elective Course-II	Concerned Department	3	0	0		3	50	50	100	3
6	Project 21ISP76	Project work		Two contact hours /week for interaction between the faculty and students.				3	100	100	200	10
								Total	**350**	**350**	**700**	**24**

VIII SEMESTER

Sl. No	Course and Course Code		Course Title	Teaching Department	Teaching Hours /Week				Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Self -Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	Seminar 21IS81		Technical Seminar		One contact hour /week for interaction between the faculty and students.				--	100	--	100	01
2	INT 21INT82		Research Internship/ Industry Internship		Two contact hours /week for interaction between the faculty and students.				03 (Batch wise)	100	100	200	15
3	NCMC	21NS83	National Service Scheme (NSS)	NSS	Completed during the intervening period of III semester to VIII semester.				--	50	50	100	0
		21PE83	Physical Education (PE) (Sports and Athletics)	PE									
		21YO83	Yoga	Yoga									
									Total	**250**	**150**	**400**	**16**

Professional Elective - II

21CS731	Object oriented Modelling and Design	21CS734	Blockchain Technology
21CS732	Digital Image Processing	21CS735	Internet of Things
21IS733	User Interface Design		

Professional Elective - III

21CS741	Software Architecture and Design Patterns	21CS744	Robotic Process Automation Design and Development
21IS742	File structures	21CS745	NOSQL Database
21CS743	Deep Learning		

Open Electives - II offered by the Department to other Department students			
21CS751	Programming in Python	21CS754	Introduction to Data Science
21CS752	Introduction to AI and ML	21CS755	
21CS753	Introduction to BigData		

Note: PCC: Professional Core Course, **PEC:** Professional Elective Courses, **OEC**–Open Elective Course, **AEC** –Ability Enhancement Courses.
L –Lecture, T – Tutorial, P- Practical / Drawing, S – Self Study Component, CIE: Continuous Internal Evaluation, SEE: Semester End Examination.

Note: VII and VIII semesters of IV year of the programme

(1) Institutions can swap VII and VIII Semester Scheme of Teaching and Examinations to accommodate research internship/ industry internship after the VI semester**.**

(2) Credits earned for the courses of VII and VIII Semester Scheme of Teaching and Examinations shall be counted against the corresponding semesters whether VII or VIII semester is completed during the beginning of IV year or later part of IV year of the programme.

PROJECT WORK (21XXP76): The objective of the Project work is

(i) To encourage independent learning and the innovative attitude of the students.
(ii) To develop interactive attitude, communication skills, organization, time management, and presentation skills.
(iii) To impart flexibility and adaptability.
(iv) To inspire team working.
(v) To expand intellectual capacity, credibility, judgment and intuition.
(vi) To adhere to punctuality, setting and meeting deadlines.
(vii) To instil responsibilities to oneself and others.
(viii) To train students to present the topic of project work in a seminar without any fear, face the audience confidently, enhance communication skills, involve in group discussion to present and exchange ideas.

CIE procedure for Project Work:

(1) Single discipline: The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide.

The CIE marks awarded for the project work, shall be based on the evaluation of project work Report, project presentation skill, and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

(2) Interdisciplinary: Continuous Internal Evaluation shall be group-wise at the college level with the participation of all guides of the college. Participation of external guide/s, if any, is desirable. The CIE marks awarded for the project work, shall be based on the evaluation of project work Report, project presentation skill, and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

SEE procedure for Project Work: SEE for project work will be conducted by the two examiners appointed by the University. The SEE marks awarded for the project work, shall be based on the evaluation of project work Report, project presentation skill, and question and answer session in the ratio 50:25:25.

TECHNICAL SEMINAR (21XXS81): The objective of the seminar is to inculcate self-learning, present the seminar topic confidently, enhance communication skill, involve in group discussion for exchange of ideas. Each student, under the guidance of a Faculty, shall choose, preferably, a recent topic of his/her interest relevant to the programme of Specialization.

(i) Carry out literature survey, systematically organize the content.
(ii) Prepare the report with own sentences, avoiding a cut and paste act.
(iii) Type the matter to acquaint with the use of Micro-soft equation and drawing tools or any such facilities.
(iv) Present the seminar topic orally and/or through PowerPoint slides.
(v) Answer the queries and involve in debate/discussion.
(**vi)** Submit a typed report with a list of references.

The participants shall take part in the discussion to foster a friendly and stimulating environment in which the students are motivated to reach high standards and become self-confident.

Evaluation Procedure:

The CIE marks for the seminar shall be awarded (based on the relevance of the topic, presentation skill, participation in the question and answer session, and quality of report) by the committee constituted for the purpose by the Head of the Department. The committee shall consist of three teachers from the department with the senior-most acting as the Chairman.

Marks distribution for CIE of the course:

Seminar Report:50 marks
Presentation skill:25 marks
Question and Answer: 25 marks. ■ No SEE component for Technical Seminar

Non – credit mandatory courses (NCMC):

National Service Scheme/Physical Education (Sport and Athletics)/ Yoga:

(1) Securing 40 % or more in CIE,35 % or more marks in SEE and 40 % or more in the sum total of CIE + SEE leads to successful completion of the registered course.

(2) In case, students fail to secure 35 % marks in SEE, they has to appear for SEE during the subsequent examinations conducted by the University.

(3) In case, any student fails to register for NSS, PE or Yoga/fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have not completed the requirements of the course. In such a case, the student has to fulfill the course requirements during subsequently to earn the qualifying CIE marks subject to the maximum programme period.

(4) Successful completion of the course shall be indicated as satisfactory in the grade card. Non-completion of the course shall be indicated as Unsatisfactory.

(5) These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses shall be mandatory for the award of degree.

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI

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III SEMESTER

Sl. No	Course and Course Code	Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
				Theory Lecture	Tutorial	Practical/ Drawing	Self -Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	T	P	S					
1	BSC 21MAT31	Mathematics Course (Common to all)	TD- Maths PSB-Maths					03	50	50	100	3
2	IPCC 21EC32	Digital System Design using Verilog	TD: ECE PSB: ECE	3	0	2		03	50	50	100	4
3	IPCC 21EC33	Basic Signal Processing	TD: ECE PSB: ECE	3	0	2		03	50	50	100	4
4	PCC 21EC34	Analog Electronic Circuits	TD: ECE PSB: ECE	3	0	0	1	03	50	50	100	3
5	PCC 21ECL35	Analog and Digital Electronics Lab	TD: ECE PSB: ECE	0	0	2		03	50	50	100	1
6	UHV 21UH36	Social Connect and Responsibility	Any Department	0	0	1		01	50	50	100	1
7	HSMC 21KSK37/47	Samskrutika Kannada	TD and PSB HSMC	1	0	0		01	50	50	100	1
	HSMC 21KBK37/47	Balake Kannada										
	OR											
	HSMC 21CIP37/47	Constitution of India and Professional Ethics										
8	AEC 21EC38X	Ability Enhancement Course - III	TD: Concerned department PSB: Concerned Board	If offered as Theory Course				01	50	50	100	1
				1	0	0						
				If offered as lab. course				02				
				0	0	2						
								Total	**400**	**400**	**800**	**18**

9	**Scheduled activities for III to VIII semesters**	NMDC 21NS83	National Service Scheme (NSS)	NSS	All students have to register for any one of the course namely National Service Scheme, Physical Education (PE)(Sports and Athletics) and Yoga with the concerned coordinator of the course during the first week of III semester. The activities shall be carried out between III semester to VIII semester (for 5 semesters). SEE in the above courses shall be conducted during VIII semester examinations and the accumulated CIE marks shall be added to the SEE marks. Successful completion of the registered course is mandatory for the award of the degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the calendar prepared for the NSS, PE and Yoga activities.
		NMDC 21PE83	Physical Education (PE)(Sports and Athletics)	PE	
		NMDC 21YO83	Yoga	Yoga	

Course prescribed to lateral entry Diploma holders admitted to III semester B.E./B.Tech programs

1	NCMC 21MATDIP31	Additional Mathematics - I	Maths	02	02	--	--	---	100	---	100	0

Note: BSC: Basic Science Course, **IPCC:** Integrated Professional Core Course, **PCC:** Professional Core Course, **INT** –Internship, **HSMC:** Humanity and Social Science & Management Courses, **AEC**–Ability Enhancement Courses. **UHV:** Universal Human Value Course.
L –Lecture, **T –** Tutorial, P- Practical/ Drawing, **S –** Self Study Component, **CIE:** Continuous Internal Evaluation, **SEE:** Semester End Examination.**TD-**Teaching Department, **PSB**: Paper Setting department

21KSK37/47 Samskrutika Kannada is for students who speak, read and write Kannada and **21KBK37/47** Balake Kannada is for non-Kannada speaking, reading, and writing students.

Integrated Professional Core Course (IPCC): Refers to Professional Theory Core Course Integrated with practical of the same course. Credit for IPCC can be 04 and its Teaching–Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper. For more details, the regulation governing the Degree of Bachelor of Engineering /Technology (B.E./B.Tech.) 2021-22 may be referred.

21INT49Inter/Intra Institutional Internship: All the students admitted to engineering programs under the lateral entry category shall have to undergo a mandatory 21INT49 Inter/Intra Institutional Internship of 03 weeks during the intervening period of III and IV semesters. The internship shall be slated for CIE only and will not have SEE. The letter grade earned through CIE shall be included in the IV semester grade card. The internship shall be considered as a head of passing and shall be considered for vertical progression and for the award of degree. Those, who do not take up / complete the internship shall be declared fail and shall have to complete during subsequently after satisfying the internship requirements. The faculty coordinator or mentor shall monitor the students' internship progress and interact with them for the successful completion of the internship.

Non–credit mandatory courses (NCMC):

(A) Additional Mathematics I and II:

(1) These courses are prescribed for III and IV semesters respectively to lateral entry Diploma holders admitted to III semester of B.E./B.Tech., programs. They shall attend the classes during the respective semesters to complete all the formalities of the course and appear for the Continuous Internal Evaluation (CIE). In case, any student fails to register for the said course/fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have secured an F grade. In such a case, the student has to fulfill the course requirements during subsequent semester/s to earn the qualifying CIE marks. These courses are slated for CIE only and have no SEE.

(2) Additional Mathematics I and II shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses shall be mandatory for the award of degree.

(3) Successful completion of the courses Additional Mathematics I and II shall be indicated as satisfactory in the grade card. Non-completion of the courses Additional Mathematics I and II shall be indicated as Unsatisfactory.

(B) National Service Scheme/Physical Education (Sport and Athletics)/ Yoga:

(1) Securing 40 % or more in CIE,35 % or more marks in SEE and 40 % or more in the sum total of CIE + SEE leads to successful completion of the registered course.

(2) In case, students fail to secure 35 % marks in SEE, they have to appear for SEE during the subsequent examinations conducted by the University.

(3) In case, any student fails to register for NSS, PE or Yoga/fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have not completed the requirements of the course. In such a case, the student has to fulfill the course requirements during subsequent semester/s to earn the qualifying CIE marks.

(4) Successful completion of the course shall be indicated as satisfactory in the grade card. Non-completion of the course shall be indicated as Unsatisfactory.

(5) These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses shall be mandatory for the award of degree.

Ability Enhancement Course - III			
21EC381	LD (Logic Design) Lab using Pspice / MultiSIM	21EC383	LIC (Linear Integrated Circuits) Lab using Pspice / MultiSIM
21EC382	AEC (Analog Electronic Circuits) Lab	21EC384	LabVIEW Programming Basics

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(Effective from the academic year 2021 - 22)

IV SEMESTER

Sl. No	Course and Course Code	Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
				Theory Lecture	Tutorial	Practical/ Drawing	Self -Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	T	P	S					
1	BSC **21EC41**	Maths for Communication Engineers	TD, PSB-Maths					03	50	50	100	3
2	IPCC 21EC42	Digital Signal Processing	TD: ECE PSB: ECE	3	0	2		03	50	50	100	4
3	IPCC 21EC43	Circuits & Controls	TD: ECE PSB: ECE	3	0	2		03	50	50	100	4
4	PCC 21EC44	Communication Theory	TD: ECE PSB: ECE	3	0	0	1	03	50	50	100	3
5	AEC 21BE45	Biology For Engineers	BT, CHE, PHY	2	0	0		02	50	50	100	2
6	PCC 21ECL46	Communication Laboratory I	TD: ECE PSB: ECE	0	0	2		03	50	50	100	1
7	HSMC 21KSK37/47	Samskrutika Kannada	HSMC	1	0	0		01	50	50	100	1
	HSMC 21KBK37/47	Balake Kannada										
	OR											
	HSMC 21CIP37/47	Constitution of India & Professional Ethics										
8	AEC 21EC48X	Ability Enhancement Course- IV	TD and PSB: Concerned department	If offered as theory Course: 1	0	0		01	50	50	100	1
				If offered as lab. course: 0	0	2		02				
9	UHV 21UH49	Universal Human Values	Any Department	1	0	0		01	50	50	100	1
10	INT 21INT49	Inter/Intra Institutional Internship	Evaluation By the appropriate authorities	Completed during the intervening period ofII and III semesters by students admitted to first year of BE./B.Tech and during the intervening period of III and IV semesters by Lateral entry students admitted to III semester.				3	100	--	100	2
								Total	**550**	**450**	**1000**	**22**

Course prescribed to lateral entry Diploma holders admitted to III semester of Engineering programs

1	NCMC 21MATDIP41	Additional Mathematics - II	Maths	02	02	--	--	--	100	--	100	0

Note: BSC: Basic Science Course, IPCC: Integrated Professional Core Course, PCC: Professional Core Course, AEC –Ability Enhancement Courses, HSMC: Humanity and Social Science and Management Courses, UHV- Universal Human Value Courses.
L –Lecture, T – Tutorial, P- Practical/ Drawing, S – Self Study Component, CIE: Continuous Internal Evaluation, SEE: Semester End Examination.

21KSK37/47 Samskrutika Kannada is for students who speak, read and write Kannada and 21KBK37/47 Balake Kannada is for non-Kannada speaking, reading, and writing students.

Integrated Professional Core Course (IPCC): Refers to Professional Theory Core Course Integrated with Practicals of the same course. Credit for IPCC can be 04 and its Teaching – Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from practical part of IPCCshall be included in the SEE question paper.For more details the regulation governing the Degree of Bachelor of Engineering /Technology (BE/B.Tech.) 2021-22 may be referred.

Non – credit mandatory course (NCMC):

Additional Mathematics - II:

(1) Lateral entry Diploma holders admitted to III semester of B.E./B.Tech., shall attend the classes during the IV semester to complete all the

formalities of the course and appear for the Continuous Internal Evaluation (CIE). In case, any student fails to register for the said course/fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have secured an F grade. In such a case, the student has to fulfill the course requirements during subsequent semester/s to earn the qualifying CIE marks. These courses are slated for CIE only and have no SEE.

(2) Additional Mathematics I and II shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses shall be mandatory for the award of degree.

(3) Successful completion of the course Additional Mathematics II shall be indicated as satisfactory in the grade card. Non-completion of the courses Additional Mathematics II shall be indicated as Unsatisfactory.

Ability Enhancement Course - IV

21EC481	Embedded C Basics	21EC483	Octave / Scilab for Signals
21EC482	C++ Basics	21EC484	DAQ using LabVIEW

Internship of 04 weeks during the intervening period of IV and V semesters; 21INT68Innovation/ Entrepreneurship/ Societal based Internship.

(1) All the students shall have to undergo a mandatory internship of 04 weeks during the intervening period of IV and V semesters. The internship shall be slated for CIE only and will not have SEE. The letter grade earned through CIE shall be included in the VI semester grade card.The internship shall be considered as a head of passing and shall be considered for vertical progression and for the award of degree. Those, who do not take up / complete the internship shall be considered under F (fail) grade and shall have to complete during subsequently after satisfying the internship requirements.

(2) Innovation/ Entrepreneurship Internship shall be carried out at industry, State and Central Government /Non-government organizations (NGOs), micro, small and medium enterprise (MSME), Innovation centres or Incubation centres. Innovation need not be a single major breakthrough; it can also be a series of small or incremental changes. Innovation of any kind can also happen outside of the business world.

Entrepreneurship internships offers a chance to gain hands on experience in the world of entrepreneurship and helps to learn what it takes to run a small entrepreneurial business by performing intern duties with an established company. This experience can then be applied to future business endeavours. Start-ups and small companies are a preferred place to learn the business tack ticks for future entrepreneurs as learning how a small business operates will serve the intern well when he/she manages his/her own company. Entrepreneurship acts as a catalyst to open the minds to creativity and innovation. Entrepreneurship internship can be from several sectors, including technology, small and medium-sized, and the service sector.

(3) Societal or social internship.

Urbanization is increasing on a global scale; and yet, half the world's population still resides in rural areas and is devoid of many things that urban population enjoy. Rural internship is a work-based activity in which students will have a chance to solve/reduce the problems of the rural place for better living.

As proposed under the AICTE rural internship programme, activities under Societal or social internship, particularly in rural areas, shall be considered for 40 points under AICTE activity point programme.

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V SEMESTER

Sl. No	Course and Course Code	Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
				Theory Lecture	Tutorial	Practical/ Drawing	Self-Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	T	P	S					
1	BSC 21EC51	Digital Communication	TD: ECE PSB: ECE	3	0	0	1	03	50	50	100	3
2	IPCC 21EC52	Object Oriented Programming with Java & Data Structures	TD: ECE, CSE PSB: ECE	3	0	2		03	50	50	100	4
3	PCC 21EC53	Computer Communication Networks	TD: ECE PSB: ECE	3	0	0	1	03	50	50	100	3
4	PCC 21EC54	Microwave Theory & Antennas	TD: ECE PSB: ECE	3	0	0		03	50	50	100	3
5	PCC 21ECL55	Communication Lab II		0	0	2		03	50	50	100	1
6	AEC 21EC56	Research Methodology & Intellectual Property Rights	TD: Any Department PSB: As identified by University	2	0	0		02	50	50	100	2
7	HSMC 21CIV57	Environmental Studies	TD: Civil/ Environmental /Chemistry/ Biotech. PSB: Civil Engg	1	0	0		1	50	50	100	1
8	AEC 21EC58X	Ability Enhancement Course-V	Concerned Board	If offered as Theory courses: 1	0	0		01	50	50	100	1
				If offered as lab. courses: 0	0	2		02				
								Total	**400**	**400**	**800**	**18**

Ability Enhancement Course - V

21EC581	IoT (Internet of Things) Lab	21EC583	Antenna Design & Testing
21EC582	Communication Simulink Toolbox	21EC584	Microwaves toolbox

Note: BSC: Basic Science Course, PCC: Professional Core Course, IPCC: Integrated Professional Core Course, AEC –Ability Enhancement Course INT – Internship, HSMC: Humanity and Social Science & Management Courses.
L –Lecture, T – Tutorial, P- Practical/ Drawing, S – Self Study Component, CIE: Continuous Internal Evaluation, SEE: Semester End Examination.

Integrated Professional Core Course (IPCC): refers to Professional Theory Core Course Integrated with Practical of the same course. Credit for IPCC can be 04 and its Teaching – Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). Theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by CIE only and there shall be no SEE. For more details the regulation governing the Degree of Bachelor of Engineering /Technology (BE/B.Tech.) 2021-22 may be referred.

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VI SEMESTER

Sl. No	Course and Course Code	Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
				Theory Lecture	Tutorial	Practical/ Drawing	Self -Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	T	P	S					
1	HSMC 21EC61	Technological Innovation Management and Entrepreneurship	Any Department	3	0	0	0	03	50	50	100	3
2	IPCC 21EC62	Computer Organization & ARM Microcontrollers	TD: ECE PSB: ECE	3	0	2		03	50	50	100	4
3	PCC 21EC63	VLSI Design & Testing	TD: ECE PSB: ECE	3	0	0		03	50	50	100	3
4	PEC 21EC64x	Professional Elective Course-I	TD: ECE PSB: ECE					03	50	50	100	3
5	OEC 21EC65x	Open Elective Course-I	Concerned Department					03	50	50	100	3
6	PCC 21ECL66	VLSI Laboratory		0	0	2		03	50	50	100	1
7	MP 21ECMP67	Mini Project		Two contact hours /week for interaction between the faculty and students.				--	100	--	100	2
8	INT 21INT68	Innovation/Entrepreneurship /Societal Internship	Completed during the intervening period of IV and V semesters.					--	100	--	100	3
								Total	**500**	**300**	**800**	**22**

Professional Elective – I

21EC641	Artificial Neural Networks (L:T:P :: 2:2:0)	21EC643	Python Programming (L:T:P :: 2:0:2)
21EC642	Cryptography (L:T:P :: 2:2:0)	21EC644	Micro Electro Mechanical Systems (L:T:P :: 3:0:0)

Open Electives – I offered by the Department to other Department students

21EC651	Communication Engineering (L:T:P :: 3:0:0)	21EC653	Basic VLSI Design (L:T:P :: 3:0:0)
21EC652	Microcontrollers (L:T:P :: 3:0:0)	21EC654	Electronic Circuits with Verilog (L:T:P :: 2:0:2)
21EC655	Sensors & Actuators (L:T:P :: 3:0:0)		

Note: HSMC: Humanity and Social Science & Management Courses, **IPCC:** Integrated Professional Core Course, **PCC:** Professional Core Course, **PEC:** Professional Elective Courses, O**EC**–Open Elective Course, **MP** –Mini Project, INT –Internship.
L –Lecture, **T** – Tutorial, **P** - Practical / Drawing, **S** – Self Study Component, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Examination.

Integrated Professional Core Course (IPCC): Refers to Professional Theory Core Course Integrated with Practical of the same course. Credit for IPCC can be 04 and its Teaching – Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by CIE only and there shall be no SEE. For more details, the regulation governing the Degree of Bachelor of Engineering /Technology (BE/B.Tech) 2021-22 may be referred.

Professional Elective Courses(PEC):
A professional elective (PEC) course is intended to enhance the depth and breadth of educational experience in the Engineering and Technology curriculum. Multidisciplinary courses that are added supplement the latest trend and advanced technology in the selected stream of engineering. Each group will provide an option to select one course out of five courses. The minimum students' strength for offering professional electives is 10. However, this conditional shall not be applicable to cases where the admission to the programme is less than 10.

Open Elective Courses:
Students belonging to a particular stream of Engineering and Technology are not entitled for the open electives offered by their parent Department. However, they can opt an elective offered by other Departments, provided they satisfy the prerequisite condition if any. Registration to open electives shall be documented under the guidance of the Program Coordinator/ Advisor/Mentor.
Selection of an open elective shall **not be allowed** if,

(i) The candidate has studied the same course during the previous semesters of the program.
(ii) The syllabus content of open electives is similar to that of the Departmental core courses or professional electives.
(iii) A similar course, under any category, is prescribed in the higher semesters of the program.

In case, any college is desirous of offering a course (not included in the Open Elective List of the University) from streams such as Law, Business

(MBA), Medicine, Arts, Commerce, etc., can seek permission, at least one month before the commencement of the semester, from the University by submitting a copy of the syllabus along with the details of expertise available to teach the same in the college.
The minimum students' strength for offering open electives is 10. However, this conditional shall not be applicable to cases where the admission to the programme is less than 10.

Mini-project work: Mini Project is a laboratory-oriented course which will provide a platform to students to enhance their practical knowledge and skills by the development of small systems/applications.
Based on the ability/abilities of the student/s and recommendations of the mentor, a single discipline or a multidisciplinary Mini- project can be assigned to an individual student or to a group having not more than 4 students.
CIE procedure for Mini-project:
(i) Single discipline: The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two faculty members of the Department, one of them being the Guide. The CIE marks awarded for the Mini-project work shall be based on the evaluation of project report, project presentation skill, and question and answer session in the ratio of 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.
(ii) Interdisciplinary: Continuous Internal Evaluation shall be group-wise at the college level with the participation of all the guides of the project.
The CIE marks awarded for the Mini-project, shall be based on the evaluation of project report, project presentation skill, and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.
No SEE component for Mini-Project.

VII semester Class work and Research Internship /Industry Internship (21INT82)

Swapping Facility
Institutions can swap VII and VIII Semester Scheme of Teaching and Examinations to accommodate research internship/ industry internship after the VI semester**.**
(2) Credits earned for the courses of VII and VIII Semester Scheme of Teaching and Examinations shall be counted against the corresponding semesters whether VII or VIII semester is completed during the beginning of IV year or later part of IV year of the program.
Elucidation:
At the beginning of IV year of the programme i.e., after VI semester, VII semester classwork and VIII semester Research Internship /Industrial Internship shall be permitted to be operated simultaneously by the University so that students have ample opportunity for internship. In other words, a good percentage of the class shall attend VII semester classwork and similar percentage of others shall attend to Research Internship or Industrial Internship.
Research/Industrial Internship shall be carried out at an Industry, NGO, MSME, Innovation centre, Incubation centre, Start-up, Centers of Excellence (CoE), Study Centre established in the parent institute and /or at reputed research organizations / institutes. The intership can also be rural internship.
The mandatory Research internship /Industry internship is for 24 weeks. The internship shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not take up/complete the internship shall be declared fail and shall have to complete during the subsequent University examination after satisfying the internship requirements.

INT21INT82Research Internship/ Industry Internship/Rural Internship
Research internship: A research internship is intended to offer the flavour of current research going on in the research field. It helps students get familiarized with the field and imparts the skill required for carrying out research.
Industry internship: Is an extended period of work experience undertaken by students to supplement their degree for professional development. It also helps them learn to overcome unexpected obstacles and successfully navigate organizations, perspectives, and cultures. Dealing with contingencies helps students recognize, appreciate, and adapt to organizational realities by tempering their knowledge with practical constraints.

The faculty coordinator or mentor has to monitor the students' internship progress and interact with them to guide for the successful completion of the internship.
The students are permitted to carry out the internship anywhere in India or abroad. University shall not bear any expenses incurred in respect of internship.

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Swappable VII and VIII SEMESTER

VII SEMESTER

Sl. No	Course and Course Code	Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
				Theory Lecture	Tutorial	Practical/ Drawing	Self -Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	T	P	S					
1	PCC 21EC71	Advanced VLSI	TD: ECE PSB: ECE	3	0	0		3	50	50	100	3
2	PCC 21EC72	Optical & Wireless Communication	TD: ECE PSB: ECE	2	0	0		3	50	50	100	2
3	PEC 21EC72X	Professional elective Course-II	TD: ECE PSB: ECE					3	50	50	100	3
4	PEC 21EC73X	Professional elective Course-III	TD: ECE PSB: ECE					3	50	50	100	3
5	OEC 21EC74X	Open elective Course-II	Concerned Department					3	50	50	100	3
6	Project 21ECP75	Project work		Two contact hours /week for interaction between the faculty and students.				3	100	100	200	10
								Total	**350**	**350**	**700**	**24**

VIII SEMESTER

Sl. No	Course and Course Code		Course Title	Teaching Department	Teaching Hours /Week				Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Self -Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	Seminar 21EC81		Technical Seminar		One contact hour /week for interaction between the faculty and students.				--	100	--	100	01
2	INT 21INT82		Research Internship/ Industry Internship		Two contact hours /week for interaction between the faculty and students.				03 (Batch wise)	100	100	200	15
3	NCMC	21NS83	National Service Scheme (NSS)	NSS	Completed during the intervening period of III semester to VIII semester.				--	50	50	100	0
		21PE83	Physical Education (PE) (Sports and Athletics)	PE									
		21YO83	Yoga	Yoga									
									Total	**250**	**150**	**400**	**16**

Professional Elective - II

21EC721	Advanced Design Tools for VLSI (L:T:P :: 2:0:2)	21EC724	Biomedical Signal Processing (L:T:P :: 3:0:0)
21EC722	Digital Image Processing (L:T:P :: 2:0:2)	21EC725	Speech Signal Processing (L:T:P :: 3:0:0)
21EC723	DSP Algorithms & Architecture (L:T:P :: 3:0:0)		

Professional Elective - III

21EC731	IoT & Wireless Sensor Networks (L:T:P :: 3:0:0)	21EC734	Machine Learning with Python (L:T:P :: 2:0:2)
21EC732	Network Security (L:T:P :: 3:0:0)	21EC735	Multimedia Communication (L:T:P :: 2:0:2)
21EC733	Fabrication technology (L:T:P :: 3:0:0)		

Open Electives - II offered by the Department to other Department students			
21EC741	Optical & Satellite Communication (L:T:P :: 3:0:0)	21EC744	Basic Digital Signal Processing (L:T:P :: 2:0:2)
21EC742	ARM Embedded Systems (L:T:P :: 3:0:0)	21EC745	E-waste Management (L:T:P :: 3:0:0)
21EC743	Basic Digital Image Processing (L:T:P :: 2:0:2)		

Note: PCC: Professional Core Course, **PEC:** Professional Elective Courses, **OEC**–Open Elective Course, **AEC** –Ability Enhancement Courses.
L –Lecture, T – Tutorial, P- Practical / Drawing, S – Self Study Component, CIE: Continuous Internal Evaluation, SEE: Semester End Examination.

Note: VII and VIII semesters of IV year of the programme

(1) Institutions can swap VII and VIII Semester Scheme of Teaching and Examinations to accommodate research internship/ industry internship after the VI semester**.**

(2) Credits earned for the courses of VII and VIII Semester Scheme of Teaching and Examinations shall be counted against the corresponding semesters whether VII or VIII semester is completed during the beginning of IV year or later part of IV year of the programme.

PROJECT WORK (21XXP75): The objective of the Project work is

(i) To encourage independent learning and the innovative attitude of the students.
(ii) To develop interactive attitude, communication skills, organization, time management, and presentation skills.
(iii) To impart flexibility and adaptability.
(iv) To inspire team working.
(v) To expand intellectual capacity, credibility, judgment and intuition.
(vi) To adhere to punctuality, setting and meeting deadlines.
(vii) To install responsibilities to oneself and others.
(viii) To train students to present the topic of project work in a seminar without any fear, face the audience confidently, enhance communication skills, involve in group discussion to present and exchange ideas.

CIE procedure for Project Work:

(1) Single discipline: The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide.

The CIE marks awarded for the project work, shall be based on the evaluation of project work Report, project presentation skill, and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

(2) Interdisciplinary: Continuous Internal Evaluation shall be group-wise at the college level with the participation of all guides of the college. Participation of external guide/s, if any, is desirable. The CIE marks awarded for the project work, shall be based on the evaluation of project work Report, project presentation skill, and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

SEE procedure for Project Work: SEE for project work will be conducted by the two examiners appointed by the University. The SEE marks awarded for the project work shall be based on the evaluation of project work Report, project presentation skill, and question and answer session in the ratio 50:25:25.

TECHNICAL SEMINAR (21XXS81): The objective of the seminar is to inculcate self-learning, present the seminar topic confidently, enhance communication skill, involve in group discussion for exchange of ideas. Each student, under the guidance of a Faculty, shall choose, preferably, a recent topic of his/her interest relevant to the programme of Specialization.

(i) Carry out literature survey, systematically organize the content.
(ii) Prepare the report with own sentences, avoiding a cut and paste act.
(iii) Type the matter to acquaint with the use of Micro-soft equation and drawing tools or any such facilities.
(iv) Present the seminar topic orally and/or through PowerPoint slides.
(v) Answer the queries and involve in debate/discussion.
(**vi)** Submit a typed report with a list of references.

The participants shall take part in the discussion to foster a friendly and stimulating environment in which the students are motivated to reach high standards and become self-confident.

Evaluation Procedure:

The CIE marks for the seminar shall be awarded (based on the relevance of the topic, presentation skill, participation in the question and answer session, and quality of report) by the committee constituted for the purpose by the Head of the Department. The committee shall consist of three teachers from the department with the senior-most acting as the Chairman.

Marks distribution for CIE of the course:

Seminar Report:50 marks
Presentation skill:25 marks
Question and Answer: 25 marks. ■No SEE component for Technical Seminar

Non – credit mandatory courses (NCMC):

National Service Scheme/Physical Education (Sport and Athletics)/ Yoga:

(1) Securing 40 % or more in CIE,35 % or more marks in SEE and 40 % or more in the sum total of CIE + SEE leads to successful completion of the registered course.

(2) In case, students fail to secure 35 % marks in SEE, they has to appear for SEE during the subsequent examinations conducted by the University.

(3) In case, any student fails to register for NSS, PE or Yoga/fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have not completed the requirements of the course. In such a case, the student has to fulfill the course requirements during subsequently to earn the qualifying CIE marks subject to the maximum programme period.

(4) Successful completion of the course shall be indicated as satisfactory in the grade card. Non-completion of the course shall be indicated as Unsatisfactory.

(5) These course shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses shall be mandatory for the award of degree.

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B.E: Electronics & Communication Engineering / B.E: Electronics & Telecommunication Engineering
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(Effective from the academic year 2021 – 22)

III Semester

Digital System Design Using Verilog			
Course Code	**21EC32**	CIE Marks	50
Teaching Hours/Week (L: T: P: S)	(3:0:2:0)	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 13 Lab slots	Total Marks	100
Credits	04	Exam Hours	03

Course objectives: This course will enable students to:

1. To impart the concepts of simplifying Boolean expression using K-map techniques and Quine-McCluskey minimization techniques.
2. To impart the concepts of designing and analyzing combinational logic circuits.
3. To impart design methods and analysis of sequential logic circuits.
4. To impart the concepts of Verilog HDL-data flow and behavioral models for the design of digital systems.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

- Lecture method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
- Show Video/animation films to explain the different concepts of Linear Algebra & Signal Processing.
- Encourage collaborative (Group) Learning in the class .
- Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking.
- Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
- Topics will be introduced in a multiple representation.
- Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
- Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.
- Adopt Flipped class technique by sharing the materials / Sample Videos prior to the class and have discussions on the that topic in the succeeding classes.
- Give Programming Assignments.

Module-1

Principles of Combinational Logic: Definition of combinational logic, Canonical forms, Generation of switching equations from truth tables, Karnaugh maps- up to 4 variables, Quine-McCluskey Minimization Technique. Quine-McCluskey using Don't Care Terms. (Section 3.1 to 3.5 of Text 1).

Teaching-Learning Process	Chalk and Talk, YouTube videos **RBT Level:** L1, L2, L3

Module-2

Logic Design with MSI Components and Programmable Logic Devices: Binary Adders and Subtractors, Comparators, Decoders, Encoders, Multiplexers, Programmable Logic Devices (PLDs)
(Section 5.1 to 5.7 of Text 2)

Teaching-Learning Process	Chalk and Talk, YouTube videos **RBT Level:** L1, L2, L3

Module-3	
Flip-Flops and its Applications: The Master-Slave Flip-flops (Pulse-Triggered flip-flops): SR flip-flops, JK flip flops, Characteristic equations, Registers, Binary Ripple Counters, Synchronous Binary Counters, Counters based on Shift Registers, Design of Synchronous mod-n Counter using clocked T, JK, D and SR flip-flops. (Section 6.4, 6.6 to 6.9 (Excluding 6.9.3) of Text 2)	
Teaching-Learning Process	Chalk and Talk, YouTube videos **RBT Level:** L1, L2, L3
Module-4	
Introduction to Verilog: Structure of Verilog module, Operators, Data Types, Styles of Description. (Section 1.1 to 1.6.2, 1.6.4 (only Verilog), 2 of Text 3) **Verilog Data flow description:** Highlights of Data flow description, Structure of Data flow description. (Section 2.1 to 2.2 (only Verilog) of Text 3)	
Teaching-Learning Process	Chalk and Talk, YouTube videos, Programming assignments **RBT Level:** L1, L2, L3
Module-5	
Verilog Behavioral description: Structure, Variable Assignment Statement, Sequential Statements, Loop Statements, Verilog Behavioral Description of Multiplexers (2:1, 4:1, 8:1). (Section 3.1 to 3.4 (only Verilog) of Text 3) **Verilog Structural description**: Highlights of Structural description, Organization of structural description, Structural description of ripple carry adder. (Section 4.1 to 4.2 of Text 3)	
Teaching-Learning Process	Chalk and Talk, YouTube videos, Programming assignments **RBT Level:** L1, L2, L3

PRACTICAL COMPONENT OF IPCC

Using suitable simulation software, demonstrate the operation of the following circuits:

Sl.No	Experiments
1	To simplify the given Boolean expressions and realize using Verilog program.
2	To realize Adder/Subtractor (Full/half) circuits using Verilog data flow description.
3	To realize 4-bit ALU using Verilog program.
4	To realize the following Code converters using Verilog Behavioral description a) Gray to binary and vice versa b) Binary to excess3 and vice versa
5	To realize using Verilog Behavioral description: 8:1 mux, 8:3 encoder, Priority encoder
6	To realize using Verilog Behavioral description: 1:8 Demux, 3:8 decoder, 2-bit Comparator
7	To realize using Verilog Behavioral description: Flip-flops: a) JK type b) SR type c) T type and d) D type
8	To realize Counters - up/down (BCD and binary) using Verilog Behavioral description.
Demonstration Experiments (For CIE only – not to be included for SEE) Use FPGA/CPLD kits for downloading Verilog codes and check the output for interfacing experiments.	
9	Verilog Program to interface a Stepper motor to the FPGA/CPLD and rotate the motor in the specified direction (by N steps).
10	Verilog programs to interface a Relay or ADC to the FPGA/CPLD and demonstrate its working.
11	Verilog programs to interface DAC to the FPGA/CPLD for Waveform generation.
12	Verilog programs to interface Switches and LEDs to the FPGA/CPLD and demonstrate its working.

Course Outcomes

At the end of the course the student will be able to:

1. Simplify Boolean functions using K-map and Quine-McCluskey minimization technique.
2. Analyze and design for combinational logic circuits.
3. Analyze the concepts of Flip Flops (SR, D, T and JK) and to design the synchronous sequential circuits using Flip Flops.
4. Model Combinational circuits (adders, subtractors, multiplexers) and sequential circuits using Verilog descriptions.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

CIE for the theory component of IPCC

Two Tests each of **20 Marks (duration 01 hour**)

- First test at the end of 5th week of the semester
- Second test at the end of the 10th week of the semester

Two assignments each of **10 Marks**

- First assignment at the end of 4th week of the semester
- Second assignment at the end of 9th week of the semester

Scaled-down marks of two tests and two assignments added will be CIE marks for the theory component of IPCC for **30 marks**.

CIE for the practical component of IPCC

- On completion of every experiment/program in the laboratory, the students shall be evaluated and marks shall be awarded on the same day. The **15 marks** are for conducting the experiment and preparation of the laboratory record, the other **05 marks shall be for the test** conducted at the end of the semester.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to 15 marks.
- The laboratory test **(duration 03 hours)** at the end of the 15th week of the semester /after completion of all the experiments (whichever is early) shall be conducted for 50 marks and scaled down to 05 marks**.**

Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **20 marks**.

SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (duration 03 hours)

- The question paper will have ten questions. Each question is set for 20 marks.
- There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
- The students have to answer 5 full questions, selecting one full question from each module.

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper shall include questions from the practical component.

- The minimum marks to be secured in CIE to appear for SEE shall be the 12 (40% of maximum marks-30) in the theory component and 08 (40% of maximum marks -20) in the practical component. The laboratory component of the IPCC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be included**.** The maximum of 04/05 questions to be set from the practical component of IPCC, the total marks of all questions should not be more than the 20 marks.

SEE will be conducted for 100 marks and students shall secure 35% of the maximum marks to qualify in the SEE. Marks secured out of 100 will be scaled down to 50 marks.

Suggested Learning Resources:

Text Books

1. Digital Logic Applications and Design by John M Yarbrough, Thomson Learning, 2001.

2. Digital Principles and Design by Donald D Givone, McGraw Hill, 2002.

3. HDL Programming VHDL and Verilog by Nazeih M Botros, 2009 reprint, Dreamtech press.

Reference Books:

1. Fundamentals of logic design, by Charles H Roth Jr., Cengage Learning

2. Logic Design, by Sudhakar Samuel, Pearson/ Sanguine, 2007

3. Fundamentals of HDL, by Cyril P R, Pearson/Sanguine 2010

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

Programming Assignments / Mini Projects can be given to improve programming skills.

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III Semester

Basic Signal Processing			
Course Code	**21EC33**	CIE Marks	50
Teaching Hours/Week (L: T: P: S)	(3:0:2:0)	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 13 Lab slots	Total Marks	100
Credits	04	Exam Hours	03

Course objectives: This course will enable students to:

Preparation: To prepare students with fundamental knowledge/ overview in the field of Signal Processing with Familiarization with the concept of Vector spaces and orthogonality with a qualitative insight into applications in communications.

Core Competence: To equip students with a basic foundation of Signal Processing by delivering the basics of quantitative parameters for Matrices & Linear Transformations, the mathematical description of discrete time signals and systems, analyzing the signals in time domain using convolution sum, classifying signals into different categories based on their properties, analyzing Linear Time Invariant (LTI) systems in time and transform domains

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

- Lecture method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
- Show Video/animation films to explain the different concepts of Linear Algebra & Signal Processing.
- Encourage collaborative (Group) Learning in the class.
- Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking.
- Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
- Topics will be introduced in a multiple representation.
- Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
- Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.
- Adopt Flipped class technique by sharing the materials / Sample Videos prior to the class and have discussions on the that topic in the succeeding classes.
- Give Programming Assignments.

Module-1

Vector Spaces: Vector spaces and Null subspaces, Rank and Row reduced form, Independence, Basis and dimension, Dimensions of the four subspaces, Rank-Nullity Theorem, Linear Transformations Orthogonality: Orthogonal Vectors and Subspaces, Projections and Least squares, Orthogonal Bases and Gram-Schmidt Orthogonalization procedure

(Refer Chapters 2 and 3 of Text 1)

Teaching-Learning Process	Chalk and Talk, YouTube videos, Flipped Class Technique, Programming assignments **RBT Level:** L1, L2, L3

Module-2	
Eigen values and Eigen vectors: Review of Eigen values and Diagonalization of a Matrix, Special Matrices (Positive Definite, Symmetric) and their properties, Singular Value Decomposition. **(Refer Chapter 5, Text 1)**	
Teaching-Learning Process	Chalk and Talk, YouTube videos, Flipped Class Technique, Programming assignments **RBT Level:** L1, L2, L3
Module-3	
Introduction and Classification of signals: Definition of signal and systems with examples, Elementary signals/Functions: Exponential, sinusoidal, step, impulse and ramp functions **Basic Operations on signals:** Amplitude scaling, addition, multiplication, time scaling, time shift and time reversal. Expression of triangular, rectangular and other waveforms in terms of elementary signals **System Classification and properties:** Linear-nonlinear, Time variant -invariant, causal-noncausal, static-dynamic, stable-unstable, invertible. **(Text 2) [Only for Discrete Signals & Systems]**	
Teaching-Learning Process	Chalk and Talk, YouTube videos, Flipped Class Technique, Programming assignments **RBT Level:** L1, L2, L3
Module-4	
Time domain representation of LTI System: Impulse response, convolution sum. Computation of convolution sum using graphical method for unit step and unit step, unit step and exponential, exponential and exponential, unit step and rectangular, and rectangular and rectangular. **LTI system Properties in terms of impulse response:** System interconnection, Memory less, Causal, Stable, Invertible and Deconvolution and step response **(Text 2) [Only for Discrete Signals & Systems]**	
Teaching-Learning Process	Chalk and Talk, YouTube videos, Flipped Class Technique, Programming assignments **RBT Level:** L1, L2, L3
Module-5	
The Z-Transforms: Z transform, properties of the region of convergence, properties of the Z-transform, Inverse Z-transform by partial fraction, Causality and stability, Transform analysis of LTI systems. **(Text 2)**	
Teaching-Learning Process	Chalk and Talk, YouTube videos, Flipped Class Technique, Programming assignments **RBT Level:** L1, L2, L3

PRACTICAL COMPONENT OF IPCC	
Sl.No	**Experiments**
1	a. Program to create and modify a vector (array). b. Program to create and modify a matrix.
2	Programs on basic operations on matrix.
3	Program to solve system of linear equations.
4	Program for Gram-Schmidt orthogonalization.
5	Program to find Eigen value and Eigen vector.
6	Program to find Singular value decomposition.

7	Program to generate discrete waveforms.
8	Program to perform basic operation on signals.
9	Program to perform convolution of two given sequences.
10	a. Program to perform verification of commutative property of convolution. b. Program to perform verification of distributive property of convolution. c. Program to perform verification of associative property of convolution.
11	Program to compute step response from the given impulse response.
12	Programs to find Z-transform and inverse Z-transform of a sequence.

Course outcomes (Course Skill Set)

At the end of the course the student will be able to :

1. Understand the basics of Linear Algebra
2. Analyse different types of signals and systems
3. Analyse the properties of discrete-time signals & systems
4. Analyse discrete time signals & systems using Z transforms

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

CIE for the theory component of IPCC

Two Tests each of **20 Marks (duration 01 hour**)

- First test at the end of 5th week of the semester
- Second test at the end of the 10th week of the semester

Two assignments each of **10 Marks**

- First assignment at the end of 4th week of the semester
- Programming assignment at the end of 9th week of the semester, which can be implemented using programming languages like C++/Python/Java/Scilab

Scaled-down marks of two tests and two assignments added will be CIE marks for the theory component of IPCC for **30 marks**.

CIE for the practical component of IPCC

- On completion of every experiment/program in the laboratory, the students shall be evaluated and marks shall be awarded on the same day. The **15 marks** are for conducting the experiment and preparation of the laboratory record, the other **05 marks shall be for the test** conducted at the end of the semester.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to 15 marks.
- The laboratory test **(duration 03 hours)** at the end of the 15th week of the semester /after completion of all the experiments (whichever is early) shall be conducted for 50 marks and scaled down to 05 marks**.**

Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **20 marks**.

SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (duration 03 hours)

- The question paper will have ten questions. Each question is set for 20 marks.
- There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
- The students have to answer 5 full questions, selecting one full question from each module.

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper shall include questions from the practical component.

- The minimum marks to be secured in CIE to appear for SEE shall be the 12 (40% of maximum marks-30) in the theory component and 08 (40% of maximum marks -20) in the practical component. The laboratory component of the IPCC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be included**.** The maximum of 04/05 questions to be set from the practical component of IPCC, the total marks of all questions should not be more than the 20 marks.

SEE will be conducted for 100 marks and students shall secure 35% of the maximum marks to qualify in the SEE. Marks secured out of 100 will be scaled down to 50 marks.

Suggested Learning Resources:

Text Books

1. Gilbert Strang, "Linear Algebra and its Applications", Cengage Learning, 4th Edition, 2006, ISBN 97809802327
2. Simon Haykin and Barry Van Veen, "Signals and Systems", 2nd Edition, 2008, Wiley India. ISBN9971-51-239-4.

Reference Books:

1. **Michael Roberts,** "Fundamentals of Signals & Systems",2nd edition, Tata McGraw-Hill, 2010, ISBN978-0-07-070221-9.
2. **Alan** V **Oppenheim, Alan** S **WiIlsky and** S **Hamid Nawab,** "Signals and Systems" Pearson Education Asia / PHI, 2"" edition, 1997. Indian Reprint 2002.
3. **H P Hsu, R Ranjan,** "Signals and Systems", Schaum's outlines, TMH, 2006.
4. **B P Lathi,** "Linear Systems and Signals", Oxford University Press, 2005.
5. **Ganesh Rao and Satish Tunga,** "Signals and Systems", Pearson/Sanguine.
6. **Seymour Lipschutz, Marc Lipson**, "Schaums Easy Outline of Linear Algebra", 2020.

Web links and Video Lectures (e-Resources):

Video lectures on Signals and Systems by Alan V Oppenheim

Lecture 1, Introduction | MIT RES.6.007 Signals and Systems, Spring 2011 - YouTube

Lecture 2, Signals and Systems: Part 1 | MIT RES.6.007 Signals and Systems, Spring 2011 - YouTube

NPTEL video lectures signals and system:

https://www.youtube.com/watch?v=7Z3LE5uM-6Y&list=PLbMVogVj5nJQQZbah2uRZIRZ_9kfoqZyx

Video lectures on Linear Algebra by Gilbert Strang

https://www.youtube.com/watch?v=ZK3O402wf1c&list=PL49CF3715CB9EF31D&index=1

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

Programming Assignments / Mini Projects can be given to improve programming skills

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III Semester

Analog Electronic Circuits			
Course Code	**21EC34**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:1	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course objectives: This course will enable students to

- Explain various BJT parameters, connections and configurations.
- Design and demonstrate the diode circuits and transistor amplifiers.
- Explain various types of FET biasing and demonstrate the use of FET amplifiers.
- Analyze Power amplifier circuits in different modes of operation.
- Construct Feedback and Oscillator circuits using FET.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1.Lecture method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
2.Show Video/animation films to explain evolution of communication technologies.
3. Encourage collaborative (Group) Learning in the class
4.Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking
5.Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
6.Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
7.Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

BJT Biasing: Biasing in BJT amplifier circuits: The Classical Discrete circuit bias (Voltage-divider bias), Biasing using a collector to base feedback resistor.

Small signal operation and Models: Collector current and transconductance, Base current and input resistance, Emitter current and input resistance, voltage gain, Separating the signal and the DC quantities, The hybrid Π model, The T model.

MOSFETs: Biasing in MOS amplifier circuits: Fixing VGS, Fixing VG, Drain to Gate feedback resistor.

Small signal operation and modeling: The DC bias point, signal current in drain, voltage gain, small signal equivalent circuit models, transconductance, The T equivalent circuit model.

[Text 1: 3.5(3.5.1, 3.5.3), 3.6(3.6.1 to 3.6.7), 4.5(4.5.1, 4.5.2, 4.5.3), 4.6(4.6.1 to 4.6.7)]

Teaching-Learning Process	Chalk and talk method, Power Point Presentation. **Self-study topics:**Basic BJT Amplifier Configurations- Design of Common Emitter and Common collector amplifier circuits. **RBT Level:** L1, L2, L3

Module-2

MOSFET Amplifier configuration: Basic configurations, characterizing amplifiers, CS amplifier with and without source resistance RS, Source follower.

MOSFET internal capacitances and High frequency model: The gate capacitive effect, Junction capacitances, High frequency model.

Frequency response of the CS amplifier: The three frequency bands, high frequency response, Low frequency response.

Oscillators: FET based Phase shift oscillator, LC and Crystal Oscillators (no derivation) [Text 1: 4.7(4.7.1 to 4.7.4, 4.7.6) 4.8(4.8.1, 4.8.2, 4.8.3), 4.9, 12.2.2, 12.3.1, 12,3,2]	
Teaching-Learning Process	Chalk and talk method, Power Point Presentation. **Self-study topics:**Discrete Circuit MOS Amplifier – The common source amplifier and the source follower. **RBT Level:** L1, L2, L3
Module-3	
Feedback Amplifier: General feedback structure, Properties of negative feedback, The Four Basic Feedback Topologies, The series-shunt, series-series, shunt-shunt and shunt-series amplifiers (Qualitative Analysis). **Output Stages and Power Amplifiers:** Introduction, Classification of output stages, Class A output stage, Class B output stage: Transfer Characteristics, Power Dissipation, Power Conversion efficiency, Class AB output stage, Class C tuned Amplifier. [Text 1: 7.1, 7.2, 7.3, 7.4.1, 7.5.1, 7.6 (7.6.1 to 7.6.3), 13.1, 13.2, 13.3(13.3.1, 13.3.2, 13.3.3, 13.4, 13.7)]	
Teaching-Learning Process	Chalk and talk method, Power Point Presentation. **Self-study topics:**Class D power amplifier. **RBT Level:** L1, L2, L3
Module-4	
Op-Amp Circuits: Op-amp DC and AC Amplifiers, DAC - Weighted resistor and R-2R ladder, ADC-Successive approximation type, Small Signal half wave rectifier, Absolute value output circuit, Active Filters, First and second order low-pass and high-pass Butterworth filters, Band-pass filters, Band reject filters. **555 Timer and its applications:** Monostable and Astable Multivibrators. [Text 2: 6.2, 8.11(8.11.1a, 8.11.1b), 8.11.2a, 8.12.2,8.13 7.2, 7.3, 7.4, 7.5, 7.6, 7.8, 7.9, 9.4.1, 9.4.1(a), 9.4.3, 9.4.3(a)]	
Teaching-Learning Process	Chalk and talk method, Power Point Presentation. **Self-study topics:**Clippers and Clampers, Peak detector, Sample and hold circuit. **RBT Level:** L1, L2, L3
Module-5	
Overview of Power Electronic Systems: Power Electronic Systems, Power Electronic Converters and Applications. **Thyristors:** Static Anode-Cathode characteristics and Gate characteristics of SCR, Turn-ON methods, Turn-off Mechanism, Turn-OFF Methods: Natural and Forced Commutation – Class A without design consideration. **Gate Trigger Circuit:** Resistance Firing Circuit, Resistance capacitance firing circuit, Unijunction Transistor: Basic operation and UJT Firing Circuit. [Text 3: 1.3, 1.5,1.6, 2.2,2.3,2.4,2.6, 2.7,2.9, 2.10,3.2,3.5.1, 3.5.2, 3.6.1, 3.6.3,3.6.4]	
Teaching-Learning Process	Chalk and talk method, Power Point Presentation. **Self-study topics:** Basic Construction, working and applications of DIAC, TRIAC, IGBT, GTO. **RBT Level:** L1, L2, L3

Course Outcomes (Course Skill Set)

At the end of the course the student will be able to :

1. Understand the characteristics of BJTs and FETs for switching and amplifier circuits.
2. Design and analyze FET amplifiers and oscillatorswith different circuit configurations and biasing conditions.
3. Understand the feedback topologies and approximations in the design of amplifiers and oscillators.
4. Design of circuits using linear ICs for wide range applications such as ADC, DAC, filters and timers.
5. Understand the power electronic device components and its functions for basic power electronic circuits.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%.

The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored out of 100 shall be proportionally reduced to 50 marks.

Suggested Learning Resources:

Books

1. Microelectronic Circuits, Theory and Applications, Adel S Sedra, Kenneth C Smith, 6thEdition, Oxford, 2015.ISBN:978-0-19-808913-1
2. Op-Amps and Linear Integrated Circuits, Ramakant A Gayakwad, 4thEdition, Pearson Education, 2018. ISBN: 978-93-325-4991-3
3. **MD Singh and K B Khanchandani, Power Electronics, 2nd Edition, Tata Mc-Graw Hill, 2009, ISBN: 0070583897'**

Web links and Video Lectures (e-Resources):

- Integrated Electronics: Analog and Digital Circuits and Systems, Jacob Millman, Christos C. Halkias, McGraw-Hill, 2015.
- Electronic Devices and Circuit, Boylestad & Nashelsky, Eleventh Edition, Pearson, January 2015.

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III Semester

Analog and Digital Electronics Lab			
Course Code	**21ECL35**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0:0:2:0	SEE Marks	50
Credits	1	Exam Hours	3

Course objectives:

This laboratory course enables students to

- Understand the electronic circuit schematic and its working
- Realize and test amplifier and oscillator circuits for the given specifications
- Realize the opamp circuits for the applications such as DAC, implement mathematical functions and precision rectifiers.
- Study the static characteristics of SCR and test the RC triggering circuit.
- Design and test the combinational and sequential logic circuits for their functionalities.
- Use the suitable ICs based on the specifications and functions.

Sl.No.	**Experiments**
1	Design and set up the BJT common emitter voltage amplifier with and without feedback and determine the gain- bandwidth product, input and output impedances.
2	Design and set-up BJT/FET i) Colpitts Oscillator, ii) Crystal Oscillator and iii) RC Phase shift oscillator
3	Design and set up the circuits using opamp: i) Adder, ii) Integrator, iii) Differentiator and iv) Comparator
4	Obtain the static characteristics of SCR and test SCR Controlled HWR and FWR using RC triggering circuit.
5	Design and implement (a) Half Adder & Full Adder using basic gates and NAND gates, (b) Half subtractor & Full subtractor using NAND gates, (c) 4-variable function using IC74151(8:1MUX).
6	Realize (i) Binary to Gray code conversion & vice-versa (IC74139), (ii) BCD to Excess-3 code conversion and vice versa
7	a) Realize using NAND Gates: i) Master-Slave JK Flip-Flop, ii) D Flip-Flop and iii) T Flip-Flop b) Realize the shift registers using IC7474/7495: (i) SISO (ii) SIPO (iii) PISO (iv) PIPO (v) Ring counter and (vi) Johnson counter.
8	Realize a) Design Mod – N Synchronous Up Counter & Down Counter using 7476 JK Flip-flop b) Mod-N Counter using IC7490 / 7476 c) Synchronous counter using IC74192

9	Design 4-bit R – 2R Op-Amp Digital to Analog Converter (i) for a 4-bit binary input using toggle switches (ii) by generating digital inputs using mod-16
10	Pseudorandom sequence generator using IC7495
11	Test the precision rectifiers using opamp: i) Half wave rectifier ii) Full wave rectifier
12	Design and test Monostable and Astable Multivibrator using 555 Timer

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

1. Design and analyze the BJT/FET amplifier and oscillator circuits.
2. Design and test Opamp circuits to realize the mathematical computations, DAC and precision rectifiers.
3. Design and test the combinational logic circuits for the given specifications.
4. Test the sequential logic circuits for the given functionality.
5. Demonstrate the basic electronic circuit experiments using SCR and 555 timer.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 35% (18 Marks out of 50) in the semester-end examination (SEE).

Continuous Internal Evaluation (CIE):

CIE marks for the practical course is **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment to be evaluated for conduction with observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled downed to 30 marks (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8th week of the semester and the second test shall be conducted after the 14th week of the semester.
- In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability. Rubrics suggested in Annexure-II of Regulation book
- The average of 02 tests is scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and average marks of two tests is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

SEE marks for the practical course is 50 Marks.

SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University

All laboratory experiments are to be included for practical examination.

(Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.

Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.

Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)

Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.

The duration of SEE is 03 hours

Rubrics suggested in Annexure-II of Regulation book

Suggested Learning Resources:

1. Fundamentals of Electronic Devices and Circuits Lab Manual, David A Bell, 5th Edition, 2009, Oxford University Press.
2. Op-Amps and Linear Integrated Circuits, Ramakant A Gayakwad, 4th Edition, Pearson Education, 2018. ISBN: 978-93-325-4991-3.
3. Fundamentals of Logic Design, Charles H Roth Jr., Larry L Kinney, Cengage Learning, 7th Edition.

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III Semester

LD (Logic Design) Lab using Pspice / MultiSIM			
Course Code	**21EC381**	CIE Marks	50
Teaching Hours/Week (L: T:P: S)	0:0:2:0	SEE Marks	50
Credits	1	Exam Hours	03

Course objectives:

- Impart the concepts of De Morgan's Theorem, SOP, POS forms.
- Impart the concepts of designing and analyzing combinational logic circuits.
- Impart the concepts of analysis of sequential logic circuits.
- Analyze and design any given synchronous sequential circuits.

Sl.No	**Experiments**
1	Implementation of De Morgan's theorem and SOP/POS expressions using Pspice/Multisim.
2	Implementation of Half Adder, Full Adder, Half Subtractor and Full Subtractor using Pspice/ Multisim.
3	Design and implementation of 4-bit Parallel Adder/ Subtractor using IC 7483 and BCD to Excess-3 code conversion and vice-versa using Pspice/Multisim.
4	Design and implement of IC 7485 5-bit magnitude comparator using Pspice/Multisim.
5	To Realize Adder & Subtractor using IC 74153 (4:1 MUX) and 4-variable function using IC74151 (8:1MUX) using Pspice/Multisim.
6	To realize Adder and Subtractor using IC 74139/ 74155N (Demux/Decoder) and Binary to Gray code conversion & vice versa using 74139/ 74155N using Pspice/Multisim.
7	SR, Master-Slave JK, D & T flip-flops using NAND Gates using Pspice/Multisim.
8	Design and realize the Synchronous counters (up/down decade/binary) using Pspice/Multisim.
9	Realize the shift registers and their modes (SISO, PISO, PIPO, SIPO) using 7474/7495 using Pspice/Multisim.
10	Design Pseudo Random Sequence generator using 7495 using Pspice/Multisim.
11	Design Serial Adder with Accumulator and simulate using Pspice/Multisim.
12	Design using Pspice/Multisim Mod-N Counters.

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

1. Demonstrate the truth table of various expressions and combinational circuits using logic gates.
2. Design various combinational circuits such as adders, subtractors, comparators, multiplexers and code converters.
3. Construct flips-flops, counters and shift registers.
4. Design and implement synchronous counters.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall

be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 35% (18 Marks out of 50) in the semester-end examination (SEE).

Continuous Internal Evaluation (CIE):

CIE marks for the practical course is **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment to be evaluated for conduction with observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled downed to 30 marks (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8th week of the semester and the second test shall be conducted after the 14th week of the semester.
- In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability. Rubrics suggested in Annexure-II of Regulation book
- The average of 02 tests is scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and average marks of two tests is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

SEE marks for the practical course is 50 Marks.

SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University

All laboratory experiments are to be included for practical examination.

(Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.

Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.

Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)

Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.

The duration of SEE is 03 hours

Rubrics suggested in Annexure-II of Regulation book

Suggested Learning Resources:

- Digital Logic Applications and Design by John M Yarbrough, Thomson Learning, 2001
- Digital Principles and Design by Donald D Givone, McGraw Hill, 2002.

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III Semester

AEC (Analog Electronic Circuits) Lab			
Course Code	21EC382	CIE Marks	50
Teaching Hours/Week (L: T:P: S)	0:0:2:0	SEE Marks	50
Credits	1	Exam Hours	2

Course objectives:

- To provide practical exposure to the students on designing, setting up, executing and debugging various electronic circuits using simulation software.
- To give the knowledge and practical exposure on simple applications of analog electronic circuits.

Sl.No	**Experiments using Pspice/MultiSIM software**
1	Experiments to realize diode clipping (single, double ended) circuits.
2	Experiments to realize diode clamping (positive, negative) circuits.
3	Experiments to realize Full wave rectifier without filter (and set-up to measure the ripple factor, Vp-p, Vrms, etc.).
4	Design and conduct an experiment on Series Voltage Regulator using Zener diode to determine line/load regulation characteristics.
5	Realize BJT Darlington Emitter follower without bootstrapping and determine the gain, input and output impedances (other configurations of emitter follower can also be considered).
6	Set-up and study the working of complementary symmetry class B push pull power amplifier (other power amplifiers can also be suitably considered) and calculate the efficiency.
7	Design and set-up the oscillator circuits (Hartley, Colpitts, etc. using BJT/FET) and determine the frequency of oscillation.
8	Design and set-up the crystal oscillator and determine the frequency of oscillation.
9	Experiment to realize Input and Output characteristics of BJT Common emitter configuration and evaluation of parameters.
10	Experiments to realize Transfer and drain characteristics of a MOSFET.
11	Experiments to realize UJT triggering circuit for Controlled Full wave Rectifier.
12	Design and simulation of Regulated power supply.

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

1. Understand the circuit schematic and its working.
2. Study the characteristics of different electronic devices.
3. Design and test simple electronic circuits as per the specifications using discrete electronic components.
4. Compute the parameters from the characteristics of active devices.
5. Familiarize with EDA software which can be used for electronic circuit simulation.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 35% (18 Marks out of 50) in the semester-end examination (SEE).

Continuous Internal Evaluation (CIE):

CIE marks for the practical course is **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment to be evaluated for conduction with observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled downed to 30 marks (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8th week of the semester and the second test shall be conducted after the 14th week of the semester.
- In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability. Rubrics suggested in Annexure-II of Regulation book
- The average of 02 tests is scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and average marks of two tests is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

SEE marks for the practical course is 50 Marks.

SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University.

All laboratory experiments are to be included for practical examination.

(Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.

Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.

Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners).

Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.

The duration of SEE is 03 hours.

Rubrics suggested in Annexure-II of Regulation book.

Suggested Learning Resources:

1. David A Bell, "Fundamentals of Electronic Devices and Circuits Lab Manual, 5th Edition, 2009, Oxford University Press.
2. Muhammed H Rashid, "Introduction to PSpice using OrCAD for circuits and electronics", 3rd Edition, Prentice Hall, 2003.

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III Semester

LIC (Linear Integrated Circuits) Lab using Pspice / MultiSIM			
Course Code	**21EC383**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0:0:2:0	SEE Marks	50
Credits	1	Exam Hours	03

Course objectives:

- To apply operational amplifiers in linear and nonlinear applications.
- To acquire the basic knowledge of special function ICs.
- To use Multisim/Pspice software for circuit design and simulation

Sl.No	**Experiments using Pspice / MultiSIM** Every experiment has to be designed, circuit to be drawn / constructed and executed in the specified software. Results are also to be noted and inferred.
	Note: Standard design procedure to be adopted.
1	To realize using op-amp an Inverting Amplifier and Non-Inverting Amplifier
2	To realize using op-amps i) Summing Amplifier ii)Difference amplifier
3	To realize using op-amps an Instrumentation Amplifier
4	To realize using op-amps i) Differentiator ii)Integrator
5	To realize using op-amps a Full wave Precision Rectifier
6	To realize using op-amps • Inverting and Non-Inverting Zero Crossing Detectors • Positive and Negative Voltage level detectors
7	To realize using op-amp an Inverting Schmitt Trigger
8	To realize using op-amp an Astable Multivibrator
9	To design and implement using op-amps • Butterworth I & II order Low Pass Filter • Butterworth I & II order High Pass Filter
10	To design and implement using op-amp a RC Phase Shift Oscillator
11	To design and implement Mono-stable Multivibrator using 555 timer
12	To design and implement 4 - bit R-2R Digital to Analog Converter

Course outcomes (Course Skill Set):

After studying this course, students will be able to;

1. Sketch/draw circuit schematics, construct circuits, analyze and troubleshoot circuits containing op-amps, resistors, diodes, capacitors and independent sources.
2. Relate to the manufacturer's data sheets of IC 555 timer and IC µa741 op-amp.
3. Realize and verify the operation of analog integrated circuits like Amplifiers, Precision Rectifiers, Comparators and Waveform generators.
4. Design and implement analog integrated circuits like Oscillators, Active filters, Timer circuits, Data converters and compare the experimental results with theoretical values.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 35% (18 Marks out of 50) in the semester-end examination (SEE).

Continuous Internal Evaluation (CIE):

CIE marks for the practical course is **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment to be evaluated for conduction with observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled downed to 30 marks (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8th week of the semester and the second test shall be conducted after the 14th week of the semester.
- In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability. Rubrics suggested in Annexure-II of Regulation book
- The average of 02 tests is scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and average marks of two tests is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

SEE marks for the practical course is 50 Marks.

SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University

All laboratory experiments are to be included for practical examination.

(Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.

Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.

Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)

Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.

The duration of SEE is 03 hours

Rubrics suggested in Annexure-II of Regulation book

Suggested Learning Resources:

Op-Amps and Linear Integrated Circuits, Ramakant A Gayakwad, 4th Edition, Pearson Education, 2018.

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III Semester

LabVIEW Programming Basics			
Course Code	**21EC384**	CIE Marks	50
Teaching Hours/Week (L: T:P: S)	0:0:2:0	SEE Marks	50
Credits	1	Exam Hours	03

Course objectives:

- Aware of various front panel controls and indicators.
- Connect and manipulate nodes and wires in the block diagram.
- Locate various toolbars and pull-down menus for the purpose of implementing specific functions.
- Locate and utilize the context help window.
- Familiar with LabVIEW and different applications using it.
- Run a Virtual Instrument (VI).

Sl.No	**VI Programs (using LabVIEW software) to realize the following:**
1	Basic arithmetic operations: addition, subtraction, multiplication and division
2	Boolean operations: AND, OR, XOR, NOT and NAND
3	Sum of 'n' numbers using 'for' loop
4	Factorial of a given number using 'for' loop
5	Determine square of a given number
6	Factorial of a given number using 'while 'loop
7	Sorting even numbers using 'while' loop in an array
8	Finding the array maximum and array minimum
	Demonstration Experiments (For CIE)
9	Build a Virtual Instrument that simulates a heating and cooling system. The system must be able to be controlled manually or automatically.
10	Build a Virtual Instrument that simulates a Basic Calculator (using formula node).
11	Build a Virtual Instrument that simulates a Water Level Detector.
12	Demonstrate how to create a basic VI which calculates the area and perimeter of a circle.

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

1. Use Lab VIEW to create data acquisition, analysis and display operations
2. Create user interfaces with charts, graph and buttons
3. Use the programming structures and data types that exist in Lab VIEW
4. Use various editing and debugging techniques

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course.

The student has to secure not less than 35% (18 Marks out of 50) in the semester-end examination (SEE).

Continuous Internal Evaluation (CIE):

CIE marks for the practical course is **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment to be evaluated for conduction with observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled downed to 30 marks (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8th week of the semester and the second test shall be conducted after the 14th week of the semester.
- In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability. Rubrics suggested in Annexure-II of Regulation book
- The average of 02 tests is scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and average marks of two tests is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

SEE marks for the practical course is 50 Marks.

SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University

All laboratory experiments are to be included for practical examination.

(Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.

Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.

Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)

Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.

The duration of SEE is 03 hours

Rubrics suggested in Annexure-II of Regulation book

Suggested Learning Resources:

1. Virtual Instrumentation using LABVIEW, Jovitha Jerome, PHI, 2011
2. Virtual Instrumentation using LABVIEW, Sanjay Gupta, Joseph John, TMH, McGraw Hill, Second Edition, 2011.

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IV Semester

Maths for Communication Engineers			
Course Code	**21EC41**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	3:0:0:1	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

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IV Semester

Digital Signal Processing			
Course Code	21EC42	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:2:0	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 8-10 Lab slots	Total Marks	100
Credits	04	Exam Hours	03

Course objectives:

1. **Preparation:** To prepare students with fundamental knowledge/ overview in the field of Digital Signal Processing
2. **Core Competence:** To equip students with a basic foundation of Signal Processing by delivering the basics of Discrete Fourier Transforms & their properties, design of filters and overview of digital signal processors

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecture method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
2. Show Video/animation films to explain the different concepts of Digital Signal Processing
3. Encourage collaborative (Group) Learning in the class
4. Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
6. Topics will be introduced in a multiple representation.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.
9. Adopt Flipped class technique by sharing the materials / Sample Videos prior to the class and have discussions on the that topic in the succeeding classes
10. Give Programming Assignments

Module-1

Discrete Fourier Transforms (DFT): Frequency domain sampling and Reconstruction of Discrete Time Signals, The Discrete Fourier Transform, DFT as a linear transformation, Properties of the DFT: Periodicity, Linearity and Symmetry properties, Multiplication of two DFTs and Circular Convolution **[Text 1]**

Teaching-Learning Process	Chalk and Talk, YouTube videos, Programming assignments **RBT Level:** L1, L2, L3

Module-2

Additional DFT Properties, **Linear filtering methods based on the DFT:** Use of DFT in Linear Filtering, Filtering of Long data Sequences. Fast-Fourier-Transform (FFT) algorithms: Efficient Computation of the DFT: Radix-2 FFT algorithms for the computation of DFT and IDFT decimation in-time **[Text 1]**

Teaching-Learning Process	Chalk and Talk, YouTube videos, Programming assignments **RBT Level:** L1, L2, L3

Module-3

Design of FIR Filters: Characteristics of practical frequency-selective filters, Symmetric and Anti-symmetric FIR filters, Design of Linear-phase FIR (low pass and High pass) filters using windows - Rectangular, Hamming, Hanning, Bartlett windows. Structure for FIR Systems: Direct form, Cascade form and Lattice structures **[Text1]**

Teaching-Learning Process	Chalk and Talk, YouTube videos, Programming assignments **RBT Level:** L1, L2, L3

Module-4

IIR Filter Design: Infinite Impulse response Filter Format, Bilinear Transformation Design Method, Analog Filters using Low pass prototype transformation, Normalized Butterworth Functions, Bilinear Transformation and Frequency Warping, Bilinear Transformation Design Procedure, Digital Butterworth (Lowpass and Highpass) Filter Design using BLT. Realization of IIR Filters in Direct form I and II **[Text 2]**

Teaching-Learning Process	Chalk and Talk, YouTube videos, Programming assignments **RBT Level:** L1, L2, L3

Module-5

Digital Signal Processors: DSP Architecture, DSP Hardware Units, Fixed point format, Floating point Format, IEEE Floating point formats, Fixed point digital signal processors, FIR and IIR filter implementations in Fixed point systems. **[Text 2]**

Teaching-Learning Process	Chalk and Talk, YouTube videos, Programming assignments **RBT Level:** L1, L2, L3

PRACTICAL COMPONENT OF IPCC

List of Programs to be implemented & executed using any programming languages like C++/Python/Java/Scilab / MATLAB/CC Studio (but not limited to)

1. Computation of N point DFT of a given sequence and to plot magnitude and phase spectrum.
2. Computation of circular convolution of two given sequences and verification of commutative, distributive and associative property of convolution.
3. Computation of linear convolution of two sequences using DFT and IDFT.
4. Computation of circular convolution of two given sequences using DFT and IDFT
5. Verification of Linearity property, circular time shift property & circular frequency shift property of DFT.
6. Verification of Parseval's theorem
7. Design and implementation of IIR (Butterworth) low pass filter to meet given specifications.
8. Design and implementation of IIR (Butterworth) high pass filter to meet given specifications.
9. Design and implementation of low pass FIR filter to meet given specifications.
10. Design and implementation of high pass FIR filter to meet given specifications.
11. To compute N- Point DFT of a given sequence using DSK 6713 simulator
12. To compute linear convolution of two given sequences using DSK 6713 simulator
13. To compute circular convolution of two given sequences using DSK 6713 simulator

Course outcomes (Course Skill Set)

At the end of the course the student will be able to:

1. Determine response of LTI systems using time domain and DFT techniques
2. Compute DFT of real and complex discrete time signals
3. Compute DFT using FFT algorithms
4. Design FIR and IIR Digital Filters
5. Design of Digital Filters using DSP processor

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

CIE for the theory component of IPCC

Two Tests each of **20 Marks (duration 01 hour**)

- First test at the end of 5th week of the semester
- Second test at the end of the 10th week of the semester

Two assignments each of **10 Marks**

- First assignment at the end of 4th week of the semester
- Programming assignment at the end of 9th week of the semester, which can be implemented using programming languages like C++/Python/Java/Scilab

Scaled-down marks of two tests and two assignments added will be CIE marks for the theory component of IPCC for **30 marks**.

CIE for the practical component of IPCC

- On completion of every experiment/program in the laboratory, the students shall be evaluated and marks shall be awarded on the same day. The **15 marks** are for conducting the experiment and preparation of the laboratory record, the other **05 marks shall be for the test** conducted at the end of the semester.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to 15 marks.
- The laboratory test **(duration 03 hours)** at the end of the 15th week of the semester /after completion of all the experiments (whichever is early) shall be conducted for 50 marks and scaled down to 05 marks**.**

Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **20 marks**.

SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (duration 03 hours)

- The question paper will have ten questions. Each question is set for 20 marks.
- There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
- The students have to answer 5 full questions, selecting one full question from each module.

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper shall include questions from the practical component.

- The minimum marks to be secured in CIE to appear for SEE shall be the 12 (40% of maximum marks-30) in the theory component and 08 (40% of maximum marks -20) in the practical component. The laboratory component of the IPCC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be included**.** The maximum of 04/05 questions to be set from the practical component of IPCC, the total marks of all questions should not be more than the 20 marks.

SEE will be conducted for 100 marks and students shall secure 35% of the maximum marks to qualify in the SEE. Marks secured will be scaled down to 50.

Suggested Learning Resources:

Text Books:

1. Proakis & Manolakis, “Digital Signal Processing - Principles Algorithms & Applications”, 4th Edition, Pearson education, New Delhi, 2007. ISBN: 81-317-1000-9.
2. Li Tan, Jean Jiang, “Digital Signal processing - Fundamentals and Applications”, Academic Press, 2013, ISBN: 978-0-12-415893.

Reference Books:

1. Sanjit K Mitra, “Digital Signal Processing, A Computer Based Approach”, 4th Edition, McGraw Hill Education, 2013,
2. Oppenheim & Schaffer, “Discrete Time Signal Processing", PHI, 2003.
3. D Ganesh Rao and Vineeth P Gejji, “Digital Signal Processing" Cengage India Private Limited, 2017, ISBN: 9386858231

Web links and Video Lectures (e-Resources):

By Prof. S. C. Dutta Roy, IIT Delhi

https://nptel.ac.in/courses/117102060

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

Programming Assignments / Mini Projects can be given to improve programming skills

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI
B.E: Electronics & Communication Engineering / B.E: Electronics & Telecommunication Engineering
NEP, Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
(Effective from the academic year 2021 – 22)

IV Semester

Circuits & Controls			
Course Code	**21EC43**	CIE Marks	50
Teaching Hours/Week (L: T: P: S)	(3:0:2:0)	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 12 Lab slots	Total Marks	100
Credits	04	Exam Hours	03

Course objectives: This course will enable students to:

1. Apply mesh and nodal techniques to solve an electrical network.
2. Solve different problems related to Electrical circuits using Network Theorems and Two port network.
3. Familiarize with the use of Laplace transforms to solve network problems.
4. Understand basics of control systems and design mathematical models using block diagram reduction, SFG, etc.
5. Understand Time domain and Frequency domain analysis.
6. Familiarize with the State Space Model of the system.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

- Lecture method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
- Show Video/animation films to explain the different concepts of Linear Algebra & Signal Processing.
- Encourage collaborative (Group) Learning in the class .
- Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking.
- Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
- Topics will be introduced in a multiple representation.
- Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
- Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.
- Adopt Flipped class technique by sharing the materials / Sample Videos prior to the class and have discussions on the that topic in the succeeding classes.
- Give Programming Assignments.

Module-1

Basic concepts and network theorems

Types of Sources, Loop analysis, Nodal analysis with independent DC and AC Excitations.
(Textbook 1: 2.3, 4.1, 4.2, 4.3, 4.4, 10.6)

Super position theorem, Thevenin's theorem, Norton's Theorem, Maximum Power transfer Theorem.
(Textbook 2: 9.2, 9.4, 9.5, 9.7)

Teaching-Learning Process	Chalk and Talk, YouTube videos, Demonstrate the concepts using circuits **RBT Level:** L1, L2, L3

Module-2	
Two port networks: Short- circuit Admittance parameters, Open- circuit Impedance parameters, Transmission parameters, Hybrid parameters (Textbook 3: 11.1, 11.2, 11.3, 11.4, 11.5) **Laplace transform and its Applications**: Step Ramp, Impulse, Solution of networks using Laplace transform, Initial value and final value theorem (Textbook 3: 7.1, 7.2, 7.4, 7.7, 8.4)	
Teaching-Learning Process	Chalk and Talk **RBT Level:** L1, L2, L3
Module-3	
Basic Concepts and representation: Types of control systems, effect of feedback systems, differential equation of physical systems (only electrical systems), Introduction to block diagrams, transfer functions, Signal Flow Graphs (Textbook 4: Chapter 1.1, 2.2, 2.4, 2.5, 2.6)	
Teaching-Learning Process	Chalk and Talk, YouTube videos **RBT Level:** L1, L2, L3
Module-4	
Time Response analysis: Time response of first order systems. Time response of second order systems, time response specifications of second order systems (Textbook 4: Chapter 5.3, 5.4) **Stability Analysis:** Concepts of stability necessary condition for stability, Routh stability criterion, relative stability Analysis (Textbook 4: Chapter 5.3, 5.4, 6.1, 6.2, 6.4, 6.5)	
Teaching-Learning Process	Chalk and Talk, Any software tool to show time response **RBT Level:** L1, L2, L3
Module-5	
Root locus: Introduction the root locus concepts, construction of root loci (Textbook 4: 7.1, 7.2, 7.3) **Frequency Domain analysis and stability**: Correlation between time and frequency response and Bode plots (Textbook 4: 8.1, 8.2, 8.4) **State Variable Analysis:** Introduction to state variable analysis: Concepts of state, state variable and state models. State model for Linear continuous –Time systems, solution of state equations. (Textbook 4: 12.2, 12.3, 12.6)	
Teaching-Learning Process	Chalk and Talk, Any software tool to plot Root locus, Bode plot **RBT Level:** L1, L2, L3

PRACTICAL COMPONENT OF IPCC

Using suitable hardware and simulation software, demonstrate the operation of the following circuits:

Sl.No	Experiments
1	Verification of Superposition theorem
2	Verification of Thevenin's theorem
3	Speed torque characteristics of i)AC Servomotor ii) DC Servomotors
4	Determination of time response specification of a second order Under damped System, for different damping factors.
5	Determination of frequency response of a second order System
6	Determination of frequency response of a lead lag compensator
7	Using Suitable simulation package study of speed control of DC motor using i) Armature control ii) Field control

8	Using suitable simulation package, draw Root locus & Bode plot of the given transfer function.
Demonstration Experiments (For CIE only, not for SEE)	
9	Using suitable simulation package, obtain the time response from state model of a system.
10	Implementation of PI, PD Controllers.
11	Implement a PID Controller and hence realize an Error Detector.
12	Demonstrate the effect of PI, PD and PID controller on the system response.

Course Outcomes

At the end of the course the student will be able to:

1. Analyse and solve Electric circuit, by applying, loop analysis, Nodal analysis and by applying network Theorems.
2. Evaluate two port parameters of a network and Apply Laplace transforms to solve electric networks.
3. Deduce transfer function of a given physical system, from differential equation representation or Block Diagram representation and SFG representation.
4. Calculate time response specifications and analyse the stability of the system.
5. Draw and analyse the effect of gain on system behaviour using root loci.
6. Perform frequency response Analysis and find the stability of the system.
7. Represent State model of the system and find the time response of the system.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

CIE for the theory component of IPCC

Two Tests each of **20 Marks (duration 01 hour**)

- First test at the end of 5th week of the semester
- Second test at the end of the 10th week of the semester

Two assignments each of **10 Marks**

- First assignment at the end of 4th week of the semester
- Second assignment at the end of 9th week of the semester

Scaled-down marks of two tests and two assignments added will be CIE marks for the theory component of IPCC for **30 marks**.

CIE for the practical component of IPCC

- On completion of every experiment/program in the laboratory, the students shall be evaluated and marks shall be awarded on the same day. The **15 marks** are for conducting the experiment and preparation of the laboratory record, the other **05 marks shall be for the test** conducted at the end of the semester.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to 15 marks.
- The laboratory test **(duration 03 hours)** at the end of the 15th week of the semester /after completion of all the experiments (whichever is early) shall be conducted for 50 marks and

scaled down to 05 marks**.**

Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **20 marks**.

SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (duration 03 hours)

- The question paper will have ten questions. Each question is set for 20 marks.
- There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
- The students have to answer 5 full questions, selecting one full question from each module.

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper shall include questions from the practical component.

- The minimum marks to be secured in CIE to appear for SEE shall be the 12 (40% of maximum marks-30) in the theory component and 08 (40% of maximum marks -20) in the practical component. The laboratory component of the IPCC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be included**.** The maximum of 04/05 questions to be set from the practical component of IPCC, the total marks of all questions should not be more than the 20 marks.

SEE will be conducted for 100 marks and students shall secure 35% of the maximum marks to qualify in the SEE. Marks secured out of 100 shall be reduced proportionally to 50.

Suggested Learning Resources:

Text Books

1. Engineering circuit analysis, William H Hayt, Jr, Jack E Kemmerly, Steven M Durbin, Mc Graw Hill Education, Indian Edition 8e.
2. Networks and Systems, D Roy Choudhury, New age international Publishers, second edition.
3. Network Analysis, M E Van Valkenburg, Pearson, 3e.
4. Control Systems Engineering, I J Nagrath, M. Gopal, New age international Publishers, Fifth edition.

Web links and Video Lectures (e-Resources):

- https://nptel.ac.in/courses/108106098
- https://nptel.ac.in/courses/108102042

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

Programming Assignments / Mini Projects can be given to improve programming skills

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IV Semester

Communication Theory			
Course Code	**21EC44**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:1	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course objectives: This course will enable students to

- Understand and analyse concepts of Analog Modulation schemes viz; AM, FM., Low pass sampling and Quantization as a random process.
- Understand and analyse concepts digitization of signals viz; sampling, quantizing and encoding.
- Evolve the concept of SNR in the presence of channel induced noise and study Demodulation of analog modulated signals.
- Evolve the concept of quantization noise for sampled and encoded signals and study the concepts of reconstruction from these samples at a receiver.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecture method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
2. Show Video/animation films to explain evolution of communication technologies.
3. Encourage collaborative (Group) Learning in the class.
4. Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
6. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
7. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

AMPLITUDE MODULATION: Introduction, Amplitude Modulation: Time & Frequency Domain description, Switching modulator, Envelop detector.

DOUBLE SIDE BAND-SUPPRESSED CARRIER MODULATION: Time and Frequency Domain description, Ring modulator, Coherent detection, Costas Receiver, Quadrature Carrier Multiplexing.

SINGLE SIDE–BAND AND VESTIGIAL SIDEBAND METHODS OF MODULATION: SSB Modulation, VSB Modulation, Frequency Translation, Frequency Division Multiplexing, Theme Example: VSB Transmission of Analog and Digital Television.

[Text1: 3.1 to 3.8]

Teaching-Learning Process	Chalk and talk method, Power Point Presentation. **Self-study topics:** Properties of the Fourier Transform, Dirac Delta Function. **RBT Level:** L1, L2, L3

Module-2

ANGLE MODULATION: Basic definitions, Frequency Modulation: Narrow Band FM, Wide Band FM, Transmission bandwidth of FM Signals, Generation of FM Signals, Demodulation of FM Signals, FM Stereo Multiplexing, Phase–Locked Loop: Nonlinear model of PLL, Linear model of PLL, Nonlinear Effects in FM

Systems. The Superheterodyne Receiver [Text1: 4.1 to 4.6]	
Teaching-Learning Process	Chalk and talk method, Power Point Presentation, YouTube videos. **Self-study topics:** FM Broadcasting System [Ref1] **RBT Level:** L1, L2, L3
Module-3	
NOISE: Shot Noise, Thermal noise, White Noise, Noise Equivalent Bandwidth. **NOISE IN ANALOG MODULATION**: Introduction, Receiver Model, Noise in DSB-SC receivers. Noise in AM receivers, Threshold effect, Noise in FM receivers, Capture effect, FM threshold effect, FM threshold reduction, Preemphasis and De-emphasis in FM (Text1: 5.10, 6.1 to 6.6)	
Teaching-Learning Process	Chalk and talk method, Power Point Presentation, YouTube videos. **Self-study topics:** Mean, Correlation and Covariance functions of Random Processes **RBT Level:** L1, L2, L3
Module-4	
SAMPLING AND QUANTIZATION: Introduction, Why Digitize Analog Sources? The Low pass Sampling process Pulse Amplitude Modulation. Time Division Multiplexing, Pulse-Position Modulation, Generation of PPM Waves, Detection of PPM Waves. (Text1: 7.1 to 7.7)	
Teaching-Learning Process	Chalk and talk method, Power Point Presentation, YouTube videos. **Self-study topics:** T1 carrier systems [Ref1] **RBT Level:** L1, L2, L3
Module-5	
SAMPLING AND QUANTIZATION (Contd): The Quantization Random Process, Quantization Noise, Pulse–Code Modulation: Sampling, Quantization, Encoding, Regeneration, Decoding, Filtering, Multiplexing; Delta Modulation (Text1: 7.8 to 7.10), Application examples - (a) Video + MPEG (Text1:7.11) and (b) Vocoders (refer Section 6.8 of Reference Book 1)	
Teaching-Learning Process	Chalk and talk method, Power Point Presentation, YouTube videos. **Self-study topics:** Digital Multiplexing. [Ref1] **RBT Level:** L1, L2, L3

Course Outcomes (Course Skill Set)

At the end of the course the student will be able to:

1. Understand the amplitude and frequency modulation techniques and perform time and frequency domain transformations.
2. Identify the schemes for amplitude and frequency modulation and demodulation of analog signals and compare the performance.
3. Characterize the influence of channel noise on analog modulated signals.
4. Understand the characteristics of pulse amplitude modulation, pulse position modulation and pulse code modulation systems.
5. Illustration of digital formatting representations used for Multiplexers, Vocoders and Video transmission.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module. Marks scored out of 100 shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Books

1. Simon Haykins & Moher, Communication Systems, 5th Edition, John Wiley, India Pvt. Ltd, 2010, ISBN 978 – 81 – 265 – 2151 – 7.

Reference Books

1. B P Lathi and Zhi Ding, Modern Digital and Analog Communication Systems, Oxford University Press., 4th edition, 2010, ISBN: 97801980738002.
2. Simon Haykins, An Introduction to Analog and Digital Communication, John Wiley India Pvt. Ltd., 2008, ISBN 978–81–265–3653–5.
3. H Taub & D L Schilling, Principles of Communication Systems, TMH, 2011.

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IV Semester

Communication Laboratory I			
Course Code	**21ECL46**	CIE Marks	50
Teaching Hours/Week (L: T: P: S)	0:0:2:0	SEE Marks	50
Credits	1	Exam Hours	3

Course objectives:

This laboratory course enables students to

- Model an analog communication system signal transmission and reception.
- Realize the electronic circuits to perform analog and pulse modulations and demodulations.
- Verify the sampling theorem and relate the signal and its spectrum before and after sampling.
- Understand the process of PCM and delta modulations.
- Understand the PLL operation.

Sl.No.	**Experiments**
1	Design of active second order Butterworth low pass and high pass filters.
2	Amplitude Modulation and Demodulation of (a) Standard AM and (b) DSBSC (LM741 and LF398 ICs can be used)
3	Frequency modulation and demodulation
4	Design and test Time Division Multiplexing and Demultiplexing of two bandlimited signals.
5	Design and test i) Pulse sampling, flat top sampling and reconstruction. ii) Pulse amplitude modulation and demodulation.
6	Design and test BJT/FET Mixer
7	Pulse Code Modulation and demodulation
8	Phase locked loop Synthesis
9	Illustration of (a) AM modulation and demodulation and display the signal and its spectrum. (b) DSB-SC modulation and demodulation and display the signal and its spectrum. (Use MATLAB/SCILAB)
10	Illustration of FM modulation and demodulation and display the signal and its spectrum. (Use MATLAB/SCILAB)
11	Illustrate the process of sampling and reconstruction of low pass signals. Display the signals and its spectrums of both analog and sampled signals. (Use MATLAB/SCILAB).
12	Illustration of Delta Modulation and the effects of step size selection in the design of DM encoder. (Use MATLAB/SCILAB)

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

1. Demonstrate the AM and FM modulation and demodulation by representing the signals in time and frequency domain.
2. Design and test the sampling, Multiplexing and PAM with relevant circuits.
3. Demonstrate the basic circuitry and operations used in AM and FM receivers.
4. Illustrate the operation of PCM and delta modulations for different input conditions.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 35% (18 Marks out of 50) in the semester-end examination (SEE).

Continuous Internal Evaluation (CIE):

CIE marks for the practical course is **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment to be evaluated for conduction with observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled downed to 30 marks (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8th week of the semester and the second test shall be conducted after the 14th week of the semester.
- In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability. Rubrics suggested in Annexure-II of Regulation book
- The average of 02 tests is scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and average marks of two tests is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

SEE marks for the practical course is 50 Marks.

SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University

All laboratory experiments are to be included for practical examination.

(Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.

Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.

Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by

examiners.
General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners).
Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.
The duration of SEE is 03 hours.

Rubrics suggested in Annexure-II of Regulation book

Suggested Learning Resources:

1. Louis E Frenzel, Principles of Electronic Communication Systems, McGraw Hill Education (India) Private Limited, 2016.
2. B P Lathi, Zhi Ding, Modern Digital and Analog Communication Systems, Oxford University Press, 2015.

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IV Semester

Embedded C Basics			
Course Code	**21EC481**	CIE Marks	50
Teaching Hours/Week (L: T:P: S)	0:0:2:0	SEE Marks	50
Credits	1	Exam Hours	3

Course objectives:

- Understand the basic programming of Microprocessor and microcontroller.
- To develop the microcontroller-based programs for various applications.

Sl.No	**Experiments**
	Conduct the following experiments by writing C Program using Keil microvision simulator (any 8051 microcontroller can be chosen as the target).
1	Write a 8051 C program to multiply two 16 bit binary numbers.
2	Write a 8051 C program to find the sum of first 10 integer numbers.
3	Write a 8051 C program to find factorial of a given number.
4	Write a 8051 C program to add an array of 16 bit numbers and store the 32 bit result in internal RAM
5	Write a 8051 C program to find the square of a number (1 to 10) using look-up table.
6	Write a 8051 C program to find the largest/smallest number in an array of 32 numbers
7	Write a 8051 C program to arrange a series of 32 bit numbers in ascending/descending order
8	Write a 8051 C program to count the number of ones and zeros in two consecutive memory locations.
9	Write a 8051 C program to scan a series of 32 bit numbers to find how many are negative.
10	Write a 8051 C program to display “Hello World” message (either in simulation mode or interface an LCD display).
11	Write a 8051 C program to convert the hexadecimal data 0xCFh to decimal and display the digits on ports P0, P1 and P2 (port window in simulator).

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

1. Write C programs in 8051 for solving simple problems that manipulate input data using different instructions of 8051 C.
2. Develop testing and experimental procedures on 8051 Microcontroller, analyze their operation under different cases.
3. Develop programs for 8051 Microcontroller to implement real world problems.
4. Design and Develop Mini projects

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 35% (18 Marks out of 50) in the semester-end examination (SEE).

Continuous Internal Evaluation (CIE):

CIE marks for the practical course is **50 Marks**.
The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.
Each experiment to be evaluated for conduction with observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.
Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
Total marks scored by the students are scaled downed to 30 marks (60% of maximum marks).
Weightage to be given for neatness and submission of record/write-up on time.
Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8th week of the semester and the second test shall be conducted after the 14th week of the semester.
In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
The suitable rubrics can be designed to evaluate each student's performance and learning ability. Rubrics suggested in Annexure-II of Regulation book
The average of 02 tests is scaled down to **20 marks** (40% of the maximum marks).
The Sum of scaled-down marks scored in the report write-up/journal and average marks of two tests is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

SEE marks for the practical course is 50 Marks.
SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University
All laboratory experiments are to be included for practical examination.
(Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.
Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.
Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.
General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)
Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.
The duration of SEE is 03 hours
Rubrics suggested in Annexure-II of Regulation book

Suggested Learning Resources:

"The 8051 Microcontroller: Hardware, Software and Applications", V Udayashankara and M S Mallikarjuna Swamy, McGraw Hill Education, 1st edition, 2017.

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IV Semester

C++ Basics			
Course Code	**21EC482**	CIE Marks	50
Teaching Hours/Week (L: T:P: S)	0:0:2:0	SEE Marks	50
Credits	1	Exam Hours	03

Course objectives:

- Understand object-oriented programming concepts, and apply them in solving problems.
- To create, debug and run simple C++ programs.
- Introduce the concepts of functions, friend functions, inheritance, polymorphism and function overloading.
- Introduce the concepts of exception handling and multithreading.

Sl.No	**Experiments**
1	Write a C++ program to find largest, smallest & second largest of three numbers using inline functions MAX & Min.
2	Write a C++ program to calculate the volume of different geometric shapes like cube, cylinder and sphere using function overloading concept.
3	Define a STUDENT class with USN, Name & Marks in 3 tests of a subject. Declare an array of 10 STUDENT objects. Using appropriate functions, find the average of the two better marks for each student. Print the USN, Name & the average marks of all the students.
4	Write a C++ program to create class called MATRIX using two-dimensional array of integers, by overloading the operator == which checks the compatibility of two matrices to be added and subtracted. Perform the addition and subtraction by overloading + and – operators respectively. Display the results by overloading the operator <<. If (m1 == m2) then m3 = m1 + m2 and m4 = m1 – m2 else display error
5	Demonstrate simple inheritance concept by creating a base class FATHER with data members: *First Name, Surname, DOB & bank Balance* and creating a derived class SON, which inherits: Surname & Bank Balance feature from base class but provides its own feature: First Name & DOB. Create & initialize F1 & S1 objects with appropriate constructors & display the FATHER & SON details.
6	Write a C++ program to define class name FATHER & SON that holds the income respectively. Calculate & display total income of a family using Friend function.
7	Write a C++ program to accept the student detail such as name & 3 different marks by get_data() method & display the name & average of marks using display() method. Define a friend function for calculating the average marks using the method mark_avg().
8	Write a C++ program to explain virtual function (Polymorphism) by creating a base class polygon which has virtual function areas two classes rectangle & triangle derived from polygon & they have area to calculate & return the area of rectangle & triangle respectively.
9	Design, develop and execute a program in C++ based on the following requirements: An EMPLOYEE class containing data members & members functions: i) Data members: employee number (an integer), Employee_ Name (a string of characters), Basic_ Salary (in integer), All_ Allowances (an integer), Net_Salary (an integer). (ii) Member functions: To read the data of an employee, to calculate Net_Salary & to print the values of all the data members. (All_Allowances = 123% of Basic, Income Tax (IT) =30% of gross salary (=basic_ Salary_All_Allowances_IT).
10	Write a C++ program with different class related through multiple inheritance & demonstrate the use of different access specified by means of members variables & members functions.
11	Write a C++ program to create three objects for a class named count object with data members

	such as roll_no & Name. Create a members function set_data ( ) for setting the data values & display ( ) member function to display which object has invoked it using „this" pointer.
12	Write a C++ program to implement exception handling with minimum 5 exceptions classes including two built in exceptions.

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

1. Write C++ program to solve simple and complex problems
2. Apply and implement major object-oriented concepts like message passing, function overloading, operator overloading and inheritance to solve real-world problems.
3. Use major C++ features such as Templates for data type independent designs and File I/O to deal with large data set.
4. Analyze, design and develop solutions to real-world problems applying OOP concepts of C++

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 35% (18 Marks out of 50) in the semester-end examination (SEE).

Continuous Internal Evaluation (CIE):

CIE marks for the practical course is **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment to be evaluated for conduction with observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled downed to 30 marks (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8th week of the semester and the second test shall be conducted after the 14th week of the semester.
- In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability. Rubrics suggested in Annexure-II of Regulation book
- The average of 02 tests is scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and average marks of two tests is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

SEE marks for the practical course is 50 Marks.

SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University

All laboratory experiments are to be included for practical examination.

(Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.

Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.

Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and

result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)
Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.
The duration of SEE is 03 hours

Rubrics suggested in Annexure-II of Regulation book

Suggested Learning Resources:

1. Object oriented programming in TURBO C++, Robert Lafore, Galgotia Publications, 2002
2. The Complete Reference C++, Herbert Schildt, 4th Edition, Tata McGraw Hill, 2003.
3. Object Oriented Programming with C++, E Balaguruswamy, 4th Edition, Tata McGraw Hill, 2006.

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IV Semester

Octave / Scilab for Signals			
Course Code	**21EC483**	CIE Marks	50
Teaching Hours/Week (L: T:P: S)	0:0:2:0	SEE Marks	50
Credits	1	Exam Hours	03

Course objectives:

1. **Preparation**: To prepare students with fundamental knowledge/ overview in the field of signals and processing.
2. **Core Competence**: To equip students with a basic foundation in electronic engineering and mathematics fundamentals required for comprehending the operation and application of signal processing.
3. **Professionalism & Learning Environment**: To inculcate in students an ethical and professional attitude by providing an academic environment inclusive of effective communication, teamwork, ability to relate engineering issues to a broader social context, and life-long learning needed for a successful professional career.

Sl.No	**Experiments**
1	Verify the Sampling theorem.
2	Determine linear convolution, Circular convolution and Correlation of two given sequences. Verify the result using theoretical computations.
3	Determine the linear convolution of two given point sequences using FFT algorithm. Verify the result using theoretical computations.
4	Determine the correlation using FFT algorithm. Verify the result using theoretical computations.
5	Determine the spectrum of the given sequence using FFT. Verify the result using theoretical computations.
6	Design and test FIR filter using Windowing method (Hamming, Hanning and Rectangular window) for the given order and cut-off frequency.
7	Design and test IIR Butterworth 1^{st} and 2^{nd} order low & high pass filter.
8	Design and test IIR Chebyshev 1^{st} and 2^{nd} order low & high pass filter.
9	Generation of an AM – Suppressed Carrier Wave & visualization of the time domain and frequency domain plots.
10	Generation and visualization of standard test signals (both continuous and discrete time).
11	Generation and visualization of audio signal (pre-recorded) and generation of echo.
12	Generation and visualization of the STFT of a chirp (and other related) signal.

Course outcomes (Course Skill Set):
At the end of the course the student will be able to:

- Demonstrate the DSP concepts on signal generation and sampling using Scilab/Octave
- Design and verify the computation of discrete signals using Scilab/Octave.
- Demonstrate and verify the application of FFT/DFT algorithm for a given signal using Scilab/Octave.
- Design and demonstrate programs to evaluate different types of low and high pass FIR filters using Scilab/Octave.
- Design, demonstrate and visualize different real world signals using Scilab/Octave programs.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 35% (18 Marks out of 50) in the semester-end examination (SEE).

Continuous Internal Evaluation (CIE):

CIE marks for the practical course is **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

Each experiment to be evaluated for conduction with observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.

Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.

Total marks scored by the students are scaled downed to 30 marks (60% of maximum marks).

Weightage to be given for neatness and submission of record/write-up on time.

Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8th week of the semester and the second test shall be conducted after the 14th week of the semester.

In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.

The suitable rubrics can be designed to evaluate each student's performance and learning ability. Rubrics suggested in Annexure-II of Regulation book

The average of 02 tests is scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and average marks of two tests is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

SEE marks for the practical course is 50 Marks.

SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University

All laboratory experiments are to be included for practical examination.

(Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.

Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.

Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)

Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.

The duration of SEE is 03 hours

Rubrics suggested in Annexure-II of Regulation book

Suggested Learning Resources:

Digital Signal Processing Using MATLAB, John G Proakis and Vinay K Ingle, Cengage Learning, 2011

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IV Semester

DAQ using LabVIEW			
Course Code	21EC484	CIE Marks	50
Teaching Hours/Week (L: T:P: S)	0:0:2:0	SEE Marks	50
Credits	1	Exam Hours	03

Course objectives:

- Process the knowledge of loop constructs.
- Fundamentals of graphical programming and use LabVIEW modules
- Implement 'Timing' functions.
- Input algebraic formulas via 'Formula Nodes' and 'Expression Nodes'.

Sl.No	**Experiments**
1	Data acquisition using LabVIEW for temperature measurement with thermocouple.
2	Data acquisition using LabVIEW for temperature measurement with AD590.
3	Data acquisition using LabVIEW for temperature measurement with RTD.
4	Data acquisition using LabVIEW for temperature measurement with Thermistor.
5	Creation of a CRO using LabVIEW and measurement of frequency and amplitude from external source.
6	Create function generator using LabVIEW and display the amplitude and frequency on CRO (externally connected)
7	Demonstrate amplitude modulation considering modulating and carrier wave from external source.
8	Interface LEDs to DAQ output and implement counter.
9	Data acquisition using LabVIEW for load / strain measurement using suitable transducers.
10	Demonstrate binary to grey code converter (& vice versa) using DAQ card.
11	Data acquisition using LabVIEW for distance/humidity measurement using suitable transducers.
12	Reading audio input with Microphones and output using DAQ card.

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

1. Build temperature indicating instruments using LabVIEW (NI DAQ)
2. Interface peripheral devices/instruments to LabVIEW
3. Build LabVIEW modules to sense and process audio inputs
4. Apply programming structures, data types, and the analysis and signal processing algorithms in LabVIEW
5. Debug and troubleshoot applications

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course.

The student has to secure not less than 35% (18 Marks out of 50) in the semester-end examination (SEE).

Continuous Internal Evaluation (CIE):

CIE marks for the practical course is **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment to be evaluated for conduction with observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled downed to 30 marks (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8th week of the semester and the second test shall be conducted after the 14th week of the semester.
- In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability. Rubrics suggested in Annexure-II of Regulation book
- The average of 02 tests is scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and average marks of two tests is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

SEE marks for the practical course is 50 Marks.

SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University

All laboratory experiments are to be included for practical examination.

(Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.

Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.

Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)

Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.

The duration of SEE is 03 hours

Rubrics suggested in Annexure-II of Regulation book

Suggested Learning Resources:

1. Virtual Instrumentation using LABVIEW, Jovitha Jerome, PHI, 2011
2. Virtual Instrumentation using LABVIEW, Sanjay Gupta, Joseph John, TMH, McGraw Hill, Second Edition, 2011.

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V Semester

Digital Communication			
Course Code	**21EC51**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	3:0:0:1	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course objectives:

- Understand the concept of signal processing of digital data and signal conversion to symbols at the transmitter and receiver.
- Compute performance metrics and parameters for symbol processing and recovery in ideal and corrupted channel conditions.
- Understand the principles of spread spectrum communications.
- Understand the basic principles of information theory and various source coding techniques.
- Build a comprehensive knowledge about various Source and Channel Coding techniques.
- Discuss the different types of errors and error detection and controlling codes used in the communication channel.
- Understand the concepts of convolution codes and analyze the code words using time domain and transform domain approach.

Teaching-Learning Process (General Instructions)

The sample strategies, which the teacher can use to accelerate the attainment of the various course outcomes are listed in the following:

1. Lecture method (L) does not mean only the traditional lecture method, but a different type of teaching method may be adopted to develop the outcomes.
2. Arrange visits to nearby PSUs such as BHEL, BEL, ISRO, etc., and small-scale communication industries.
3. Show Video/animation films to explain the functioning of various modulation techniques, Channel, and source coding.
4. Encourage collaborative (Group) Learning in the class
5. Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking
6. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize & analyze information rather than simply recall it.
7. Topics will be introduced in multiple representations.
8. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
9. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Digital Modulation Techniques: Phase shift Keying techniques using coherent detection: generation, detection and error probabilities of BPSK and QPSK, M–ary PSK, M–ary QAM. Frequency shift keying techniques using Coherent detection: BFSK generation, detection and error probability. Non coherent orthogonal modulation techniques: BFSK, DPSK Symbol representation, Block diagrams treatment of Transmitter and Receiver, Probability of error (without derivation of probability of error equation).

Teaching-Learning Process	Chalk and talk method, Simulation of modulation techniques, Power Point Presentation, YouTube videos Animation of BPSK, QPSK, BFSK and DPSK. Problems on Generation and detection of DPSK, QPSK. **Self-study topic**: Minimum shift keying and Non-coherent BFSK **RBT Level:** L1, L2, L3

Module-2	
Signalling Communication through Band Limited AWGN Channels: **Signalling over AWGN Channels**- Introduction, Geometric representation of signals, Gram- Schmidt Orthogonalization procedure, Conversion of the continuous AWGN channel into a vector channel (without statistical characterization), Optimum receivers using coherent detection: ML Decoding, Correlation receiver, matched filter receiver. **Signal design for Band limited Channels**: Design of band limited signals for zero lSI-The Nyquist Criterion (statement only), Design of band limited signals with controlled lSI-Partial Response signals, Probability of error for detection of Digital PAM: Symbol-by-Symbol detection of data with controlled lSI.	
Teaching-Learning Process	Chalk & talk method, PowerPoint Presentation, YouTube videos **Self-study topics**: Maximum Likelihood detection, Channel equalization **RBT Level:** L1, L2, L3
Module-3	
Principles of Spread Spectrum: Spread Spectrum Communication Systems: Model of a Spread Spectrum Digital Communication System, Direct Sequence Spread Spectrum Systems, Effect of De-spreading on a narrowband Interference, Probability of error (statement only), Some applications of DS Spread Spectrum Signals, Generation of PN Sequences, Frequency Hopped Spread Spectrum, CDMA based on IS-95.	
Teaching-Learning Process	Chalk & talk method, Seminar about security issues in communication systems **RBT Level:** L1, L2, L3
Module-4	
Introduction to Information Theory: Measure of information, Average information content of symbols in long independent sequences. **Source Coding:** Encoding of the Source Output, Shannon's Encoding Algorithm, Shannon-Fano Encoding Algorithm, Huffman coding. **Error Control Coding:** Introduction, Examples of Error control coding, methods of Controlling Errors, Types of Errors, types of Codes.	
Teaching-Learning Process	Chalk and talk method, Problems on source coding, error control codes **RBT Level:** L1, L2, L3
Module-5	
Linear Block Codes: Matrix description of Linear Block Codes, Error Detection & Correction capabilities of Linear Block Codes, Single error correction Hamming code, Table lookup Decoding using Standard Array. **Convolution codes:** Convolution Encoder, Time domain approach, Transform domain approach, Code Tree, Trellis and State Diagram.	
Teaching-Learning Process	Chalk and talk method, Animation of convolution encoders **RBT Level:** L1, L2, L3
Course outcomes (Course Skill Set) At the end of the course the student will be able to: 1. Analyze different digital modulation techniques and choose the appropriate modulation technique for the given specifications. 2. Test and validate symbol processing and performance parameters at the receiver under ideal and corrupted bandlimited channels. 3. Differentiate various spread spectrum schemes and compute the performance parameters of communication system. 4. Apply the fundamentals of information theory and perform source coding for given message 5. Apply different encoding and decoding techniques with error Detection and Correction.	
Assessment Details (both CIE and SEE)	

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module. Marks scored out of 100 shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Text Books:

1. Simon Haykin, "Digital Communication Systems", John Wiley & sons, First Edition, 2014, ISBN 978-0-471-64735-5.
2. John G Proakis and Masoud Salehi, "Fundamentals of Communication Systems", 2014 Edition, Pearson Education, ISBN 978-8-131-70573-5.
3. K Sam Shanmugam, "Digital and analog communication systems", John Wiley India Pvt. Ltd, 1996.
4. Hari Bhat, Ganesh Rao, "Information Theory and Coding", Cengage, 2017.
5. Todd K Moon, "Error Correction Coding", Wiley Std. Edition, 2006.

Reference Books:

1. Bernard Sklar, "Digital Communications – Fundamentals and Applications", Second Edition, Pearson Education, 2016, ISBN: 9780134724058.
2. K Sam Shanmugam, "Digital and analog communication systems", John Wiley India Pvt. Ltd, 1996.

Web links and Video Lectures (e-Resources)

- https://nptel.ac.in/courses/108102096

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI
B.E: Electronics & Communication Engineering / B.E: Electronics & Telecommunication Engineering
NEP, Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
(Effective from the academic year 2021 – 22)

V Semester

Object Oriented Programming with Java & Data Structures			
Course Code	**21EC52**	CIE Marks	50
Teaching Hours/Week (L: T: P: S)	(3:0:2:0)	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 13 Lab slots	Total Marks	100
Credits	04	Exam Hours	03

Course objectives:

The goal of the course 'Object Oriented Programming with Java & Data Structures' is

1. To make students learn fundamentals features of object oriented language and JAVA
2. To set up a Java JDK environment to create, debug and run simple Java programs.
3. To Illustrate linear representation of data structures: Stack, Queues, Lists.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. In addition to the traditional lecture method, different types of innovative teaching methods may be adopted so that the delivered lessons shall develop student's theoretical and programming skills.
2. State the need for learning Programming with real-life examples.
3. Support and guide the students for self–study.
4. You will also be responsible for assigning homework, grading assignments and quizzes, and documenting students' progress.
5. Encourage the students for group learning to improve their creative and analytical skills.
6. Show short related video lectures in the following ways:
   - As an introduction to new topics (pre-lecture activity).
   - As a revision of topics (post-lecture activity).
   - As additional examples (post-lecture activity).
   - As an additional material of challenging topics (pre-and post-lecture activity).
   - As a model solution of some exercises (post-lecture activity).

Module-1: Introduction to JAVA

An Overview of Java: Object-Oriented Programming, A First Simple program,

Data types, Variables and arrays: Primitive types, Booleans, A Closer Look at Literals, Variables, Type conversion and casting, Arrays,

Introducing Classes: Class fundamentals, Declaring objects, Assigning Object Reference Variables, Introducing Methods, Constructors, The this keyword, Garbage collection, The finalize() method, A stack class.

TextBook 1: Ch: 2, Ch: 3, Ch: 6

Teaching-Learning Process	Chalk and Talk, PowerPoint Presentation **RBT Level:** L1, L2, L3

Module-2: OOP in JAVA

A Closer Look at Methods and classes: Overloading methods, Using objects as parameters, Returning objects, Access control, static members, final members, Command LIne Arguments, String Class.
Inheritance Basics: Member access and Inheritance, A Superclass Variable can reference a subclass object, Using Super, Creating a Multilevel Hierarchy, When Constructors are called.

Text Book 1: Ch: 7

Teaching-Learning	Chalk and Talk, PowerPoint Presentation

Process	**RBT Level:** L1, L2, L3
Module-3: Inheritance and Exception Handling	
Java Collection Framework: Inheritance Hierarchy, Collection interface, The HashSet Class, Generic Collections, Generic methods, Generic Wildcards. Iterators, TreeSet class, LinkedHashset Class, EnumSet Class, List Interface, ArrayList and Vector classes, Linked class, ListIterator interface. Text Book 2: Ch: 4	
Teaching-Learning Process	Chalk and Talk, PowerPoint Presentation **RBT Level:** L1, L2, L3
Module-4: Stack, Queues, Linked data structures	
Stacks: Stack operations, JCF Stack class, A stack interface, An indexed implementation, A linked implementation, Abstracting the common code, Queues: Queue operations, JCF Queue Interface, A simple queue interface, An indexed implementation, Application: A Client-Server system. Text Book 2: Ch: 5, Ch: 6	
Teaching-Learning Process	Chalk and Talk, PowerPoint Presentation **RBT Level:** L1, L2, L3
Module-5: Lists, Trees, Binary Tree	
Lists: JCF list interface, Range-view operation sublist( ), List iterators, Other List types. Tree: Tree definitions, Decision trees, Ordered trees, Traversal algorithms Binary Tree: Definitions, Full binary trees, Complete Binary trees, Binary tree traversal algorithms, Expression tree. Text Book 2: Ch: 7, Ch: 10, Ch: 11	
Teaching-Learning Process	Chalk and Talk, PowerPoint Presentation **RBT Level:** L1, L2, L3

PRACTICAL COMPONENT OF IPCC	
Sl.No	**Experiments**
1	Use Eclipse or NetBeans IDE and acquaint with the various menus. Create a test project, add a test class, and run it. Try debug step by step with a small program of about 10 to 15 lines which contains at least one if else condition and a for loop. To include suitable Small Java programs.
2	Design a class to represent a Student (details include the Student ID, Name of the Student, Branch, year, location and college). Assign initial values using constructor. Design a sub-class with methods to accept the marks & attendance and hence calculate average of marks of 6 subjects and attendance percentage.
3	Write a recursive and non recursive Java program to implement i) Linear search ii) Binary search
4	Write a Java program to implement i) Bubble sort ii) Selection sort iii) quick sort iv) insertion sort
5	Write a Java program to generate 'N' Fibonacci numbers using recursive and non-recursive methods.
6	Write a menu-driven Java program to implement the following data structures using an array: a)Stack ADT (b) Queue ADT
7	Write a menu-driven Java program to implement the following operations on Singly Linked List (SLL): a) Create a SLL of integers. b) Insert a given integer from SLL. c) Delete a given integer into SLL. d) Display the contents of SLL.
8	Write a Java program to perform the following operations:

	a) Insert an element into a Binary Search Tree (BST). b) Delete an element from a BST. c) Search for a key element in a BST d) Traverse the BST in pre-order, in-order & post-order.
9	Write a java program to demonstrate method overloading and constructors overloading.
10	Write a Java programs to implement the following using a singly linked list and perform the given operations. a) Stack ADT i) push an element into stack ii) pop an element from the stack iii) display the contents of the stack
11	Write a Java programs to implement the following using a singly linked list and perform the given operations. b) Queue ADT i) insert an element into queue ii) delete an element from the queue iii) display the contents of the queue
12	Write a java program that works as a simple calculator. Use a Grid Layout to arrange Buttons for digits and for the + - * % operations. Add a text field to display the result. Handle any possible exceptions like divide by zero.

Course Outcomes

At the end of the course the student will be able to:

1. Use OOP concepts effectively to build simple application programs.
2. Set up a Java JDK environment to create, debug and run simple java programs
3. Explain and implement the object oriented core-concepts such as class, object, inheritance and exception handling using JAVA.
4. Implement the data structures such as Arrays, Lists, Stack, Queue and Trees using Java
5. Make a decision on choosing a suitable data structure for a specific application program.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

CIE for the theory component of IPCC

Two Tests each of **20 Marks (duration 01 hour**)

- First test at the end of 5th week of the semester
- Second test at the end of the 10th week of the semester

Two assignments each of **10 Marks**

- First assignment at the end of 4th week of the semester
- Second assignment at the end of 9th week of the semester

Scaled-down marks of two tests and two assignments added will be CIE marks for the theory component of IPCC for **30 marks**.

CIE for the practical component of IPCC

- On completion of every experiment/program in the laboratory, the students shall be evaluated and marks shall be awarded on the same day. The **15 marks** are for conducting the experiment and preparation of the laboratory record, the other **05 marks shall be for the test** conducted at the end of the semester.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks.

Marks of all experiments' write-ups are added and scaled down to 15 marks.

- The laboratory test **(duration 03 hours)** at the end of the 15th week of the semester /after completion of all the experiments (whichever is early) shall be conducted for 50 marks and scaled down to 05 marks**.**

Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **20 marks**.

SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (duration 03 hours)

- The question paper will have ten questions. Each question is set for 20 marks.
- There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
- The students have to answer 5 full questions, selecting one full question from each module.

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper shall include questions from the practical component.

- The minimum marks to be secured in CIE to appear for SEE shall be the 12 (40% of maximum marks-30) in the theory component and 08 (40% of maximum marks -20) in the practical component. The laboratory component of the IPCC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be included**.** The maximum of 04/05 questions to be set from the practical component of IPCC, the total marks of all questions should not be more than the 20 marks.

SEE will be conducted for 100 marks and students shall secure 35% of the maximum marks to qualify in the SEE. Marks secured will be scaled down to 50.

Suggested Learning Resources:

Text Books

1. "JAVA The Complete Reference", Herbert Schildt, 7th Edition, Tata McGraw Hill, 2007.
2. "Data Structures with Java", John R Hubbard, 2nd edition, Schaum's Outlines.

Reference Books

1. "Fundamentals of OOP and Data Structures in Java", Richard Wiener, Lewis J Pinson, Cambridge University Press, 2000.
2. "Object Oriented Programming and Java", Danny Poo, Derek Kion, Swarnalatha Ashok, Springer, 2nd edition, 2007.
3. "Java Fundamentals", Herbert Schildt, Dale Skrien, McGraw Hill Education, 2017.
4. "Data Structures and Algorithms Made Easy in JAVA: Data Structure and Algorithmic Puzzles", Narasimha Karumanchi, CareerMonk Publications, Second edition, 2011.
5. "Data Structures & Algorithms in Java", Goodrich, Tamassia, Goldwasser, Universities Press; Second edition, 2005.

Web links and Video Lectures (e-Resources):

- VTU e-Shikshana Program
- VTU EDUSAT Program
- https://www.youtube.com/watch?v=CFD9EFcNZTQ
- https://www.youtube.com/watch?v=grEKMHGYyns

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

Quizzes, Assignments, Seminars

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V Semester

Computer Communication Networks			
Course Code	**21EC53**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	3:0:0:1	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course objectives: This course will enable students to:

1. Understand the layering architecture of OSI reference model and TCP/IP protocol suite.
2. Understand the protocols associated with each layer.
3. Learn the different networking architectures and their representations.
4. Learn the functions and services associated with each layer.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecture method (L): the traditional lecture method, or a different type of teaching method may be adopted to develop the outcomes.
2. Show Video/animation films to explain the functioning of various concepts in networking.
3. Encourage collaborative (Group) Learning in the class.
4. Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking .
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
6. Demonstrate implementation of various protocols to help better understand the functioning of various concepts in networking.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Introduction: Data communication: Components, Data representation, Data flow, Networks: Network criteria, Physical Structures, Network types: LAN, WAN, Switching, The Internet. (1.1,1.2, 1.3 (1.3.1to 1.3.4 of Text).

Network Models: TCP/IP Protocol Suite: Layered Architecture, Layers in TCP/IP suite, Description of layers, Encapsulation and Decapsulation, Addressing, Multiplexing and Demultiplexing, The OSI Model: OSI Versus TCP/IP. (2.2, 2.3 of Text)

Data-Link Layer: Introduction: Nodes and Links, Services, Two Categories' of link, Sublayers, Link Layer addressing: Types of addresses, ARP (9.1, 9.2 (9.2.1, 9.2.2))

Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, YouTube videos, Animation of OSI and TCP-IP protocol suites, Example of ARP and RARP. **Self-Study**: Internet standards and administration, **RBT Level:** L1, L2, L3

Module-2

Data Link Control (DLC) services: Framing, Flow and Error Control. (11.1 of Text)

Media Access Control: Random Access: ALOHA, CSMA, CSMA/CD, CSMA/CA. (12.1 of Text).

Connecting Devices: Hubs, Switches, Virtual LANs: Membership, Configuration, Communication between Switches, Advantages. (17.1,17.2 of text)

Wired and Wireless LANs: Ethernet Protocol, Standard Ethernet. (13.1, 13.2 (13.2.1 to 13.2.5 of Text)

Introduction to wireless LAN: Architectural Comparison, Characteristics, Access Control. (15.1 of Text)	
Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, YouTube videos, Animations showing Framing, CSMA, Connecting devices, Problems on ALOHA, CSMA, Framing and Standard ethernet. **Self-Study**: Fast Ethernet, Gigabit ethernet & IEEE802.11 wireless LANs **RBT Level:** L1, L2, L3

Module-3

Network Layer: Introduction, Network Layer services: Packetizing, Routing and Forwarding, Other services, Packet Switching: Datagram Approach, Virtual Circuit Approach, IPV4 Addresses: Address Space, Classful Addressing, Classless Addressing, DHCP, Network Address Resolution (18.1(excluding 18.1.3), 18.2, 18.4 of Text)
Network Layer Protocols: Internet Protocol (IP): Datagram Format, Fragmentation, Options, Security of IPv4 Datagrams. (19.1of Text), IPv6 addressing and Protocol (22.1 and 22.2).
Unicast Routing: Introduction, Routing Algorithms: Distance Vector Routing, Link State Routing, Path vector routing. (20.1, 20.2 of Text)

Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, YouTube videos, Animation of DHCP, routing protocols, Numericals on Addressing, **Self-Study**: Network Layer performance, RIP, OSPF **RBT Level:** L1, L2, L3

Module-4

Transport Layer: Introduction: Transport Layer Services, Connectionless and Connection oriented Protocols, Transport Layer Protocols: Simple protocol, Stop and wait protocol, Go-BackN Protocol, Selective repeat protocol, Piggybacking (23.1, 23.2.1, 23.2.2, 23.2.3, 23.2.4, 23.2.5 of Text)

Transport-Layer Protocols in the Internet: User Datagram Protocol: User Datagram, UDP Services, UDP Applications, Transmission Control L1, L2, L3 Protocol: TCP Services, TCP Features, Segment, Connection, State Transition diagram, Windows in TCP, Error control, TCP congestion control. (24.2, 24.3.1, 24.3.2, 24.3.3, 24.3.4, 24.3.6, 24.3.8, 24.3.9 of Text)

***Note: Exclude FSMs for CIE and SEE**

Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, YouTube videos, Animation/Implementation of Flow control protocols and TCP using simulators, **Self-Study**: Flow Control in TCP **RBT Level:** L1, L2, L3

Module-5

Application Layer: Introduction: providing services, Application- layer paradigms, Standard Client – Server Protocols: Hyper Text Transfer Protocol, FTP: Two connections, Control Connection, Data Connection, Electronic Mail: Architecture, Domain Name system: Name space, DNS in internet, Resolution, DNS Messages, Registrars, DDNS, security of DNS. (25.1, 26.1.2, 26.2, 26.3, 26.6 of Text)
Quality of Service (30.1, 30.2.) Network Security (31.1)

Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, YouTube videos, Animation/Implementation of HTTP, FTP, DNS using network simulators, **Self Study**: WWW , TELNET **RBT Level:** L1, L2, L3

Course outcomes (Course Skill Set)

At the end of the course the student will be able to:

1. Understand the concepts of networking thoroughly.
2. Identify the protocols and services of different layers.
3. Distinguish the basic network configurations and standards associated with each network.
4. Discuss and analyse the various applications that can be implemented on networks.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end

examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module. Marks scored out of 100 shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Text Books:

Forouzan, "Data Communications and Networking", 5th Edition, McGraw Hill, 2013, ISBN: 1-25-906475-3.

Reference Books:

1. James J Kurose, Keith W Ross, "Computer Networks", Pearson Education.
2. Wayne Tomasi, "Introduction to Data Communication and Networking", Pearson India, 1st edition.
3. Andrew Tannenbaum, "Computer Networks", Prentice Hall.
4. William Stallings, "Data and Computer Communications", Prentice Hall.

Web links and Video Lectures (e-Resources)

- https://nptel.ac.in/courses/106105183.
- TCP/IP Tutorial and Technical Overview, (IBM Redbook) - Download From http://www.redbooks.ibm.com/abstracts/gg243376.html
- TCP/IP Guide, Charles M Kozierok, Available Online - http://www.tcpipguide.com/
- Request for Comments (RFC) - IETF - http://www.ietf.org/rfc.html
- https://cosmolearning.org/courses/computer-networks-524/video-lectures/
- https://www.eecis.udel.edu/~bohacek/videoLectures/ComputerNetworking/ComputerNetworking_v2.html

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Implementation of simple networks and various networking protocols and algorithms using simulators like NCTUns / CISCO packet tracer and measurement of various parameters using WireShark
- Implementation of simple networks and various networking protocols and algorithms in C/C++/Python

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V Semester

Microwave Theory and Antennas			
Course Code	**21EC54**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	3:0:0:1	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course objectives: This course will enable students to :

- Describe the microwave properties and its transmission media.
- Describe the microwave devices for several applications.
- Understand the basic concepts of antenna theory.
- Identify antenna types for specific applications.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Using videos for demonstration of the fundamental principles to students for better understanding of concepts.
2. Demonstration of microwave devices and Antennas in the lab environment where students can study them in real time.

Module-1

Microwave Sources: Introduction, Gunn Diode (Text 2: 7.1,7.1.1,7.1.2)

Microwave transmission lines: Microwave frequencies, Microwave devices, Microwave systems. Transmission line equations and solutions, Reflection Coefficient and Transmission Coefficient. Standing wave and standing wave ratio. Smith chart, Single stub matching.

Text 2: 0.1, 0.2, 0.3, 3.1, 3.2, 3.3, 3.5, 3.6 (except double stub matching)

Teaching-Learning Process	Chalk and Talk would be helpful for the quantitative analysis. Videos of the Basic principles of the devices would help students to grasp better. **RBT Level:** L1, L2, L3

Module-2

Microwave Network Theory: Introduction, S matrix representation of multi-port networks (Text 1: 6.1, 6.3, 6.3.1, 6.3.2)

Microwave passive devices: Coaxial connectors and Adapters, Attenuators, Phase shifters, waveguide Tees, Magic Tee, Circulator, Isolator. (Text 1: 6.4.2, 6.4.14, 6.4.15, 6.4.16, 6.4.17 A, B)

Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2, L3

Module-3

Strip Lines: Introduction, Microstrip lines, Parallel Strip lines (Text 2: 11.1,11.2)

Antenna Basics: Introduction, Basic Antenna Parameters, Patterns, Beam Area, Radiation Intensity, Beam efficiency, Directivity and Gain, Antenna Aperture Effective height, Bandwidth, Radio communication Link, Antenna Field Zones (Text 3: 2.1-2.7, 2.9-2.11, 2.13).

Teaching-Learning Process	Chalk and talk method, Power point presentation and videos. **RBT Level:** L1, L2, L3

Module-4	
Point sources and arrays: Introduction, Point Sources, Power patterns, Power theorem, Radiation Intensity, Arrays of 2 isotropic point sources, Pattern multiplication, Linear arrays of n Isotropic sources of equal amplitude and Spacing. (Text 3: 5.1-5.6, 5.9, 5.13) **Electric Dipole**: Introduction, Short Electric dipole, Fields of a short dipole. Radiation resistance of a short dipole. Thin linear antenna (field analysis). (Text 3: 6.1-6.5)	
Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2, L3
Module-5	
Loop and Horn antenna: Introduction: Small loop, Comparison of far fields of small loop and Short dipole. Radiation resistance of small loop, Horn Antennas, Rectangular antennas. (Text 3: 7.1,7.2, 7.4, 7.6, 7.7, 7.8, 7.19, 7.20) **Antenna Types**: The Helix geometry, Helix modes, Practical design consideration for mono-filar axial mode Helical Antenna, Yagi Uda array, Parabolic Reflector (Text 3: 8.3, 8.4, 8.5, 8.8, 9.5)	
Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2, L3

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

1. Describe the use and advantages of microwave transmission
2. Analyze various parameters related to transmission lines.
3. Identify microwave devices for several applications.
4. Analyze various antenna parameters and their significance in building the RF system.
5. Identify various antenna configurations for suitable applications.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per

the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module. Marks scored out of 100 shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Text Books:

1. Microwave Engineering -Annapurna Das, Sisir K Das, TMH Publication, 2nd Edition, 2010.
2. Microwave Devices and Circuits – Samuel Y Liao, Pearson Education.
3. Antennas and Wave Propagation -John D Krauss, Ronald J Marhefka, Ahmad S Khan, 4th Edition, McGraw Hill Education, 2013.

Reference Books:

1. Microwave Engineering -David M Pozar, John Wiley India Pvt Ltd., Pvt Ltd., 3rd edition, 2008.
2. Microwave Engineering-Sushrut Das, Oxford Higher Education, 2nd Edn, 2015.
3. Antennas and Wave Propagation- Harish and Sachidananda, Oxford University Press, 2007.

Web links and Video Lectures (e-Resources)

- Nptel Videos and Lectures
- https://www.tutorialspoint.com/antenna_theory/antenna_theory_horn.html
- http://www.antenna-theory.com/antennas/smallLoop.php

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Lab based demos for the devices can be done in the form of experiments.
- Mini Projects can be given to students involving design of microwave devices and Antennas.

03.10.2022

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI
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(Effective from the academic year 2021 – 22)

V Semester

Communication Lab II			
Course Code	**21ECL55**	CIE Marks	50
Teaching Hours/Week (L: T: P: S)	0:0:2:0	SEE Marks	50
Credits	1	Exam Hours	3

Course objectives:

This laboratory course enables students to

- Design and demonstrate communication circuits for different digital modulation techniques.
- To simulate Source coding Algorithms using C/C++/ MATLAB code.
- To simulate Error correcting and detecting codes using C/C++/ MATLAB code.
- Simulate the networking concepts and protocols using C/C++/ Network simulation tool.
- Understand entropies and mutual information of different communication channels.

Sl.No.	**Experiments**
	Implement the following using discrete components
1	FSK generation and detection
2	PSK generation and detection
3	DPSK Transmitter and receiver
4	QPSK Transmitter and Receiver
	Implement the following in C/C++/MATLAB/Scilab/Python or any other Suitable software
5	Write a program to encode binary data using Huffman code and decode it.
6	Write a program to encode binary data using a (7,4) Hamming code and decode it.
7	Write a program to encode binary data using a ((3,1,2)/suitably designed) Convolution code and decode it.
8	For a given data, use CRC-CCITT polynomial to obtain the CRC code. Verify the program for the cases a) Without error b) With error
	Implement the following algorithms in C/C++/MATLAB/Network simulator
9	Write a program for congestion control using leaky bucket algorithm.
10	Write a program for distance vector algorithm to find suitable path for transmission.
11	Write a program for flow control using sliding window protocols.
12	Configure a simple network (Bus/star) topology using simulation software **OR** Configure a simple network (Ring/Mesh) topology using simulation software.
	Demonstration Experiments (For CIE)
13	Configure and simulate simple Wireless Local Area network.
14	Simulate the BER performance of (2, 1, 3) binary convolutional code with generator sequences g(1) =(1 0 1 1) and g(2) =(1 1 1 1) on AWGN channel. Use QPSK modulation scheme. Channel decoding is to be performed through Viterbi decoding. Plot the bit error rate versus SNR (dB), i.e. $P_{e,b}$ versus E_b/N_0. Consider binary input vector of size 3 lakh bits. Also find the coding gain.
15	Simulate the BER performance of (7, 4) Hamming code on AWGN channel. Use QPSK modulation

	scheme. Channel decoding is to be performed through maximum-likelihood decoding. Plot the bit error rate versus SNR (dB), i.e. $P_{e,b}$ versus E_b/N_0. Consider binary input vector of size 5 lakh bits. Use the following parity check matrix for the (7, 4) Hamming code. Also find the coding gain. $$H = \begin{bmatrix} 1 & 0 & 0 & 1 & 1 & 1 & 0 \\ 0 & 1 & 0 & 0 & 1 & 1 & 1 \\ 0 & 0 & 1 & 1 & 1 & 0 & 1 \end{bmatrix}$$
16	Simulate the BER performance of rate 1/3 Turbo code. Turbo encoder uses two recursive systematic encoders with $G(D) = \left[1, \frac{1+D^4}{1+D+D^2+D^3+D^4}\right]$ and pseudo-random interleaver. Use QPSK modulation scheme. Channel decoding is to be performed through maximum a-posteriori (MAP) decoding algorithm. Plot the bit error rate versus SNR (dB), i.e. $P_{e,b}$ versus E_b/N_0. Consider binary input vector of size of around 3 lakh bits and the block length as 10384 bits. Also find the coding gain.

Course outcomes (Course Skill Set):

On the completion of this laboratory course, the students will be able to:

1. Design and test the digital modulation circuits and display the waveforms.
2. To Implement the source coding algorithm using C/C++/ MATLAB code.
3. To Implement the Error Control coding algorithms using C/C++/ MATLAB code.
4. Illustrate the operations of networking concepts and protocols using C programming and network simulators.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 35% (18 Marks out of 50) in the semester-end examination (SEE).

Continuous Internal Evaluation (CIE):

CIE marks for the practical course is **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment to be evaluated for conduction with observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled downed to 30 marks (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8th week of the semester and the second test shall be conducted after the 14th week of the semester.
- In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability. Rubrics suggested in Annexure-II of Regulation book
- The average of 02 tests is scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and average marks of two tests is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

SEE marks for the practical course is 50 Marks.

SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by

the University

All laboratory experiments are to be included for practical examination.

(Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.

Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.

Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners).

Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.

The duration of SEE is 03 hours.

Rubrics suggested in Annexure-II of Regulation book

Suggested Learning Resources:

1. Simon Haykin, "Digital Communication Systems", John Wiley & sons, First Edition, 2014, ISBN 978-0-471-64735-5.
2. K Sam Shanmugam, "Digital and analog communication systems", John Wiley India Pvt. Ltd, 1996.
3. Forouzan, "Data Communications and Networking", 5th Edition, McGraw Hill, 2013, ISBN: 1-25-906475-3.

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V Semester

IoT (Internet of Things) Lab			
Course Code	21EC581	CIE Marks	50
Teaching Hours/Week (L: T:P: S)	0:0:2:0	SEE Marks	50
Credits	1	Exam Hours	03

Course objectives:

- To impart necessary and practical knowledge of components of Internet of Things
- To develop skills required to build real-life IoT based projects.

Sl.No	**Experiments**
1	i) To interface LED/Buzzer with Arduino/Raspberry Pi and write a program to 'turn ON' LED for 1 sec after every 2 seconds. ii) To interface Push button/Digital sensor (IR/LDR) with Arduino/Raspberry Pi and write a program to 'turn ON' LED when push button is pressed or at sensor detection.
2	i) To interface DHT11 sensor with Arduino/Raspberry Pi and write a program to print temperature and humidity readings. ii) To interface OLED with Arduino/Raspberry Pi and write a program to print temperature and humidity readings on it.
3	To interface motor using relay with Arduino/Raspberry Pi and write a program to 'turn ON' motor when push button is pressed.
4	To interface Bluetooth with Arduino/Raspberry Pi and write a program to send sensor data to smartphone using Bluetooth.
5	To interface Bluetooth with Arduino/Raspberry Pi and write a program to turn LED ON/OFF when '1'/'0' is received from smartphone using Bluetooth.
6	Write a program on Arduino/Raspberry Pi to upload temperature and humidity data to thingspeak cloud.
7	Write a program on Arduino/Raspberry Pi to retrieve temperature and humidity data from thingspeak cloud.
8	To install MySQL database on Raspberry Pi and perform basic SQL queries.
9	Write a program on Arduino/Raspberry Pi to publish temperature data to MQTT broker.
10	Write a program to create UDP server on Arduino/Raspberry Pi and respond with humidity data to UDP client when requested.
11	Write a program to create TCP server on Arduino/Raspberry Pi and respond with humidity data to TCP client when requested.
12	Write a program on Arduino/Raspberry Pi to subscribe to MQTT broker for temperature data and print it.

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

1. Understand internet of Things and its hardware and software components
2. Interface I/O devices, sensors & communication modules
3. Remotely monitor data and control devices
4. Develop real life IoT based projects

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 35% (18 Marks out of 50) in the semester-end examination (SEE).

Continuous Internal Evaluation (CIE):

CIE marks for the practical course is **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment to be evaluated for conduction with observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled downed to 30 marks (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8th week of the semester and the second test shall be conducted after the 14th week of the semester.
- In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability. Rubrics suggested in Annexure-II of Regulation book
- The average of 02 tests is scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and average marks of two tests is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

SEE marks for the practical course is 50 Marks.

SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University

All laboratory experiments are to be included for practical examination.

(Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.

Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.

Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)

Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.

The duration of SEE is 03 hours

Rubrics suggested in Annexure-II of Regulation book

Suggested Learning Resources:

1. Vijay Madisetti, Arshdeep Bahga, Internet of Things. "A Hands on Approach", University Press
2. Dr. SRN Reddy, Rachit Thukral and Manasi Mishra, "Introduction to Internet of Things: A practical Approach", ETI Labs
3. Pethuru Raj and Anupama C Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press
4. Jeeva Jose, "Internet of Things", Khanna Publishing House, Delhi
5. Adrian McEwen, "Designing the Internet of Things", Wiley
6. Raj Kamal, "Internet of Things: Architecture and Design", McGraw Hill

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V Semester

Communication Simulink Toolbox			
Course Code	**21EC582**	CIE Marks	50
Teaching Hours/Week (L: T:P: S)	0:0:2:0	SEE Marks	50
Credits	1	Exam Hours	03

Course objectives:

- To impart knowledge of simulation software in digital communications
- To develop skills required to build and analyze the performance of various simulated communication systems under different conditions

Sl. No.	Experiments
1	Modulation & demodulation of a random binary data stream using 16 – QAM.
2	Bit error rate (BER) improvement using Pulse Shaping on 16 – QAM signal. (Use forward error correction (FEC) coding.)
3	Perform OFDM modulation and obtain time domain and frequency domain plots to show a low-rate signal, a high-rate signal, and a frequency selective multipath channel response.
4	(a) Simulate basic OFDM with no cyclic prefix. (b) Perform Equalization, Convolution, and Cyclic Prefix Addition on basic OFDM.
5	OFDM with FFT Based Oversampling - Modify an OFDM+ Cyclic Prefix signal to efficiently output an oversampled waveform from the OFDM modulator.
6	Simulate a basic communication system in which the signal is first QPSK modulated and then subjected to Orthogonal Frequency Division Multiplexing (OFDM).
7	Obtain the scatter plots & eye diagrams of a QPSK signal to visualize the signal behaviour in presence of AWGN.
8	(a) Generate a multiband signal using the Communications Toolbox. (b) Random noise generation using Simulink & display histogram plots of Gaussian, Rayleigh, Rician, and Uniform noise.
9	QPSK Transmitter and Receiver in Simulink.
10	Multipath Fading Channel in Simulink – For example: Simulate QPSK transmission over a • multipath Rayleigh fading channel and • a multipath Rician fading channel.
11	Adjacent and Co-Channel Interference using Simulink. • Use PSK-modulated signals to show the effects of adjacent and co-channel interference on a transmitted signal.
12	Modulation Classification with Deep Learning • Predict Modulation Type Using CNN

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

1. Perform sampling, aliasing, filtering, and quadrature modulation through simulation.
2. Plot signal space representation of digital modulation techniques.
3. Design and implement a pulse shape and matched filter to avoid inter-symbol interference and maximize receiver SNR.
4. Demonstrate advanced wireless communication techniques like Multipath fading, CCI etc. and model the same using MATLAB / Simulink.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course.

The student has to secure not less than 35% (18 Marks out of 50) in the semester-end examination (SEE).

Continuous Internal Evaluation (CIE):

CIE marks for the practical course is **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment to be evaluated for conduction with observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled downed to 30 marks (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8th week of the semester and the second test shall be conducted after the 14th week of the semester.
- In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability. Rubrics suggested in Annexure-II of Regulation book
- The average of 02 tests is scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and average marks of two tests is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

SEE marks for the practical course is 50 Marks.

SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University

All laboratory experiments are to be included for practical examination.

(Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.

Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.

Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)

Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.

The duration of SEE is 03 hours

Rubrics suggested in Annexure-II of Regulation book

Suggested Learning Resources:

1. Communication Toolbox – Examples (https://in.mathworks.com/)
2. "Digital Communication Laboratory" Courseware by Professor Lee C Potter, Dr. Yang Yang, Electrical and Computer Engineering, The Ohio State University.

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V Semester

Antenna Design & Testing			
Course Code	**21EC583**	CIE Marks	50
Teaching Hours/Week (L: T:P: S)	0:0: 2 :0	SEE Marks	50
Credits	1	Exam Hours	03

Course objectives:

- To understand the various antenna parameters.
- Conduct experiments to study the Radiation pattern of Antennas.
- Design different types of antenna arrays and study the pattern characteristics (MATLAB)
- Design of MMIC antennas like Patch Antenna and study the characteristics.

Sl.No	**Experiments**
1	To obtain the radiation pattern of a Yagi-Uda Antenna array and calculate its directivity.
2	To obtain the radiation pattern of a Dipole Antenna array and calculate its directivity.
3	To calculate the aperture of a Dipole Antenna.
4	To obtain the near and far fields of a given antenna and compare the fields.
5	To obtain the Radiation pattern of a microstrip antenna.
6	To obtain the resonant frequency of a Yagi-Uda /Dipole antenna.
7	To obtain the bandwidth of a given Antenna.
8	Plot 2-D and 3-D radiation pattern of omnidirectional antenna using MATLAB.
9	Design and implementation of a broadside array using MATLAB.
10	Design and implementation of an endfire array using MATLAB.
Demonstration Experiments (For CIE)	
11	Design of a Patch Antenna using HFSS Software.
12	Design of a dipole Antenna using HFSS Software.

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

1. Analyze the radiation pattern and characteristics of antenna
2. Ability to design various antenna
3. Ability to use different software tools to study antenna characteristics
4. Analyze radiation pattern of linear array antennas

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 35% (18 Marks out of 50) in the semester-end examination (SEE).

Continuous Internal Evaluation (CIE):

CIE marks for the practical course is **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment to be evaluated for conduction with observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning

of the practical session.

- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled downed to 30 marks (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8th week of the semester and the second test shall be conducted after the 14th week of the semester.
- In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability. Rubrics suggested in Annexure-II of Regulation book
- The average of 02 tests is scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and average marks of two tests is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

SEE marks for the practical course is 50 Marks.

SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University

All laboratory experiments are to be included for practical examination.

(Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.

Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.

Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)

Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.

The duration of SEE is 03 hours

Rubrics suggested in Annexure-II of Regulation book

Suggested Learning Resources:

1. Antennas and Wave Propagation -John D Krauss, Ronald J Marhefka, Ahmad S Khan, 4th Edition, McGraw Hill Education, 2013.
2. https://www.mathworks.com/help/antenna/
3. Help and demo files of the HFSS and MATLAB software

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V Semester

Microwaves Toolbox			
Course Code	**21EC584**	CIE Marks	50
Teaching Hours/Week (L: T:P: S)	0:0:2:0	SEE Marks	50
Credits	1	Exam Hours	03

Course objectives:

- Identification of microwave components/devices.
- Study basic principles of operation of microwave devices/ components

Sl.No	**Experiments**
1	V- I Characteristics of Gunn-diode.
2	Study of characteristics of Magic Tee.
3	Coupling and Isolation characteristics of microstrip directional coupler.
4	Determination of power division of microstrip power divider.
5	Determination of resonance characteristics of microstrip ring resonator and computation of dielectric constant of the substrate.
6	Measurement of frequency, guide wavelength, power and attenuation in a microwave Test bench.
7	Study of characteristics of E plane Tee / H plane Tee.
8	To measure unknown impedance using Smith chart through test bench setup.
9	Measurement of VSWR and reflection coefficient and attenuation in a microwave test bench setup.
10	Study propagation of wave using rectangular waveguide using MATLAB.
11	Study of impedance matching using MATLAB.
12	To calculate phase and group velocity using MATLAB.

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

1. Demonstrate the characteristics of microwave sources.
2. Demonstrate the characteristics of directional coupler
3. Study of microwave measurement procedure.
4. Apply MATLAB toolbox for study of microwaves phenomena.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 35% (18 Marks out of 50) in the semester-end examination (SEE).

Continuous Internal Evaluation (CIE):

CIE marks for the practical course is **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment to be evaluated for conduction with observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.

- Total marks scored by the students are scaled downed to 30 marks (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8th week of the semester and the second test shall be conducted after the 14th week of the semester.
- In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability. Rubrics suggested in Annexure-II of Regulation book
- The average of 02 tests is scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and average marks of two tests is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

SEE marks for the practical course is 50 Marks.

SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University

All laboratory experiments are to be included for practical examination.

(Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.

Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.

Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)

Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.

The duration of SEE is 03 hours

Rubrics suggested in Annexure-II of Regulation book

Suggested Learning Resources:

MATLAB

1. Microwave Engineering -Annapurna Das, Sisir K Das, TMH Publication, 2nd Edition, 2010.
2. Antennas and Wave Propagation -John D Krauss, Ronald J Marhefka, Ahmad S Khan, 4th Edition, McGraw Hill Education, 2013.
3. https://www.mathworks.com/help/antenna
4. https://www.mathworks.com/help/antenna/ref/waveguide.html

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI
B.E: Electronics & Communication Engineering / B.E: Electronics & Telecommunication Engineering
NEP, Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
(Effective from the academic year 2021 – 22)

VI Semester

Computer Organization & ARM Microcontrollers			
Course Code	**21EC62**	CIE Marks	50
Teaching Hours/Week (L: T: P: S)	(3:0:2:0)	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 12 Lab slots	Total Marks	100
Credits	04	Exam Hours	03

Course objectives: This course will enable students to:

1. Explain the basic organization of a computer system.
2. Demonstrate functioning of different sub systems, such as processor, Input/output, and memory.
3. Describe the architectural features and instructions of 32-bit microcontroller ARM Cortex M3.
4. Apply the knowledge gained for Programming ARM Cortex M3 for different applications.
5. Understand the basic hardware components and their selection method based on the characteristics and attributes of an embedded system.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

- Lecture method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
- Encourage collaborative (Group) Learning in the class.
- Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking.
- Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
- Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
- Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.
- Give Programming Assignments.

Module-1

Basic Structure of Computers: Basic Operational Concepts, Bus Structures, Performance – Processor Clock, Basic Performance Equation, Clock Rate, Performance Measurement.
Text Book 1: Chapter 1 – 1.3, 1.4, 1.6 (1.6.1-1.6.4, 1.6.7), Chapter 2 – 2.2 to 2.10
Input/Output Organization: Accessing I/O Devices, Interrupts – Interrupt Hardware, Direct Memory Access, Buses, Interface Circuits, Standard I/O Interfaces – PCI Bus, SCSI Bus, USB.
Text Book 1: Chapter 4 – 4.1, 4.2, 4.4, 4.5, 4.6, 4.7

Teaching-Learning Process	Chalk and Talk, YouTube videos **RBT Level:** L1, L2, L3

Module-2

Memory System: Basic Concepts, Semiconductor RAM Memories, Read Only Memories, Speed, Size, and Cost, Cache Memories – Mapping Functions, Replacement Algorithms, Performance Considerations.
Text book 1: Chapter 5 – 5.1 to 5.4, 5.5 (5.5.1, 5.5.2), 5.6

Basic Processing Unit: Some Fundamental Concepts, Execution of a Complete Instruction, Multiple Bus Organization, Hard-wired Control, Micro programmed Control. Basic concepts of pipelining,

Text book 1: Chapter7, Chapter 8 – 8.1

Teaching-Learning Process	Chalk and Talk, YouTube videos **RBT Level:** L1, L2, L3

Module-3
ARM Embedded Systems: Introduction, RISC design philosophy, ARM design philosophy, Embedded system hardware – AMBA bus protocol, ARM bus technology, Memory, Peripherals, Embedded system software – Initialization (BOOT) code, Operating System, Applications. ARM Processor Fundamentals, ARM core dataflow model, registers, current program status register, Pipeline, Exceptions, Interrupts and Vector Table, Core extensions. Text book 2: Chapter 1, 2

Teaching-Learning Process	Chalk and Talk, YouTube videos **RBT Level:** L1, L2, L3

Module-4
Introduction to the ARM Instruction set: Introduction, Data processing instructions, Load - Store instruction, Software interrupt instructions, Program status register instructions, Loading constants, ARMv5E extensions, Conditional Execution. Text book 2: Chapter 3

Teaching-Learning Process	Chalk and Talk, Power point presentations, Programming assignments **RBT Level:** L1, L2, L3

Module-5
Introduction to the THUMB instruction set: Introduction, THUMB register usage, ARM – THUMB interworking, Other branch instructions, Data processing instructions, Stack instructions, Software interrupt instructions. **Efficient C Programming**: Overview of C Compilers and optimization, Basic C Data types, C looping structures. Text book 2: Chapter 4, 5

Teaching-Learning Process	Chalk and Talk, Power point presentations, Programming assignments **RBT Level:** L1, L2, L3

PRACTICAL COMPONENT OF IPCC

Conduct the following experiments by writing Assembly Language Program (ALP) using ARM Cortex M3 Registers using an evaluation board/simulator and the required software tool.

Sl.No	Experiments
1	Write an ALP to i) multiply two 16-bit binary numbers. ii) add two 64-bit numbers.
2	Write an ALP to find the sum of first 10 integer numbers.
3	Write an ALP to find factorial of a number.
4	Write an ALP to add an array of 16-bit numbers and store the 32-bit result in internal RAM.
5	Write an ALP to find the square of a number (1 to 10) using look-up table.
6	Write an ALP to find the largest/smallest number in an array of 32 numbers.
7	Write an ALP to arrange a series of 32-bit numbers in ascending/descending order.
8	i) Write an ALP to count the number of ones and zeros in two consecutive memory locations. ii)Write an ALP to Scan a series of 32-bit numbers to find how many are negative.

Demonstration Experiments (For CIE only not for SEE)	
Conduct the following experiments on an ARM CORTEX M3 evaluation board using evaluation version of Embedded 'C' & Keil µvision-4 tool/compiler.	
9	Interface a Stepper motor and rotate it in clockwise and anti-clockwise direction.
10	Interface a DAC and generate Triangular and Square waveforms.
11	Display the Hex digits 0 to F on a 7-segment LED interface, with a suitable delay in between.
12	Interface a simple Switch and display its status through Relay, Buzzer and LED.

Course Outcomes

At the end of the course the student will be able to:

1. Explain the basic organization of a computer system.
2. Demonstrate functioning of different sub systems, such as processor, Input/output, and memory.
3. Describe the architectural features and instructions of 32-bit microcontroller ARM Cortex M3.
4. Apply the knowledge gained for Programming ARM Cortex M3 for different applications.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

CIE for the theory component of IPCC

Two Tests each of **20 Marks (duration 01 hour**)

- First test at the end of 5th week of the semester
- Second test at the end of the 10th week of the semester

Two assignments each of **10 Marks**

- First assignment at the end of 4th week of the semester
- Second assignment at the end of 9th week of the semester

Scaled-down marks of two tests and two assignments added will be CIE marks for the theory component of IPCC for **30 marks**.

CIE for the practical component of IPCC

- On completion of every experiment/program in the laboratory, the students shall be evaluated and marks shall be awarded on the same day. The **15 marks** are for conducting the experiment and preparation of the laboratory record, the other **05 marks shall be for the test** conducted at the end of the semester.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to 15 marks.
- The laboratory test **(duration 03 hours)** at the end of the 15th week of the semester /after completion of all the experiments (whichever is early) shall be conducted for 50 marks and scaled down to 05 marks**.**

Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **20 marks**.

SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (duration 03 hours)

- The question paper will have ten questions. Each question is set for 20 marks.
- There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
- The students have to answer 5 full questions, selecting one full question from each module.

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper shall include questions from the practical component.

- The minimum marks to be secured in CIE to appear for SEE shall be the 12 (40% of maximum marks-30) in the theory component and 08 (40% of maximum marks -20) in the practical component. The laboratory component of the IPCC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be included**.** The maximum of 04/05 questions to be set from the practical component of IPCC, the total marks of all questions should not be more than the 20 marks.

SEE will be conducted for 100 marks and students shall secure 35% of the maximum marks to qualify in the SEE. Marks secured will be scaled down to 50.

Suggested Learning Resources:

Textbooks

1. Carl Hamacher, Zvonko Vranesic, Safwat Zaky, Computer Organization, 5th Edition, Tata McGraw Hill, 2002. (Listed topics only from Chapters 1, 2, 4, 5, 8).
2. Andrew N Sloss, Dominic System and Chris Wright, “ARM System Developers Guide”, Elsevier, Morgan Kaufman publisher, 1st Edition, 2008.

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

Programming Assignments / Mini Projects can be given to improve programming skills

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VI Semester

VLSI Design and Testing			
Course Code	**21EC63**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	3:0:0:1	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course objectives:

- Impart knowledge of MOS transistor theory and CMOS technology
- Learn the operation principles and analysis of inverter circuits.
- Infer the operation of Semiconductor memory circuits.
- Demonstrate the concept of CMOS testing.

Teaching-Learning Process (General Instructions)

The sample strategies, which the teacher can use to accelerate the attainment of the various course outcomes are listed in the following:

1. Lecture method (L) does not mean only the traditional lecture method, but a different type of teaching method may be adopted to develop the outcomes.
2. Arrange visits to nearby PSUs and industries.
3. Show Video/animation films to explain the functioning of various fabrication & testing techniques.
4. Encourage collaborative (Group) Learning in the class
5. Topics will be introduced in multiple representations.
6. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Introduction: A Brief History, MOS Transistors, CMOS Logic (1.1 to 1.4 of TEXT1)

MOS Transistor Theory: Introduction, Long-channel I-V Characteristics, Non-ideal I-V Effects, DC Transfer Characteristics (2.1, 2.2, 2.4 and 2.5 of TEXT1).

Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, YouTube videos, Videos on transistor working **Self-study topics**: MOSFET Scaling and Small-Geometry Effects **RBT Level:** L1, L2, L3

Module-2

Fabrication: CMOS Fabrication and Layout, Introduction, CMOS Technologies, Layout Design Rules, (1.5 and 3.1 to 3.3 of TEXT1).

Delay: Introduction, Transient Response, RC Delay Model, Linear Delay Model, Logical Efforts of Paths (4.1 to 4.5 of TEXT1, except sub-sections 4.3.7, 4.4.5, 4.4.6, 4.5.5 and 4.5.6).

Teaching-Learning Process	Chalk and talk method, Power point presentation, YouTube videos, Videos on fabrication **Self-study topics**: Layouts of complex design using Euler's method **RBT Level:** L1, L2, L3

Module-3

Semiconductor Memories: Introduction, Dynamic Random Access Memory (DRAM) and Static Random Access Memory (SRAM), Nonvolatile Memory, Flash Memory, Ferroelectric Random Access Memory (FRAM) (10.1 to 10.6 of TEXT2)

Teaching-Learning	Chalk and talk method, PowerPoint Presentation, YouTube videos on Standard

Process	cell memory Design **Self-study topics**: Memory array design **RBT Level:** L1, L2, L3
Module-4	
Faults in digital circuits: Failures and faults, Modelling of faults, Temporary faults **Test generation for combinational logic circuits**: Fault diagnosis of digital circuits, test generation techniques for combinational circuits, Detection of multiple faults in combinational logic circuits. (1.1 to 1.3, 2.1 to 2.3 of TEXT3)	
Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, YouTube videos, videos on testing algorithms for test generation **Self-study topics**: Testable combinational logic circuits **RBT Level:** L1, L2, L3
Module-5	
Test generation for sequential circuits: Testing of sequential circuits as iterative combinational circuits, state table verification, test generation based on circuits structure, functional fault models, test generation based on functional fault models. **Design of testable sequential circuits**: Controllability and Observability, Adhoc design rules, design of diagnosable sequential circuits, The scan path technique, LSSD, Random Access scan technique, partial scan. (4.1 to 4.5, 5.1 to 5.7 of TEXT3)	
Teaching-Learning Process	Chalk and talk method/Power point presentation, YouTube videos **Self-study topics**: Memory testing techniques **RBT Level:** L1, L2, L3

Course outcomes (Course Skill Set)

At the end of the course the student will be able to:

1. Demonstrate understanding of MOS transistor theory, CMOS fabrication flow and technology scaling.
2. Draw the basic gates using the stick and layout diagram with the knowledge of physical design aspects.
3. Interpret memory elements along with timing considerations.
4. Interpret testing and testability issues in combinational logic design.
5. Interpret testing and testability issues in combinational logic design.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20**

Marks (duration 01 hours)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module. Marks scored out of 100 shall be reduced proportionally to 50 marks

Suggested Learning Resources:

Text Books:

1. "CMOS VLSI Design- A Circuits and Systems Perspective", Neil H E Weste, and David Money Harris 4th Edition, Pearson Education.
2. "CMOS Digital Integrated Circuits: Analysis and Design", Sung Mo Kang & Yosuf Leblebici, Third Edition, Tata McGraw-Hill.
3. "Digital Circuit Testing and Testability", Lala Parag K, New York, Academic Press, 1997.

Reference Books:

1. "Basic VLSI Design", Douglas A Pucknell, Kamran Eshraghian, 3rd Edition, Prentice Hall of India publication, 2005.
2. "Essential of Electronic Testing for Digital, Memory and Mixed Signal Circuits", Vishwani D Agarwal, Springer, 2002.

Web links and Video Lectures (e-Resources)

- https://www.youtube.com/watch?v=oL8SKNxEaHs&list=PLLy_2iUCG87Bdulp9brz9AcvW_TnFCUmM
- https://www.youtube.com/watch?v=lRpt1fCHd8Y&list=PLCmoXVuSEVHlEJi3SwdyJ4EICffuyqpjk
- https://www.youtube.com/watch?v=yLqLD8Y4-Qc

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Model displayed for clear understanding of fabrication process of MOS transistor
- Practise session can be held to understand the significance of various layers in MOS process, with the help of coloured layouts

03.10.2022

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VI Semester

VLSI Laboratory			
Course Code	**21ECL66**	CIE Marks	50
Teaching Hours/Week (L: T: P: S)	0:0:2:0	SEE Marks	50
Credits	1	Exam Hours	3

Course objectives:

This laboratory course enables students to

- Design, model, simulate and verify digital circuits.
- Design layouts and perform physical verification of CMOS digital circuits.
- Perform ASIC design flow and understand the process of synthesis, synthesis constraints and evaluating the synthesis reports to obtain optimum gate level netlist.
- Perform RTL-GDSII flow and understand the stages in ASIC.

Sl.No.	**Experiments**
	ASIC Digital Design
1	4-Bit Adder • Write Verilog Code • Verify the Functionality using Test-bench • Synthesize the design by setting proper constraints and obtain the netlist. From the report generated identify Critical path, Maximum delay, Total number of cells, Power requirement and Total area required
2	4-Bit Booth Multiplier • Write Verilog Code • Verify the Functionality using Test-bench • Synthesize the design by setting proper constraints and obtain the netlist. From the report generated identify Critical path, Maximum delay, Total number of cells, Power requirement and Total area required
3	32-Bit ALU Supporting 4-Logical and 4-Arithmetic operations, using case and if statement for ALU Behavioral Modeling • Write Verilog Code • Verify functionality using Test-bench • Synthesize the design targeting suitable library and by setting area and timing constraints • Tabulate the Area, Power and Delay for the Synthesized netlist • Identify Critical path
4	Latch and Flip-Flop • Synthesize the design and compare the synthesis report (D, SR, JK)
	ASIC Analog Design
5	a) Capture the schematic of CMOS inverter with load capacitance of 0.1pF and set the widths of Inverter with Wn = Wp, Wn = 2Wp, Wn = Wp/2 and length at selected technology. Carry out the following:

	i. Set the input signal to a pulse with rise time, fall time of 1ns and pulse width of 10ns and the time period of 20ns and plot the input voltage and output voltage of designed inverter? ii. From the simulation result compute tpHL, tpLH and td for all three geometrical settings of width? iii. Tabulate the results of delay and find the best geometry for minimum delay for CMOS inverter? b) Draw layout of inverter with Wp/Wn = 40/20, use optimum layout methods. Verify for DRC and LVS, extract parasitic and perform post layout simulations, compare the results with pre-layout simulations. Record the observations.
6	a) Capture the schematic of 2-input CMOS NAND gate having similar delay as that of CMOS inverter computed in experiment above. Verify the functionality of NAND gate and also find out the delay td for all four possible combinations of input vectors. Table the results. Increase the drive strength to 2X and 4X and tabulate the results. b) Draw the layout of NAND with Wp/Wn = 40/20, use optimum layout methods. Verify for DRC and LVS, extract parasitic and perform post layout simulations, compare the results with pre-layout simulations. Record the observations.
7	a) Capture schematic of Common Source Amplifier with PMOS Current Mirror Load and find its transient response and AC response? Measure the Unit Gain Bandwidth (UGB), amplification factor by varying transistor geometries, study the impact of variation in width to UGB. b) Draw Layout of common source amplifier, use optimum layout methods. Verify for DRC & LVS, extract parasitic and perform post layout simulations, compare the results with pre-layout simulations. Record the observations.
8	a) Capture schematics of two-stage operational amplifier and measure the following: i. UGB ii. dB Bandwidth iii. Gain Margin and phase margin with and without coupling capacitance iv. Use the op-amp in the inverting and non-inverting configuration and verify its functionality. v. Study the UGB, 3dB bandwidth, gain and power requirement in op-amp by varying the stage wise transistor geometries and record the observations. b) Draw layout of two-stage operational amplifier with minimum transistor width set to 300 (in 180/90/45 nm technology), choose appropriate transistor geometries as per the results obtained in part a. Use optimum layout methods. Verify for DRC and LVS, extract parasitic and perform post layout simulations, compare the results with pre-layout simulations. Record the observations.
	Demonstration Experiments (For CIE)
9	UART • Write Verilog Code • Verify the Functionality using Test-bench • Synthesize the design targeting suitable library and by setting area and timing constraints • Tabulate the Area, Power and Delay for the Synthesized netlist, Identify Critical path
10	For synthesized netlist carry out the following: • Floor planning • Placement and Routing • Record the parameters such as no. of metal layers used for routing, flip method for placement of standard cells • Physical Verification and record the DRC and LVS reports • Generate GDSII

11	Design and characterize 6T binary SRAM cell and measure the following: • Read Time, Write Time, SNM, Power • Draw Layout of 6T SRAM, use optimum layout methods. Verify for DRC & LVS, extract parasitic and perform post layout simulations, compare the results with pre-layout simulations. Record the observations.

Course outcomes (Course Skill Set):

On the completion of this laboratory course, the students will be able to:

1. Design and simulate combinational and sequential digital circuits using Verilog HDL.
2. Understand the synthesis process of digital circuits using EDA tool.
3. Perform ASIC design flow and understand the process of synthesis, synthesis constraints and evaluating the synthesis reports to obtain optimum gate level netlist.
4. Design and simulate basic CMOS circuits like inverter, common source amplifier, differential amplifier, SRAM.
5. Perform RTL_GDSII flow and understand the stages in ASIC design.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 35% (18 Marks out of 50) in the semester-end examination (SEE).

Continuous Internal Evaluation (CIE):

CIE marks for the practical course is **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment to be evaluated for conduction with observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled downed to 30 marks (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8th week of the semester and the second test shall be conducted after the 14th week of the semester.
- In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability. Rubrics suggested in Annexure-II of Regulation book
- The average of 02 tests is scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and average marks of two tests is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

SEE marks for the practical course is 50 Marks.

SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University

All laboratory experiments are to be included for practical examination.
(Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be

decided jointly by examiners.
Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.
Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.
General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners).
Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.
The duration of SEE is 03 hours.
Rubrics suggested in Annexure-II of Regulation book

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VI Semester

Communication Engineering			
Course Code	**21EC651**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	3:0:0: 1	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course objectives:

This course will enable students to:

- Describe essential elements of an electronic communication system.
- Understand Amplitude, Frequency & Phase modulations, and Amplitude demodulation.
- Define the sampling theorem and methods to generate pulse modulations.
- Learn the various methods of digital modulation techniques and compare the different schemes.
- Introduce the basic concepts of information theory and coding.
- Understand the basic concepts of wireless and cellular communications.

Teaching-Learning Process (General Instructions)

The sample strategies, which the teacher can use to accelerate the attainment of the various course outcomes are listed in the following:

1. Lecture method (L) does not mean only the traditional lecture method, but a different type of teaching method may be adopted to develop the outcomes.
2. Show Video/animation films to explain the evolution of communication technologies.
3. Encourage collaborative (Group) Learning in the class
4. Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
6. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
7. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Introduction to Electronic Communications: Historical perspective, Electromagnetic frequency spectrum, Signal and its representation, Elements of electronic communications system, primary communication resources, signal transmission concepts, Analog and digital transmission, Modulation, Concept of frequency translation, Signal radiation and propagation (Text 1: 1.1 to 1.10)

Teaching-Learning Process	Chalk and talk method, Power Point Presentation **Self-study topics:** Classification of Signals and systems **RBT Level:** L1, L2, L3

Module-2

Amplitude Modulation Techniques: Types of analog modulation, Principle of amplitude modulation, AM power distribution, Limitations of AM, (TEXT 1: 4.1, 4.2, 4.4, 4.6)

Angle Modulation Techniques: Principles of Angle modulation, Theory of FM-basic Concepts, Theory of phase modulation (TEXT1: 5.1, 5.2, 5.5)

Teaching-Learning Process	Chalk and talk method/Power point presentation **Self-study topics:** DSBSC, SSB and VSB modulation techniques and comparison. **RBT Level:** L1, L2, L3

Module-3	
Sampling Theorem and Pulse Modulation Techniques: Digital Versus Analog Transmissions, Sampling Theorem, Classification of pulse modulation techniques, PAM, PWM, PPM, PCM, Quantization of signals (TEXT 1: 7.2 to 7.8)	
Teaching-Learning Process	Chalk and talk method **Self-study topics:** Differential PCM and Delta Modulation **RBT Level:** L1, L2, L3
Module-4	
Digital Modulation Techniques: Types of digital Modulation, ASK, FSK, PSK, QPSK. (TEXT 1: 9.1 to 9.5) **Information Theory, Source and Channel Coding:** Information, Entropy and its properties, Shannon,-Hartley Theorem, Objectives of source coding, Source coding technique, Shannon source coding theorem, Channel coding theorem, Error Control and Coding. [Text1: 10.1,10.2, 10.11.2, 11.1 to 11.3, 11.8, 11.9, 11.12]	
Teaching-Learning Process	Chalk and talk method, Power Point Presentation. **Self-study topics:** Quadrature Amplitude Modulation, Comparison of Digital Modulation techniques. **RBT Level:** L1, L2, L3
Module-5	
Evolution of wireless communication systems: Brief History of wireless communications, Advantages of wireless communication, disadvantages of wireless communications, wireless network generations, Comparison of wireless systems, Evolution of next generation networks, Applications of wireless communication (TEXT 2: 1.1 to 1.7) **Principles of Cellular Communications:** Cellular terminology, Cell structure and Cluster, Frequency reuse concept, Cluster size and system capacity, Method of locating cochannel cells, Frequency reuse distance (TEXT 2: 4.1 to 4.7)	
Teaching-Learning Process	Chalk and talk method/Power point presentation **Self-study topics:** Basic propagation mechanisms, Multipath fading. **RBT Level:** L1, L2, L3

Course outcomes (Course Skill Set)

At the end of the course the student will be able to:

1. Describe the scheme and concepts of radiation and propagation of communication signals through air.
2. Understand the AM and FM modulation techniques and represent the signal in time and frequency domain relations.
3. Understand the process of sampling and quantization of signals and describe different methods to generate digital signals.
4. Describe the basic digital modulation techniques, channel capacity, source coding technique and the channel coding.
5. Compare the different wireless communication systems and describe the structure of cellular communication.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module. Marks scored out of 100 shall be reduced proportionally to 50 marks

Suggested Learning Resources:

Books:

1. T L Singal, Analog and Digital Communications, McGraw Hill Education (India) Private Limited, 2012, 0-07-107269-1
2. T L Singal, Wireless Communications, McGraw Hill Education (India) Private Limited, 2016, ISBN:0-07-068178-3.

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VI Semester

Microcontrollers			
Course Code	**21EC652**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	3:0:0:1	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course objectives:

This course will enable students to:

- Understand the difference between a Microprocessor and a Microcontroller and embedded microcontrollers.
- Familiarize the basic architecture of 8051 microcontroller.
- Program 8051microprocessor using Assembly Level Language and C.
- Understand the interrupt system of 8051 and the use of interrupts.
- Understand the operation and use of inbuilt Timers/Counters and Serial port of 8051.
- Interface 8051 to external memory and I/O devices using its I/O ports.

Teaching-Learning Process (General Instructions)

The sample strategies, which the teacher can use to accelerate the attainment of the various course outcomes are listed in the following:

1. Lecture method (L) does not mean only the traditional lecture method, but a different type of teaching method may be adopted to develop the outcomes.
2. Show Video/animation films to explain the functioning of various techniques.
3. Encourage collaborative (Group) Learning in the class
4. Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
6. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
7. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.
8. Give Programming Assignments.

Module-1

8051 Microcontroller: Microprocessor Vs Microcontroller, Embedded Systems, Embedded Microcontrollers, 8051 Architecture- Registers, Pin diagram, I/O ports functions, Internal Memory organization. External Memory (ROM & RAM) interfacing.
Text2 : Chapter 1 section 1.1 to 1.3, chapter 3 sections 3.1 to 3.3

Teaching-Learning Process	Chalk and talk method, Simulation of modulation techniques **RBT Level:** L1, L2, L3

Module-2

8051 Instruction Set: Addressing Modes, Data Transfer instructions, Arithmetic instructions, Logical instructions, Bit manipulation instructions. Simple Assembly language program examples (without loops) to use these instructions.
Text2 : Chapter 5 , chapter 6, chapter 7, chapter 8

Teaching-Learning Process	Chalk and talk method/Power point presentation **RBT Level:** L1, L2, L3

Module-3	
8051 Jump and Call instructions & Embedded C Jump and Call Instructions, Calls & Subroutine instructions. Assembly language program examples on subroutine and involving loops. Text2 : chapter 8 section 8.1 to 8.4 **8051 Programming in C**: Data Types and Time delay in 8051 C, I/O programming in 8051 C, Logical Operations in C. Text1 : chapter 7 section 7.1 to 7.3	
Teaching-Learning Process	Chalk and talk method **RBT Level:** L1, L2, L3
Module-4	
8051 Timers and Serial Port **8051 Timers and Counters** – Operation and Assembly language programming to generate a pulse using Mode-1 and a square wave using Mode- 2 on a port pin. **8051 Serial Communication**- Basics of Serial Data Communication, RS- 232 standard, 9 pin RS232 signals, Simple Serial Port programming in Assembly and C to transmit a message and to receive data serially. Text1 : Chapter 9 section 9.1 Chapter 10 section 10.1 to 10.5	
Teaching-Learning Process	Chalk and talk method **RBT Level:** L1, L2, L3
Module-5	
8051 Interrupts and Interfacing Applications 8051 Interrupts. 8051 Assembly language programming to generate an external interrupt using a switch, 8051 C programming to generate a square waveform on a port pin using a Timer interrupt. **Interfacing** 8051 to ADC-0804, DAC, LCD and Stepper motor and their 8051 Assembly and C language interfacing programming. Text 1: Chapter 11 section 11.1 and 11.2 Chapter 13 section 13.1 to 13.2, chapter 12 section 12.1, chapter 17 section 17.2	
Teaching-Learning Process	Chalk and talk method/Power point presentation **RBT Level:** L1, L2, L3

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

1. Explain the difference between Microprocessors & Microcontrollers, Architecture of 8051 Microcontroller, Interfacing of 8051 to external memory and Instruction set of 8051.
2. Develop 8051 Assembly level programs using 8051 instruction set.
3. Develop 8051 Assembly / C language program to generate timings and waveforms using 8051 timers, to send & receive serial data using 8051 serial port.
4. Develop 8051 Assembly / C language programs to generate square wave on 8051 I/O port pin using interrupt and C Programme to send & receive serial data using 8051 serial port.
5. Interface various peripheral devices to 8051 using I/O ports.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester

3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module. Marks scored out of 100 shall be reduced proportionally to 50 marks

Suggested Learning Resources:

Text Books:

1. "The 8051 Microcontroller and Embedded Systems – using assembly and C", Muhammad Ali Mazidi, Janice Gillespie Mazidi and Rollin D McKinlay; PHI, 2006 / Pearson, 2006.
2. "The 8051 Microcontroller", Kenneth J Ayala, 3rd Edition, Thomson/Cengage Learning.

Reference Books:

1. "The 8051 Microcontroller Based Embedded Systems", Manish K Patel, McGraw Hill, 2014, ISBN: 978-93-329-0125-4.
2. "Microcontrollers: Architecture, Programming, Interfacing and System Design", Raj Kamal, Pearson Education, 2005.

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VI Semester

Basic VLSI Design			
Course Code	**21EC653**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	3:0:0:1	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course objectives:

- Impart knowledge of MOS transistor theory and CMOS technologies
- Impart knowledge on architectural choices and performance trade-offs involved in designing and realizing the circuits in CMOS technology
- Cultivate the concepts of subsystem design processes
- Demonstrate the concepts of CMOS testing

Teaching-Learning Process (General Instructions)

The sample strategies, which the teacher can use to accelerate the attainment of the various course outcomes are listed in the following:

1. Lecture method (L) does not mean only the traditional lecture method, but a different type of teaching method may be adopted to develop the outcomes.
2. Show Video/animation films to explain the functioning of various techniques.
3. Encourage collaborative (Group) Learning in the class
4. Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
6. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
7. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.
8. Incorporate programming examples given under Activity based learning.

Module-1

Introduction: A Brief History, MOS Transistors, MOS Transistor Theory, Ideal I-V Characteristics, Non-ideal I-V Effects, DC Transfer Characteristics (1.1, 1.3, 2.1, 2.2, 2.4, 2.5 of TEXT2).
Fabrication: nMOS Fabrication, CMOS Fabrication [P-well process, N-well process, Twin tub process], BiCMOS Technology (1.7, 1.8, 1.10 of TEXT1).

Teaching-Learning Process	Chalk and talk method, YouTube videos, Power point presentation **RBT Level:** L1, L2

Module-2

MOS and BiCMOS Circuit Design Processes: MOS Layers, Stick Diagrams, Design Rules and Layout.
Basic Circuit Concepts: Sheet Resistance, Area Capacitances of Layers, Standard Unit of Capacitance, Some Area Capacitance Calculations, Delay Unit, Inverter Delays, Driving Large Capacitive Loads (3.1 to 3.3, 4.1, 4.3 to 4.8 of TEXT1).

Teaching-Learning Process	Chalk and talk method/Power point presentation **RBT Level:** L1, L2, L3

Module-3	
Scaling of MOS Circuits: Scaling Models & Scaling Factors for Device Parameters **Subsystem Design Processes**: Some General considerations, An illustration of Design Processes, **Illustration of the Design Processes**: Regularity, Design of an ALU Subsystem, The Manchester Carry-chain and Adder Enhancement Techniques (5.1, 5.2, 7.1, 7.2, 8.2, 8.3, 8.4.1, 8.4.2 of TEXT1).	
Teaching-Learning Process	Chalk and talk method, YouTube videos, Power point presentation **RBT Level:** L1, L2, L3
Module-4	
Subsystem Design: Some Architectural Issues, Switch Logic, Gate (restoring) Logic, Parity Generators, Multiplexers, The Programmable Logic Array (PLA) (6.1 to 6.3, 6.4.1, 6.4.3, 6.4.6 of TEXT1). **FPGA Based Systems**: Introduction, Basic concepts, Digital design and FPGAs, FPGA based System design, FPGA architecture, Physical design for FPGAs (1.1 to 1.4, 3.2, 4.8 of TEXT3).	
Teaching-Learning Process	Chalk and talk method, YouTube videos, Power point presentation **RBT Level:** L1, L2, L3
Module-5	
Memory, Registers and Aspects of system Timing: System Timing Considerations, Some commonly used Storage/Memory elements (9.1, 9.2 of TEXT1). **Testing and Verification**: Introduction, Logic Verification, Logic Verification Principles, Manufacturing Test Principles, Design for testability (12.1, 12.1.1, 12.3, 12.5, 12.6 of TEXT 2).	
Teaching-Learning Process	Chalk and talk method/Power point presentation **RBT Level:** L1, L2, L3

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

1. Demonstrate understanding of MOS transistor theory, CMOS fabrication flow and technology scaling.
2. Draw the basic gates using the stick and layout diagrams with the knowledge of physical design aspects.
3. Interpret Memory elements along with timing considerations
4. Demonstrate knowledge of FPGA based system design
5. Interpret testing and testability issues in VLSI Design
6. Analyze CMOS subsystems and architectural issues with the design constraints.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module. Marks scored out of 100 shall be reduced proportionally to 50 marks

Suggested Learning Resources:

Text Books:

1. "Basic VLSI Design"- Douglas A Pucknell & Kamran Eshraghian, PHI, 3rd Edition.
2. "CMOS VLSI Design- A Circuits and Systems Perspective", Neil H E Weste, David Harris, Ayan Banerjee, 3rd Edition, Pearson Education.
3. "FPGA Based System Design", Wayne Wolf, Pearson Education, 2004, Technology and Engineering.

Web links and Video Lectures (e-Resources)

- https://nptel.ac.in/courses/117101058
- https://nptel.ac.in/courses/117106093
- https://youtu.be/9SnR3M3CIm4
- https://nptel.ac.in/courses/108/107/108107129/

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

Wherever necessary **Cadence/Synopsis/Menta Graphics tools** must be used.

1.Write Verilog Code for the following circuits and their Test Bench for verification, observe the waveform and synthesize the code with technological library with given Constraints*. Do the initial timing verification with gate level simulation.

i. An inverter
ii. A Buffer
iii. Transmission Gate
iv. Basic/universal gates
v. Flip flop -RS, D, JK, MS, T
vi. Serial & Parallel adder
vii. 4-bit counter [Synchronous and Asynchronous counter]

2. Design an op-amp with given specification* using given differential amplifier Common source and Common Drain amplifier in library** and completing the design flow mentioned below:

a. Draw the schematic and verify the following
i) DC Analysis
ii) AC Analysis
iii) Transient Analysis
b. Draw the Layout and verify the DRC, ERC
c. Check for LVS
d. Extract RC and back annotate the same and verify the Design.

03.10.2022

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VI Semester

Electronic Circuits with Verilog			
Course Code	**21EC654**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	2:0:2:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course objectives:

- To understand the basic Verilog HDL design flow.
- To understand the basic Verilog programming concepts.
- To describe the simple logic circuits using dataflow, gate-level, and behavioural level modelling.
- To model digital systems using advanced concepts of Verilog HDL.

Teaching-Learning Process (General Instructions)

The sample strategies, which the teacher can use to accelerate the attainment of the various course outcomes are listed in the following:

1. Lecture method (L) does not mean only the traditional lecture method, but a different type of teaching method may be adopted to develop the outcomes.
2. Show Video/animation films to explain the functioning of various techniques.
3. Encourage collaborative (Group) Learning in the class
4. Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
6. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
7. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.
8. Give programming assignments.

Module-1

Overview of Digital Design with Verilog HDL: Evolution of CAD, emergence of HDLs, typical HDL-flow, why Verilog HDL?, trends in HDLs. (Text 1)
Hierarchical Modeling Concepts: Top-down and bottom-up design methodology, differences between modules and module instances, parts of a simulation, design block, stimulus block. (Text 1)

Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2, L3

Module-2

Basic Concepts: Lexical conventions, datatypes, system tasks, compiler directives. (Text 1)
Modules and Ports: Module definition, port declaration, connecting ports, hierarchical name referencing. (Text 1)

Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2, L3

Module-3

Gate-Level Modeling: Modeling using basic Verilog gate primitives, description of and/or and buf/not type gates, rise, fall and turn-off delays, min, max, and typical delays. (Text1)
Dataflow Modeling: Continuous assignments, delay specification, expressions, operators, operands, operator types. (Text 1)

Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2, L3

Module-4

Behavioral Description: Behavioral Description Highlights, Structure of the HDL Behavioral Description, Sequential Statements, IF Statement, The case Statement , Verilog casex and casez The wait-for Statement. The Loop Statement, For-Loop, While-Loop, Verilog repeat, Verilog forever (content with respect to Verilog only) (Text 2)

Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2, L3

Module-5

Structural Description: Highlights of Structural Description, Organization of Structural Description Binding (4.1, 4.2, 4.3 till example 4.9) (Text 2)
Tasks and Functions: Differences between tasks and functions, declaration, invocation, automatic tasks and functions. (Text 1)

Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2, L3

Course outcomes (Course Skill Set)
At the end of the course the student will be able to:

1. Under the Verilog HDL design flow.
2. Describe the basic concepts of Verilog HDL programming.
3. Design of digital electronics circuits using dataflow, behavioural, gate-level, and structural modelling.
4. Design complex digital circuits using advanced Verilog concepts.

Assessment Details (both CIE and SEE)
The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:
Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**
(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).
CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.
Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module. Marks scored out of 100 shall be reduced proportionally to 50 marks

Suggested Learning Resources:

Text Books:

1. "Verilog HDL: A Guide to Digital Design and Synthesis", Samir Palnitkar, Pearson education, Second edition.
2. "HDL programming (VHDL and Verilog)", Nazeih M Botros, John Wiley India Pvt. Ltd., 2008.

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VI Semester

Sensors & Actuators			
Course Code	**21EC655**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course objectives:

- To provide the fundamental knowledge about sensors and measurement system.
- To impart the knowledge of static and dynamic characteristics of instruments and understand the factors in selection of instruments for measurement.
- To discuss the principle, design and working of transducers for the measurement of physical time varying quantities.
- Understand the working of various actuators suitable in industrial process control systems.
- Understand the principle and application of smart sensors.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Explain the fundamental concepts required for the module in the introduction phase for the module.
2. Conducting quiz after completion of every module in class and evaluate.
3. Asking questions about completed previous topic, will aid to assess the student understanding.
4. Evaluate the internals answer booklet by correcting the mistakes if any.
5. Modules revision at the end as well use practical lab sessions and demonstrate the concepts if applicable and feasible.

Module-1

Sensors and measurement system: Sensors and transducers, Classifications of transducers-primary & secondary, active & passive, analog and digital transducers. Smart sensors.

Measurement: Definition, significance of measurement, instruments and measurement systems. mechanical, electrical and electronic instruments. Elements of generalized measurement system with example. Input-output configuration of measuring instruments and measurement systems, methods of correction for interfering and modifying inputs.

Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, More examples relating to applications **RBT Level:** L1, L2, L3

Module-2

Static and Dynamic Characteristics: Static calibration and error calibration curve, accuracy and precision, indications of precision, static error, scale range and scale span, reproducibility and drift, repeatability, signal to noise ratio, sensitivity, linearity, hysteresis, threshold, dead zone and dead time, resolution, signal to noise ratio, factors influencing the choice of transducers/instruments.

Dynamic response – Dynamic characteristics, Transfer function of generalized first order system, time constant. Transfer function of generalized second order system, natural frequency and Damping ratio.

Teaching-Learning Process	Chalk and talk method, Power point presentation, VI Lab to demonstrate the characteristics of sensors, More examples relating to applications **RBT Level:** L1, L2, L3

Module-3	
Measurement of Temperature: RTD, Thermistor, Thermocouple, laws of thermocouple, Thermopile, AD590. **Measurement of Displacement**: Introduction, Principles of Transduction, Variable resistance devices, variable Inductance Transducer, Variable Capacitance Transducer, Hall Effect Devices, Proximity Devices, Digital Transducer.	
Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, Virtual instrumentation Lab to demonstrate the characteristics of sensors **RBT Level:** L1, L2, L3
Module-4	
Measurement of Strain: Introduction, Types of Strain Gauges, Theory of operation of resistance strain gauges, Types of Electrical Strain Gauges –Wire gauges, unbounded strain gauges, foil gauges, semiconductor strain gauges (principle, types & list of characteristics only), Strain gauge Circuits – Wheatstone bride circuit, Applications. **Measurement of Force & Torque:** Introduction, Force measuring sensor –Load cells – column types devices, proving rings, cantilever beam, pressductor. Hydraulic load cell, electronic weighing system. Torque measurement: Absorption type, transmission type, stress type & deflection type.	
Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, More examples relating to applications **RBT Level:** L1, L2, L3
Module-5	
Actuators and process control system: Introduction. Block diagram and description of process control system with an example. Introduction, Block diagram of Final control operation, Signal conversions analog, digital, pneumatic signal. Actuators, Control elements. **Electrical actuating systems:** Solid-state switches, Solenoids, Electric Motors- Principle of operation and its application: D.C motors, AC motors, Synchronous Motor, Stepper motors. **Pneumatic Actuators**: Principle and working of pneumatic actuators. (Numerical problems on the topic). **Hydraulic Actuators:** Principle and working of Hydraulic actuators. (Numerical problems on the topic).	
Teaching-Learning Process	Chalk and talk method, Power point presentation More examples relating to applications **RBT Level:** L1, L2, L3

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

1. Discuss the fundamental concepts related to sensors and measurement, functional elements of measurement system, I/O Characteristics of measurement system.
2. Interpret and analyse the static and dynamic characteristics of instruments.
3. Elucidate the working principle and usage of different transducers for temperature, displacement and level measurement.
4. Discuss the principle and working of different types of actuators used in industrial application.
5. Discuss the principle and working of strain, force and torque measurement.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module. Marks scored out of 100 shall be reduced proportionally to 50 marks

Suggested Learning Resources:

Text Books:

1. Electrical and Electronic Measurements and Instrumentation, A K Sawhney, 17th Edition, (Reprint 2004), Dhanpat Rai & Co. Pvt. Ltd., 2004.
2. Instrumentation: Devices and Systems, C S Rangan, G R Sarma, V S V Mani, 2nd Edition (32 Reprint), McGraw Hill Education (India), 2014.
3. Process Control Instrumentation Technology by C D Johnson, 7th Edition, Pearson Education Private Limited, New Delhi 2002.

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B.E: Electronics & Communication Engineering / B.E: Electronics & Telecommunication Engineering
NEP, Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
(Effective from the academic year 2021 – 22)

VI Semester

Artificial Neural Networks			
Course Code	**21EC641**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	2:2:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course objectives:

- Preparation: To prepare students with fundamental knowledge and comprehensive understanding of artificial neural networks.
- Core Competence: To equip students to develop and configure ANNs with different types of learning algorithms for real world problems.
- Professionalism & Learning Environment: To inculcate an engineering student an ethical and professional attitude by providing an academic environment inclusive of effective communication, teamwork, ability to relate engineering issues to a broader social context, and life-long learning needed for a successful professional career.

Teaching-Learning Process (General Instructions)

The sample strategies, which the teacher can use to accelerate the attainment of the various course outcomes are listed in the following:

1. Lecture method (L) does not mean only the traditional lecture method, but a different type of teaching method may be adopted to develop the outcomes.
2. Show Video/animation films to explain the functioning of various learning algorithms.
3. Encourage collaborative (Group) Learning in the class.
4. Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking.
5. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
6. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1	
Introduction: Neural Networks, Application Scope of Neural Networks. **Artificial Neural Network: An Introduction**. - Fundamental Concept, Evolution of Neural Networks, Basic models of Artificial Neural Networks (ANN), Important Technologies of ANNs, McCulloch-Pitts Neuron, Linear Separability. **Text 1**: 1,1.1,1.2,2.1,2.2,2.3,2.4,2.5,2.6.	
Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, YouTube videos, Animation of basic model of a neuron in comparison of biological neuron. **RBT Level:** L1, L2, L3

Module-2	
Hebb Network and simple problems **Supervised Learning Network – Introduction** –Perceptron Networks-Theory, Perceptron learning rule, architecture, flowchart for training Process, Perceptron training algorithm for single output classes, Perceptron training algorithm for Multiple output classes, Perceptron Network Testing Algorithm, Adaptive Linear Neuron- Theory, Delta rule, Architecture, flowchart, Training, Testing algorithm (Adaline), Multiple Adaptive Linear Neurons -Theory, Architecture, Flowchart, Training algorithm.	
Teaching-	Chalk and talk method, PowerPoint Presentation, YouTube videos, Animation of

Learning Process	supervised learning algorithms. Problems on Hebb network **RBT Level:** L1, L2, L3

Module-3

Back–Propagation Network - Theory, Architecture, Flowchart for training process, Training Algorithm, Learning Factors of Back-Propagation Network, Testing Algorithm of Back-Propagation Network. Radial Basis Function Network, Time Delay Neural Network, Functional Link Networks.
Text 1: 3.5,3.6,3.7,3.8.

Teaching-Learning Process	Chalk and talk method, Power Point Presentation, YouTube videos Self-study topics: Architecture, Flowchart, Training and Testing algorithm. **RBT Level:** L1, L2, L3

Module-4

Associative Memory Network – Introduction, Training algorithm for Pattern association- Hebb Rule. Associative Memory Network - Theory, Architecture, Flowchart, Training algorithm, Testing Algorithm, Heteroassociative Memory Network- Theory, architecture, Testing algorithm, Hopfield Networks – Discrete Hopfield Network – architecture, Training algorithm, Testing algorithm of Discrete Hopfield Network.
Text 1: 4.1,4.2,4.3,4.4,4.6.

Teaching-Learning Process	Chalk and talk method, Power Point Presentation, YouTube videos Self-study topics: Architecture, Flowchart, Training and Testing algorithm. **RBT Level:** L1, L2, L3

Module-5

Unsupervised Learning Networks – Introduction, Fixed weight competitive nets – Maxnets, Architecture, Testing/application algorithm of Maxnet. Mexican Hat Net- Architecture, Flowchart, algorithm, Kohonen Self organizing Feature Maps – Theory, architecture. Learning Vector quantization – Theory, Architecture.
Text 1: 5.1,5.2-5.2.1,5.2.2,5.3- 5.3.1,5.3.2,5.4- 5.4.1,5.4.2.

Teaching-Learning Process	Chalk and talk method, Power Point Presentation, YouTube videos Self-study topics: Architecture, Flowchart, Training and Testing algorithm. **RBT Level:** L1, L2, L3

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

1. Compare and contrast the biological neural network and ANN.
2. Discuss the ANN for pattern classification.
3. Develop and configure ANN's with different types of functions and learning algorithms.
4. Apply ANN for real world problems.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester

5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module. Marks scored out of 100 shall be reduced proportionally to 50 marks

Suggested Learning Resources:

Text Book:

S N Sivanandam and S N Deepa, "Principles of Soft Computing", 2nd Edition, Wiley India Pvt. Ltd., 2014.

Reference Book:

Simon Haykin, "Neural Networks: A comprehensive foundation", 2nd Edition, PHI, 1998.

VI Semester

Cryptography			
Course Code	**21EC642**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	2:2:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course objectives:

This course will enable students to:

- Preparation: To prepare students with fundamental knowledge/ overview in the field of Information Security with knowledge of mathematical concepts required for cryptography.
- Core Competence: To equip students with a basic foundation of Cryptography by delivering the basics of symmetric key and public key cryptography and design of pseudo random sequence generation technique

Teaching-Learning Process (General Instructions)

The sample strategies, which the teacher can use to accelerate the attainment of the various course outcomes are listed in the following:

1. Lecture method (L) does not mean only the traditional lecture method, but a different type of teaching method may be adopted to develop the outcomes.
2. Show Video/animation films to explain the different Cryptographic Techniques / Algorithms
3. Encourage collaborative (Group) Learning in the class
4. Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
6. Topics will be introduced in a multiple representation.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.
9. Adopt Flipped class technique by sharing the materials / Sample Videos prior to the class and have discussions on the that topic in the succeeding classes
10. Give Programming Assignments

Module-1

Basic Concepts of Number Theory and Finite Fields: Divisibility and The Division Algorithm Euclidean algorithm, Modular arithmetic, Groups, Rings and Fields, Finite fields of the form GF(p), Polynomial Arithmetic, Finite Fields of the Form GF(2^m) (Text 1: Chapter 3)

Teaching-Learning Process	Chalk and Talk, YouTube videos, Flipped Class Technique Programming on implementation of Euclidean algorithm, multiplicative inverse, Finite fields of the form GF(p), construction of finite field over GF(2^m). **RBT Level:** L1, L2, L3

Module-2

Introduction: Computer Security Concepts, A Model for Network Security (Text 1: Chapter 1)
Classical Encryption Techniques: Symmetric cipher model, Substitution techniques, Transposition techniques (Text 1: Chapter 1)

Teaching-Learning Process	Chalk and Talk, YouTube videos, Flipped Class Technique and PPTs. Programming on Substitution and Transposition techniques. Self-study topics: Security Mechanisms, Services and Attacks. **RBT Level:** L1, L2, L3

Module-3

Block Ciphers: Traditional Block Cipher structure, Data encryption standard (DES) (Text 1: Chapter 2: Section1, 2) The AES Cipher. (Text 1: Chapter 4: Section 2, 3, 4) **More on Number Theory**: Prime Numbers, Fermat's and Euler's theorem, discrete logarithm. (Text 1: Chapter 7: Section 1, 2, 5)	
Teaching-Learning Process	Chalk and Talk, YouTube videos, Flipped Class Technique and PPTs. Implementation of SDES using programming languages like C++/Python/Java/Scilab. Self-study topics: DES S-Box- Linear and differential attacks **RBT Level:** L1, L2, L3
Module-4	
ASYMMETRIC CIPHERS: Principles of Public-Key Cryptosystems, The RSA algorithm, Diffie - Hellman Key Exchange, Elliptic Curve Arithmetic, Elliptic Curve Cryptography (Text 1: Chapter 8, Chapter 9: Section 1, 3, 4)	
Teaching-Learning Process	Chalk and Talk, YouTube videos, Flipped Class Technique and PPTs. Implementation of Asymmetric key algorithms using programming languages like C++/Python/Java/Scilab Numerical examples on Elliptic Curve Cryptography **RBT Level:** L1, L2, L3
Module-5	
Pseudo-Random-Sequence Generators and Stream Ciphers: Linear Congruential Generators, Linear Feedback Shift Registers, Design and analysis of stream ciphers, Stream ciphers using LFSRs, A5, Hughes XPD/KPD, Nanoteq, Rambutan, Additive generators, Gifford, Algorithm M, PKZIP (Text 2: Chapter 16)	
Teaching-Learning Process	Chalk and Talk, YouTube videos, Flipped Class Technique and PPTs. Implementation of simple stream ciphers using programming languages like C++/Python/Java/Scilab. **RBT Level:** L1, L2, L3

Course outcomes (Course Skill Set)

At the end of the course the student will be able to:

1. Explain traditional cryptographic algorithms of encryption and decryption process.
2. Use symmetric and asymmetric cryptography algorithms to encrypt and decrypt the data.
3. Apply concepts of modern algebra in cryptography algorithms.
4. Design pseudo random sequence generation algorithms for stream cipher systems.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module. Marks scored out of 100 shall be reduced proportionally to 50 marks

Suggested Learning Resources:

Text Books:

1. William Stallings , "Cryptography and Network Security Principles and Practice", Pearson Education Inc., 6th Edition, 2014, ISBN: 978-93-325-1877-3
2. Bruce Schneier, "Applied Cryptography Protocols, Algorithms, and Source code in C", Wiley Publications, 2nd Edition, ISBN: 9971-51-348-X.

Reference Books:

1. Cryptography and Network Security, Behrouz A Forouzan, TMH, 2007.
2. Cryptography and Network Security, Atul Kahate, TMH, 2003.

Web links and Video Lectures (e-Resources)

- https://nptel.ac.in/courses/106105031

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Programming Assignments / Mini Projects can be given to improve programming skills

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VI Semester

Python Programming			
Course Code	**21EC643**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	2:0:2:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course objectives:

- To learn programming using Python
- Develop application using Python

Teaching-Learning Process (General Instructions)

The sample strategies, which the teacher can use to accelerate the attainment of the various course outcomes are listed in the following:

1. In addition to the traditional lecture method, different types of innovative teaching methods may be adopted so that the delivered lessons shall develop student's theoretical and programming skills.
2. State the need for learning Programming with real-life examples.
3. Support and guide the students for self–study.
4. You will also be responsible for assigning homework, grading assignments and quizzes, and documenting students' progress
5. Encourage the students for group learning to improve their creative and analytical skills.
6. Show short, related video lectures in the following ways:
   - As an introduction to new topics (pre-lecture activity).
   - As a revision of topics (post-lecture activity).
   - As additional examples (post-lecture activity).
   - As an additional material of challenging topics (pre-and post-lecture activity).
   - As a model solution of some exercises (post-lecture activity).

Module-1

Python Basics, Python language features, History , Entering Expressions into the Interactive Shell, The Integer, Floating-Point, and String Data Types, String Concatenation and Replication, Storing Values in Variables, Your First Program, Dissecting Your Program, Flow control, Boolean Values, Comparison Operators, Boolean Operators, Mixing Boolean and Comparison Operators, Elements of Flow Control, Program Execution, Flow Control Statements, Importing Modules, Ending a Program Early with sys.exit(), Functions, def Statements with Parameters, Return Values and return Statements, The None Value, Keyword Arguments and print(), Local and Global Scope, The global Statement, Exception Handling, A Short Program: Guess the Number
Textbook 1: Chapters 1 – 3

Teaching-Learning Process	Chalk and talk method, Simulation of modulation techniques **RBT Level:** L1, L2, L3

Module-2

Data Structures: Lists: The List Data Type, Working with Lists Strings: Manipulating Strings, Working with Strings, Useful String Methods Tuples and Dictionaries, basics Using Data Structures to Model Real-World Things, Manipulating Strings.
Textbook 1: Chapters 4 – 6

Teaching-Learning Process	Chalk and talk method/Power point presentation **RBT Level:** L1, L2, L3

Module-3	
Pattern Matching with Regular Expressions, Finding Patterns of Text Without Regular Expressions, Finding Patterns of Text with Regular Expressions, More Pattern Matching with Regular Expressions,, The findall() Method, Character Classes, Making Your Own Character Classes, The Caret and Dollar Sign Characters, The Wildcard Character, Review of Regex Symbols. Reading and Writing Files, Files and File Paths, The os.path Module, The File Reading/Writing Process, Saving Variables with the shelve Module, Saving Variables with the pprint. pformat() Function Textbook 1: Chapters 7, 8	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation **RBT Level:** L1, L2, L3
Module-4	
Classes and objects: Programmer-defined types, Attributes, Rectangles, Instances as return values, Objects are mutable, Copying, Classes and functions: Time, Pure functions, Modifiers, Prototyping versus planning, Classes and methods: Object-oriented features, Printing objects, Another example, The init method, The__str__ method, Operator overloading, Type-based dispatch, Polymorphism. Textbook 2: Textbook 2: Chapters 15 – 18	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation **RBT Level:** L1, L2, L3
Module-5	
HTTP, The World's simplest Web Browser, Retrieving an image over HTTP, Retrieving web pages with urllib, Parsing html and scraping the web, Parsing HTML using RE, BeautifulSoup, Reading binary files using urllib, XML, Parsing XML, Looping through nodes, JSON, Parsing JSON, API, geocoding Web Service, Security & API usage, What is database?, Database Concepts, Database Browser, Creating a database table, SQL, Spidering Twitter, Basic data modeling, Programming with multiple tables, Three kinds of Keys, JOIN Text book : Chapter 2, 13, 15	
Teaching-Learning Process	Chalk and talk method/Power point presentation **RBT Level:** L1, L2, L3

Course outcomes (Course Skill Set)

At the end of the course the student will be able to:

1. To acquire programming skills in Python
2. To demonstrate data structure representation using Python
3. To develop the skill of pattern matching and files in Python
4. To acquire Object Oriented Skills in Python
5. To develop the ability to write database applications in Python

Assessment Details (both CIE and SEE)

The weightage of Continuous 5 End Examination) taken together.

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module. Marks scored out of 100 shall be reduced proportionally to 50 marks

Suggested Learning Resources:

Text Books:

1. Al Sweigart, "Automate the Boring Stuff with Python",1st Edition, No Starch Press, 2015. (Available under CC-BY-NC-SA license at https://automatetheboringstuff.com/) (Chapters 1 to 8)
2. Allen B Downey, "Think Python: How to Think Like a Computer Scientist", 2nd Edition, Green Tea Press, 2015. (Available under CC-BY-NC license at http://greenteapress.com/thinkpython2/thinkpython2.pdf) (Chapters 15 - 18) (Download pdf/html files from the above links)
3. Charles R. Severance, "Python for Everybody: Exploring Data Using Python 3", 1st, Create Space Independent Publishing Platform, 2016

Web links and Video Lectures (e-Resources)

- https://www.youtube.com/watch?v=_xQNeOTRyig
- https://www.youtube.com/watch?v=kqtD5dpn9C8

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Write a program to generate Fibonacci series
- Write a program to find factorial of a number using function.
- Write a menu driven program to implement stack using Lists
- Create a DB using dictionaries containing key as USN and related fields containing Name, gender, Marks1, Marks2 & Marks3 of students. Implement the following functions to perform i) Update Name/gender/marks ii) search for usn and display the relevant fields iii) delete based on search for name iv)generate the report with avg marks more than 70%
- Write a program to implement search and replace multiple occurrences of a given substring in the main string in a list.
- Write a function called most_frequent that takes a string and prints the letters in decreasing order of frequency.
- Write a program that reads a file, display the contents, builds a histogram of the words in the file and print most common words in the file.
- Write a program that searches a directory and all of its subdirectories, recursively, and returns a list of complete paths for all files with a given suffix.

03.10.2022

- Write python code to extract From: and To: Email Addresses from the given text file using regular expressions. https://www.py4e.com/code3/mbox.txt.
- Consider the sentence *"From rjlowe@iupui.edu Fri Jan 4 14:50:18 2008",* Write python code to extract email address and time of the day from the given sentence
- Write a program to read, display and count number of sentences of the given file.
- Write a program that gets the current date and prints the day of the week.
- Write a function called print_time that takes two Time objects and prints total time it in the form hour:minute:second.
- Write a program that takes a birthday as input and prints the user's age and the number of days, hours, minutes and seconds until their next birthday.

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VI Semester

Micro Electro Mechanical Systems			
Course Code	**21EC644**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	3: 0 :0 : 1	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course objectives:

- **Preparation**: To prepare students with fundamental knowledge/ overview in the field of Micro Electro Mechanical Systems.
- **Core Competence**: To equip students with a basic foundation in electronic engineering, mechanical engineering, electrical engineering, chemistry, physics and mathematics fundamentals required for comprehending the operation and application of MEMS circuits, design.
- **Professionalism & Learning Environment:** To inculcate in students an ethical and professional attitude by providing an academic environment inclusive of effective communication, teamwork, ability to relate engineering issues to a broader social context, and life-long learning needed for a successful professional career.

Teaching-Learning Process (General Instructions)
These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecture method (L) does not mean only the traditional lecture method, but a different type of teaching method may be adopted to develop the outcomes
2. Show Video/animation films to explain the functioning of various
3. Encourage collaborative (Group) Learning in the class to promote critical thinking
4. Topics for seminars on several MEMS related topics and their applications
5. Encourage the students to take up mini projects and main projects
6. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Overview of MEMS and Microsystems: MEMS and Microsystem, Typical MEMS and Microsystems Products, Evolution of Microfabrication, Microsystems and Microelectronics, Multidisciplinary Nature of Microsystems, Miniaturization. Applications and Markets.
Text1: **1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9**

Teaching-Learning Process	Chalk and talk method, Animation of MEMS products and applications **RBT Level:** L1, L2, L3

Module-2

Working Principles of Microsystems: Introduction, Microsensors, Micro actuation, MEMS with Micro actuators, Micro accelerometers, Microfluidics. **Text1: 2.1,2.2, 2.3, 2.4, 2.5, 2.6**
Engineering Science for Microsystems Design and Fabrication: Introduction, Atomic Structure of Matter, Ions and Ionization Molecular Theory of Matter and Intermolecular Forces, Plasma Physics, Electrochemistry. **Text1: 3.1, 3.2, 3.3, 3.4, 3.7, 3.8**

Teaching-Learning Process	PowerPoint Presentation, YouTube videos, Animations of MEMS Micro sensors, Micro actuators, Micro accelerometers and Microfluidics, molecules, Ions and matter **RBT Level:** L1, L2, L3

Module-3	
Engineering Mechanics for Microsystems Design: Introduction, Static Bending of Thin Plates, Mechanical Vibration, Thermo mechanics, Fracture Mechanics, Thin Film Mechanics, Overview on Finite Element Stress Analysis. **Text1: 4.1,4.2,4.3,4.4,4.5,4.6,4.7**	
Teaching-Learning Process	Chalk and talk method, Power Point Presentations and supporting YouTube Videos Solve numericals related to Thin Plates, and Vibration. Self study topics: solve numericals related to other topics **RBT Level:** L1, L2, L3
Module-4	
Scaling Laws in Miniaturization: Introduction, Scaling in Geometry, Scaling in Rigid-Body Dynamics, Scaling in Electrostatic Forces, Scaling in Electromagnetic Forces, Scaling in Electricity, Scaling in Fluid Mechanics, Scaling in Heat Transfer. **Text1: 6.1, 6.2,6.3,6.4,6.5,6.6,6.7,6.8**	
Teaching-Learning Process	Chalk and Talk Method, You Tube Videos, Solve numericals related to scaling in Geometry Self study topics: solve numericals of other topics **RBT Level:** L1, L2, L3
Module-5	
Overview of Micromanufacturing: Introduction, Bulk Micromanufacturing, Surface Micromachining, The LIGA Process, Summary on Micromanufacturing. **Text1: 9.1,9.2,9.3,9.4,9.5** **Microsystem Packaging**: Introduction, Overview of Mechanical Packaging of Microelectronics, Microsystem Packaging. **Text1: 11.1,11.2, 11.3**	
Teaching-Learning Process	Power Point Presentation, YouTube videos, Animation of MEMS micromanufacturing Supporting animation videos on packaging **RBT Level:** L1, L2, L3

Course outcomes (Course Skill Set)

At the end of the course the student will be able to:

1. Appreciate the technologies related to Micro Electro Mechanical Systems.
2. Understand design and fabrication processes involved with MEMS devices.
3. Analyse the MEMS devices and develop suitable mathematical models
4. Know various application areas for MEMS device.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module. Marks scored out of 100 shall be reduced proportionally to 50 marks

Suggested Learning Resources:

Text Book:

Tai-Ran Hsu, MEMS and Micro systems: Design and Manufacture, 1st Ed, Tata Mc Graw Hill.

Reference Books:

1. **Hans H Gatzen, Volker Saile, JurgLeuthold**, Micro and Nano Fabrication: Tools and Processes, Springer, 2015.
2. **Dilip Kumar Bhattacharya, Brajesh Kumar Kaushik**, Microelectromechanical Systems (MEMS), Cengage Learning.
3. **Chang Liu**, Foundations of MEMS, Pearson Ed.

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Develop mini projects and Final year projects using MEMS components to address the real world problems

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VII Semester

Advanced VLSI			
Course Code	**21EC71**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	3:0:0:1	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course objectives:

- Learn overview of VLSI design flow
- Emphasise on Back end VLSI design flow
- Learn basics of verification with reference to System Verilog

Teaching-Learning Process (General Instructions)

The sample strategies, which the teacher can use to accelerate the attainment of the various course outcomes are listed in the following:

1. Lecture method (L) does not mean only the traditional lecture method, but a different type of teaching method may be adopted to develop the outcomes.
2. Show Video/animation films to explain the functioning of various techniques.
3. Encourage collaborative (Group) Learning in the class
4. Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
6. Topics will be introduced in multiple representations.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Introduction to ASICs: Full custom, Semi-custom and Programmable ASICs, ASIC Design flow, ASIC cell libraries. CMOS Logic: Data path Logic Cells: Data Path Elements, Adders: Carry skip, Carry bypass, Carry save, Carry select, Conditional sum, Multiplier (Booth encoding), Data path Operators, I/O cells, Cell Compilers. Text Book 1

Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2, L3

Module-2

Floor planning and placement: Goals and objectives, Measurement of delay in Floor planning, Floor planning tools, Channel definition, I/O and Power planning and Clock planning. Placement: Goals and Objectives, Min-cut Placement algorithm, Iterative Placement Improvement, Time driven placement methods, Physical Design Flow.
Routing: Global Routing: Goals and objectives, Global Routing Methods, Global routing between blocks, Back annotation. Text Book 1

Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2, L3

Module-3	
Verification Guidelines: The verification process, basic test bench functionality, directed testing, methodology basics, constrained random stimulus, randomization, functional coverage, test bench components, layered testbench. **Data Types**: Built in Data types, fixed and dynamic arrays, Queues, associative arrays, linked lists, array methods, choosing a type, creating new types with type def, creating user defined structures, type conversion, Enumerated types, constants and strings, Expression width. Text Book 2	
Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2, L3
Module-4	
Procedural Statements and Routines: Procedural statements, Tasks, Functions and void functions, Task and function overview, Routine arguments, returning from a routine, Local data storage, time values. **Connecting the test bench and design**: Separating the test bench and design, The interface construct, Stimulus timing, Interface driving and sampling, System Verilog assertions. Text Book 2	
Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2, L3
Module-5	
Randomization: Introduction, What to randomize? , Randomization in System Verilog, Random number functions, Common randomization problems, Random Number Generators. **Functional Coverage**: Coverage types, Coverage strategies, Simple coverage example, Anatomy of Cover group and Triggering a Cover group, Data sampling, Cross coverage, Generic Cover groups, Coverage options, Analyzing coverage data, measuring coverage statistics during simulation. Text Book 2	
Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2, L3

Course outcomes (Course Skill Set)

At the end of the course the student will be able to:

1. Understand VLSI design flow
2. Describe the concepts of ASIC design methodology
3. Create floor plan including partition and routing with the use of CAD algorithms
4. Will have better insights into VLSI back-end design flow
5. Learn verification basics and System Verilog

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module. Marks scored out of 100 shall be reduced proportionally to 50 marks

Suggested Learning Resources:

Text Books:

1. Michael John Sebastian Smith, Application - Specific Integrated Circuits, Addison-Wesley Professional, 2005.
2. Chris Spear, System Verilog for Verification – A guide to learning the Test bench language features, Springer Publications, Second Edition, 2010.

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Use EDA tool to design basic Analog blocks like amplifiers and 4-bit RAM
- Prepare a white paper on ASIC design flow referring to literatures of Cadence and Synopsys EDA tools
- Mini project using System Verilog

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VII Semester

Optical & Wireless Communication			
Course Code	**21EC72**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	2:0:0:1	SEE Marks	50
Total Hours of Pedagogy	30	Total Marks	100
Credits	2	Exam Hours	3

Non-MCQ pattern of CIE and SEE

Course objectives:

This course will enable students to:

- Learn the basic principle of optical fiber communication with different modes of light propagation.
- Understand the transmission characteristics and losses in optical fiber.
- Study of optical components and its applications in optical communication networks.
- Understand the concepts of propagation over wireless channels from a physics standpoint
- Understand the multiple access techniques used in cellular communications standards.
- Application of Communication theory both Physical and networking to understand GSM systems that handle mobile telephony.

Teaching-Learning Process (General Instructions)

The sample strategies, which the teacher can use to accelerate the attainment of the various course outcomes are listed in the following:

1. Lecture method (L) does not mean only the traditional lecture method, but a different type of teaching method may be adopted to develop the outcomes.
2. Show Video/animation films to explain the functioning of various techniques.
3. Encourage collaborative (Group) Learning in the class
4. Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
6. Topics will be introduced in multiple representations.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Optical Fiber Structures: Optical Fiber Modes and Configurations, Mode theory for circular waveguides, Single mode fibers, Fiber materials.

Attenuation and Dispersion: Attenuation, Absorption, Scattering Losses, Bending loss, Signal Dispersion: Modal delay, Group delay, Material dispersion.

[Text1 : 3.1, 3.2, 2.3[2.3.1 to 2.3.4], 2.4[2.4.1, 2.4.2],2.5, 2.7].

Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2, L3

Module-2

Optical Sources and detectors: Light Emitting Diode: LED Structures, Light source materials, Quantum efficiency and LED power, Laser Diodes: Modes and threshold conditions, Rate equations, External quantum efficiency, Resonant frequencies, Photodetectors: The pin Photodetector, Avalanche Photodiodes.

WDM Concepts: Overview of WDM, Isolators and Circulators, Fiber grating filters, Dielectric thin-film filters, Diffraction Gratings. [Text1: 4.2 ,4.3, 6.1, 10.1, 10.3, 10.4, 10.5, 10.7]	
Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2, L3
Module-3	
Mobile Communication Engineering: Wireless Network generations, Basic propagation Mechanisms, Mobile radio Channel. **Principles of Cellular Communications:** Cellular terminology, Cell structure and Cluster, Frequency reuse concept, Cluster size and system capacity, Frequency Reuse Distance, Cochannel Interference and signal quality. [Text2: 1.4, 2.4, 2.5, 4.1 to 4.4, 4.6, 4.7]	
Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2, L3
Module-4	
Multiple Access Techniques: FDMA, TDMA, CDMA, SDMA, Hybrid Multiple Access Techniques, Multicarrier Multiple Access Schemes. **A Basic Cellular System:** A basic cellular system connected to PSTN, Parts of basic cellular system, Operation of a cellular system. [Text2: 8.2, 8.3, 8.4.5, 8.5, 8.6, 8.10, 9.2.2, 9.2.3, 9.3]	
Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2, L3
Module-5	
Global System for Mobile (GSM): GSM Network Architecture, GSM signalling protocol architecture, Identifiers used in GSM system, GSM Channels, Frame structure for GSM, GSM Call procedures, GSM hand-off Procedures, GSM Services and features. [Text2: 11.1, 11.2,11.3,11.4, 11.5, 11.8, 11.9. 11.10]	
Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2, L3

Course outcomes (Course Skill Set)

At the end of the course the student will be able to:

1. Classification and characterization of optical fibers with different modes of signal propagation.
2. Describe the constructional features and the characteristics of optical fiber and optical devices used for signal transmission and reception.
3. Understand the essential concepts and principles of mobile radio channel and cellular communication.
4. Describe various multiple access techniques used in wireless communication systems.
5. Describe the GSM architecture and procedures to establish call set up, call progress handling and call tear down in a GSM cellular network.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation (CIE):

CIE will be the same as other core theory courses.

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.
Semester End Examination (SEE):

For non-MCQ pattern of CIE and SEE

Continuous Internal Evaluation (CIE):

At the beginning of the semester, the instructor/faculty teaching the course has to announce the methods of CIE for the course.

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module. Marks scored out of 100 shall be reduced proportionally to 50 marks

Suggested Learning Resources:

Text Books

1. Gerd Keiser, Optical Fiber Communication, 5th Edition, McGraw Hill Education (India) Private Limited, 2016. ISBN:1-25-900687-5.
2. T L Singal, Wireless Communications, McGraw Hill Education (India) Private Limited, 2016, ISBN:0-07-068178-3.

Reference Books

1. John M Senior, Optical Fiber Communications, Principles and Practice, 3rd Edition, Pearson Education, 2010, ISBN:978-81-317-3266-3
2. Theodore Rappaport, Wireless Communications: Principles and Practice, 2nd Edition, Prentice Hall Communications Engineering and Emerging Technologies Series, 2002, ISBN 0-13-042232-0.
3. Gary Mullet, Introduction to Wireless Telecommunications Systems and Networks, First Edition, Cengage Learning India Pvt Ltd., 2006, ISBN - 13: 978-81-315-0559-5.

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VII Semester

Optical & Satellite Communication			
Course Code	**21EC741**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	3:0:0:1	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course objectives: This course will enable students to:

- Learn the basic principle of optical fiber communication with different modes of light propagation.
- Understand the transmission characteristics and losses in optical fiber.
- Study of optical components and its applications in optical communication networks.
- Understand the basic principle of satellite orbits and trajectories.
- Study of electronic systems associated with a satellite and the earth station.
- Study satellite applications focusing various domains services such as remote sensing, weather forecasting and navigation.

Teaching-Learning Process (General Instructions)

The sample strategies, which the teacher can use to accelerate the attainment of the various course outcomes are listed in the following:

1. Lecture method (L) does not mean only the traditional lecture method, but a different type of teaching method may be adopted to develop the outcomes.
2. Show Video/animation films to explain the functioning of various techniques.
3. Encourage collaborative (Group) Learning in the class
4. Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
6. Topics will be introduced in multiple representations.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Optical Fiber Structures: Optical Fiber Modes and Configurations, Mode theory for circular waveguides, Single mode fibers, Fiber materials, Photonic Crystal Fibers, Fiber Optic Cables.
Attenuation and Dispersion: Attenuation: Absorption, Scattering Losses, Bending loss, Signal Dispersion: Modal delay, Group delay, Material dispersion.
[Text1 : 2.3[2.3.1 to 2.3.4], 2.4[2.4.1, 2.4.2],2.5, 2.7,2.8, 2.11, 3.1, 3.2].

Teaching-Learning Process	Chalk and talk method, Power Point Presentation. Self-study topics: Optical Spectral bands, Basic optical laws and definitions. **RBT Level:** L1, L2, L3

Module-2

Optical Sources and detectors: Light Emitting Diode: LED Structures, Light source materials, Quantum efficiency and LED power, Laser Diodes: Modes and threshold conditions, Rate equations, External quantum efficiency, Resonant frequencies, Photodetectors: The pin Photodetector, Avalanche Photodiodes.
WDM Concepts: Overview of WDM, Isolators and Circulators, Fiber grating filters, Dielectric thin-film filters, Diffraction Gratings.

Optical Amplifiers: Basic Applications and types, Erbium doped fiber amplifiers. [Text1: 4.2 ,4.3, 6.1, 10.1, 10.3, 10.4, 10.5, 10.7, 11.1, 11.3.1,11.3.2]	
Teaching-Learning Process	Chalk and talk method, Power point presentation Self-study topics: Raman Amplifiers. **RBT Level:** L1, L2, L3
Module-3	
Satellite Orbit and Trajectories: Definition, Basic Principles, Orbital parameters, Injection velocity and satellite trajectory, Types of Satellite orbits. [Text2: 2.1, 2.2, 2.3,2.4,2.5] **Satellite In-orbit Operations:** Orbital perturbations, Satellite stabilization, Orbital effects on satellite's performance, Eclipses, Look angles: Azimuth angle, Elevation angle. [Text2: 3.3, 3.4, 3.5, 3.6, 3.7]	
Teaching-Learning Process	Chalk and talk method, Power Point Presentation. Self-study topics: Satellite launch sequence. **RBT Level:** L1, L2, L3
Module-4	
Satellite Hardware: Satellite Subsystems, Power supply subsystem, Attitude and Orbit control, Tracking, Telemetry and command subsystem, Payload. [Text2: 4.1, 4.5, 4.6, 4.7,4.8] **Earth Station:** Types of earth station, Architecture, Design considerations, Testing, Earth station Hardware, Satellite tracking. [Text2: 8.1, 8.2, 8.3,8.4,8.5,8.6]	
Teaching-Learning Process	Chalk and talk method, Power Point Presentation. Self-study topics: Mechanical structure and propulsion subsystem **RBT Level:** L1, L2, L3
Module-5	
Communication Satellites: Introduction, Related Applications, Frequency Bands, Payloads, Satellite Vs. Terrestrial Networks, Satellite Television, Satellite Data Communication Services. **Applications:** Remote Sensing Satellites: Classification, Orbits, payloads. Weather Forecasting Satellites: Overview, Fundamentals, orbits and payload. Global Positioning Satellite System.	
Teaching-Learning Process	Chalk and talk method, Power point presentation Self-study topics: Regional, National and International Satellite systems **RBT Level:** L1, L2, L3

Course outcomes (Course Skill Set)

At the end of the course the student will be able to:

1. Classification and characterization of optical fibers and devices used for optical communication.
2. Understand the principle of operation of optical devices used for multiplexing and amplification of light.
3. Describe the satellite orbits and its trajectories with the definitions of parameters associated with it.
4. Describe the electronic hardware systems associated with the satellite subsystem and earth station.
5. Understand the functioning of satellites for communication, remote sensing, and weather and navigation applications.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester

2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module. Marks scored out of 100 shall be reduced proportionally to 50 marks

Suggested Learning Resources:

Text Books:

1. Gerd Keiser, Optical Fiber Communication, 5th Edition, McGraw Hill Education (India) Private Limited, 2016. ISBN:1-25-900687-5.
2. Anil K Maini, Varsha Agrawal, Satellite Communication, Wiley India Pvt. Ltd., 2015, ISBN: 978-81-265-2071-8.

Reference Books:

1. John M Senior, Optical Fiber Communications, Principles and Practice, 3rd Edition, Pearson Education, 2010, ISBN:978-81-317-3266-3
2. Timothy Pratt, Charles Bostian, Jeremy Allnutt, Satellite Communications, 2nd Edition, Wiley India Pvt. Ltd , 2017, ISBN: 978-81-265-0833-4
3. Dennis Roddy, Satellite Communications, 4th Edition, McGraw- Hill International edition, 2006.

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VII Semester

ARM Embedded Systems			
Course Code	**21EC742**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	3:0:0:1	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course objectives:

This course will enable students to:

- Explain the architectural features and instructions of 32 bit ARM microcontroller
- Develop Programs using the various instructions of ARM for different Applications.
- Understand the basic hardware components and their selection method based on the characteristics and
- Attributes of an embedded system.
- Develop the hardware software co-design and firmware design approaches.
- Explain the need of real time operating system for embedded system applications.

Teaching-Learning Process (General Instructions)

The sample strategies, which the teacher can use to accelerate the attainment of the various course outcomes are listed in the following:

1. Lecture method (L) does not mean only the traditional lecture method, but a different type of teaching method may be adopted to develop the outcomes.
2. Show Video/animation films to explain the functioning of various techniques.
3. Encourage collaborative (Group) Learning in the class
4. Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
6. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
7. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.
8. Give programming assignments.

Module-1

ARM Embedded System: RISC Design Philosophy, ARM design Philosophy, Embedded System hardware and Embedded System software.
ARM Processor Fundamentals: Registers, Current Program Status Registers, Pipeline, Exceptions, Interrupts and the Vector table, Core Extensions, Architecture Revisions, ARM processor families
(Text1 : Chapter 1 and Chapter 2)

Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2, L3

Module-2

ARM Instructions: Introduction, Data Processing Instructions, Branch Instructions, Load – Store Instructions Software Instructions, Program Status Register Instructions, Conditional Execution.
Thumb Instructions: Thumb register usage, ARM – Thumb Interworking, Other branch Instructions, Data Processing instructions, Single and Multiple Register Load Store Instructions, Stack Instructions, Software Interrupt Instructions.
(Text1: Chapter 3 and chapter 4,)

Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2, L3

Module-3

Embedded System Components: Embedded Vs General computing system, Classification of Embedded systems, Major applications and purpose of ES. Elements of an Embedded System (Block diagram and explanation), Differences between RISC and CISC, Harvard and Princeton, Big and Little Endian formats, Memory (ROM and RAM types), Sensors, Actuators, Optocoupler, Communication Interfaces (I2C, SPI, IrDA, Bluetooth, Wi-Fi, Zigbee only)

(Text 2: All the Topics from Ch-1 and Ch-2 (Fig and explanation before 2.1) 2.1.1.6 to 2.1.1.8, 2.2 to 2.2.2.3, 2.3 to 2.3.2, 2.3.3.3, selected topics of 2.4.1 and 2.4.2 only).

Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2, L3

Module-4

Embedded System Design Concepts: Characteristics and Quality Attributes of Embedded Systems, Operational and non-operational quality attributes, Embedded Systems-Application and Domain specific, Hardware Software Co-Design and Program Modeling (excluding UML), Embedded firmware design and development (excluding C language).
Text 2: Ch-3, Ch-4 (4.1, 4.2.1 and 4.2.2 only), Ch-7 (Sections 7.1, 7.2 only), Ch-9 (Sections 9.1, 9.2, 9.3.1, 9.3.2 only)

Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2, L3

Module-5

RTOS and IDE for Embedded System Design: Operating System basics, Types of operating systems, Task, process and threads (Only POSIX Threads with an example program), Thread preemption, Preemptive Task scheduling techniques, Task Communication, Task synchronization issues – Racing and Deadlock, Concept of Binary and counting semaphores (Mutex example without any program), How to choose an RTOS, Integration and testing of Embedded hardware and firmware, Embedded system Development Environment – Block diagram (excluding Keil), Disassembler/decompiler, simulator, emulator and debugging techniques
(Text 2: Ch-10 (Sections 10.1, 10.2, 10.3, 10.5.2 , 10.7, 10.8.1.1, 10.8.1.2, 10.8.2.2, 10.10 only), Ch-12, Ch-13 (a block diagram before 13.1, 13.3, 13.4, 13.5, 13.6 only)

Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2, L3

Course outcomes (Course Skill Set)

At the end of the course the student will be able to:

1. Describe the architectural features and instructions of 32 bit microcontroller ARM Cortex M3.
2. Apply the knowledge gained for Programming ARM Cortex M3 for different applications.
3. Understand the basic hardware components and their selection method based on the characteristics and attributes of an embedded system.
4. Develop the hardware software co-design and firmware design approaches.
5. Explain the need of real time operating system for embedded system applications.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module. Marks scored out of 100 shall be reduced proportionally to 50 marks

Suggested Learning Resources:

Text Books:

1. Andrew N Sloss, "ARM System Developer's guide", Elsevier Publications, 2016
2. Shibu K V, "Introduction to Embedded Systems", Tata McGraw Hill Education Private Limited, 2nd Edition.

Reference Books:

1. James K Peckol, "Embedded systems- A contemporary design tool", John Wiley, 2008.
2. Yifeng Zhu, "Embedded Systems with Arm Cortex-M Microcontrollers in Assembly Language and C", 2nd Ed., Man Press LLC ©, 2015.
3. K V K K Prasad, "Embedded real time systems", Dreamtech publications, 2003.
4. Rajkamal, "Embedded Systems",2nd Edition, McGraw hill Publications, 2010.

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VII Semester

Basic Digital Image Processing			
Course Code	**21EC743**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	2:0:2:1	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course objectives:

- Understand the fundamentals of digital image processing
- Understand the image enhancement techniques in spatial domain used in digital image processing
- Understand the frequency domain enhancement techniques in digital image processing
- Understand the Color Image Processing in digital image processing
- Understand the image restoration techniques and methods used in digital image processing

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Show Video/animation films to explain the functioning of various image processing concepts.
2. Encourage cooperative (Group) Learning through puzzles, diagrams, coding etc., in the class.
3. Encourage students to ask questions and investigate their own ideas helps improve their problem-solving skills as well as gain a deeper understanding of academic concepts.
4. Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking
5. Students are encouraged to do coding based projects to gain knowledge in image processing.
6. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
7. Topics will be introduced in multiple representations.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.
9. Arrange visits to nearby PSUs such as CAIR(DRDO), NAL, BEL, ISRO, etc., and small-scale software industries to give industry exposure.

Module-1

Digital Image Fundamentals: What is Digital Image Processing?, Origins of Digital Image Processing, Examples of fields that use DIP, Fundamental Steps in Digital Image Processing, Components of an Image Processing System, Elements of Visual Perception, Image Sensing and Acquisition, Image Sampling and Quantization, Some Basic Relationships Between Pixels.
[Text 1: Chapter 1, Chapter 2: Sections 2.1 to 2.5]

Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, YouTube videos, Videos on Image processing applications Self-study topics: Arithmetic and Logical operations Practical topics: Problems on Basic Relationships Between Pixels. **RBT Level:** L1, L2, L3

Module-2

Spatial Domain: Some Basic Intensity Transformation Functions, Histogram Processing, Fundamentals of Spatial Filtering, Smoothing Spatial Filters, Sharpening Spatial Filters
[Text 1: Chapter 3: Sections 3.2 to 3.6]

Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, YouTube videos and animations of Intensity Transformation Functions, Histogram Processing, Spatial domain filters. Self-study topics: Point, line and edge detection. Practical topics: Problems on Intensity Transformation Functions, Histogram, Spatial domain filters **RBT Level:** L1, L2, L3

Module-3

Frequency Domain: Basics of Filtering in the Frequency Domain, Image Smoothing and Image Sharpening Using Frequency Domain Filters.

[Text 1: Chapter 4: Sections 4.7 to 4.9]

Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, YouTube videos on frequency domain filtering, Color image processing. Self-study topics: Basic concept of segmentation. Practical topics: Problems on Image smoothing and sharpening **RBT Level:** L1, L2, L3

Module-4

Color Image Processing: Color Fundamentals, Color Models, Pseudo-color Image Processing.

[Text 1: Chapter 6: Sections 6.1 to 6.3]

Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, YouTube videos on Color image processing. Practical topics: Problems on Pseudo-color Image Processing **RBT Level:** L1, L2, L3

Module-5

Restoration: A model of the Image Degradation/Restoration Process, Noise models, Restoration in the Presence of Noise Only using Spatial Filtering and Frequency Domain Filtering, Inverse Filtering, Minimum Mean Square Error (Wiener) Filtering.

[Text 1: Chapter 5: Sections 5.1, to 5.4.3, 5.7, 5.8]

Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, YouTube videos on Noise models, filters and its applications. Self-study topics: Linear position invariant degradation, Estimation of degradation function. **RBT Level:** L1, L2, L3

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

1. Understand image formation and the role of human visual system plays in perception of gray and color image data.
2. Apply image processing techniques in spatial domains.
3. Apply image processing techniques in frequency (Fourier) domains.
4. Conduct independent study and analysis of Image Enhancement techniques.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester

3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module. Marks scored out of 100 shall be reduced proportionally to 50 marks

Suggested Learning Resources:

Text Book:

Digital Image Processing- Rafael C Gonzalez and Richard E Woods, PHI, 3rd Edition, 2010.

Reference Books:

1. Digital Image Processing- S Jayaraman, S Esakkirajan, T Veerakumar, Tata McGraw Hill, 2014.
2. Fundamentals of Digital Image Processing- A K Jain, PHI Learning Private Limited 2014.

Web links and Video Lectures (e-Resources)

- Image databases, https://imageprocessingplace.com/root_files_V3/image_databases.htm
- Student support materials, https://imageprocessingplace.com/root_files_V3/students/students.htm
- NPTEL Course, Introduction to Digital Image Processing, https://nptel.ac.in/courses/117105079
- Computer Vision and Image Processing, https://nptel.ac.in/courses/108103174
- Image Processing and Computer Vision – Matlab and Simulink,
- https://in.mathworks.com/solutions/image-video-processing.html

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Simulink models for Image processing

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VII Semester

Basic Digital Signal Processing			
Course Code	**21EC744**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	3:0:0:1	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course objectives:

This course will enable students to:

- **Preparation**: To prepare students with fundamental knowledge/ overview in the field of Signal Processing
- **Core Competence**: To equip students with a basic foundation of Signal Processing by delivering the mathematical description of discrete time signals and systems, classifying signals into different categories based on their properties, analyzing Linear Time Invariant (LTI)systems in time and transform domains, basics of FIR & IIR Filter Design

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecture method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
2. Show Video/animation films to explain the different concepts Digital Signal Processing.
3. Encourage collaborative (Group) Learning in the class.
4. Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
6. Topics will be introduced in a multiple representation.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.
9. Adopt Flipped class technique by sharing the materials / Sample Videos prior to the class and have discussions on the that topic in the succeeding classes
10. Give Programming Assignments.

Module-1	
Signal Definition, Signal Classification, System definition, System classification, for both continuous time and discrete time, Definition of LTI systems (Chapter1)	
Teaching-Learning Process	Chalk and talk method, YouTube videos, Flipped Class Technique, Programming assignments **RBT Level:** L1, L2, L3

Module-2	
Introduction to Fourier Transform, Fourier Series, Relating the Laplace Transform to Fourier Transform, Frequency response of continuous time systems (Chapter3)	
Teaching-Learning Process	Chalk and talk method, YouTube videos, Flipped Class Technique, Programming assignments **RBT Level:** L1, L2, L3

Module-3	
Frequency response of ideal analog filters, Salient features of Butterworth filters Design and implementation of Analog Butterworth filters to meet given specifications (Chapter8)	
Teaching-Learning Process	Chalk and talk method, YouTube videos, Flipped Class Technique, Programming assignments **RBT Level:** L1, L2, L3
Module-4	
Sampling Theorem- Statement and proof, converting the analog signal to a digital signal, Practical sampling, The Discrete Fourier Transform, Properties of DFT, Comparing the frequency response of analog and digital systems (FFT not included) (Chapter 3,4)	
Teaching-Learning Process	Chalk and talk method, YouTube videos, Flipped Class Technique, Programming assignments **RBT Level:** L1, L2, L3
Module-5	
Definition of FIR and IIR filters, Frequency response of ideal digital filters. Transforming the Analog Butterworth filter to the Digital IIR Filter using BLT to meet given specifications. Design of Low pass / High pass FIR Filters using the Window technique, to meet given specifications, Comparing the designed filter with the desired filter frequency response (Chapter8)	
Teaching-Learning Process	Chalk and talk method, Power point presentation, YouTube videos, Flipped Class Technique, Programming assignments **RBT Level:** L1, L2, L3

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

1. Understand the continuous time and discrete time signals and systems, in time and frequency domain
2. Apply the concepts of signals and systems to obtain the desired parameter/representation
3. Design analog/digital filters to meet given specifications
4. Design and implement the analog filter using components/suitable simulation tools
5. Design and implement the digital filter (FIR/IIR) using suitable simulation tools, and record the input and output of the filter for the given audio signal

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module. Marks scored out of 100 shall be reduced proportionally to 50 marks

Suggested Learning Resources:

Text Books:

1. 'Signals and Systems', Simon Haykin and Barry Van Veen, Wiley.
2. "Fundamentals of Digital Signal Processing", Lonnie C Ludeman, John Wiley and Sons, 1986.

Reference Books:

3. 'Theory and Application of Digital Signal Processing', Rabiner and Gold
4. 'Signals and Systems', Schaum's Outline series
5. 'Digital Signal Processing', Schaum's Outline series

Web links and Video Lectures (e-Resources)

By Prof. S C Dutta Roy, IIT Delhi
https://nptel.ac.in/courses/117102060

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Programming Assignments / Mini Projects can be given to improve programming skills

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VII Semester

E-waste Management			
Course Code	**21EC745**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	3:0:0:1	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course objectives:

- **Current Status:** According to a report on e-waste presented by the United Nations (UN) in World Economic Forum on January 24, 2019, the waste stream reached 48.5 MT in 2018. With such a large quantity of e-waste being generated each year, the future of e-waste recycling in India looks pretty bright. The E-waste (Management) Rules, 2016, enacted on October 1, 2017, added over 21 products (Schedule-I) under the purview of the rule.
- **Purview:** This course covers an extensive review of e-waste management in India. With a focus on the evolution of legal frameworks in India and the world, it presents impacts and outcomes; challenges and opportunities; and management strategies and practices to deal with e-waste. It also includes a survey of pan-India initiatives and trajectories of law-driven initiatives for effective e-waste management along with responses from industries and producers.
- **Scope:** There is a considerable scope for e-waste recycling in India. It is not only a solution to help mitigate e-waste management issues, but it also helps to generate employment. With the rise in e-waste recycling plants, the demand for employees with all levels of qualification and skills also increases.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecture method (L) does not mean only the traditional lecture method, but a different type of teaching method may be adopted to develop the outcomes.
2. Show Video/animation films to explain the functioning of various techniques.
3. Encourage collaborative (Group) Learning in the class
4. Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
6. Topics will be introduced in multiple representations.
7. Discuss how every concept can be applied to the real world - and when that's possible, it helps to improve the students' understanding.
8. Arrange visits to nearby industries to give industry exposure.

Module-1

Sustainable development and e-waste management: Importance of electrical and electronic equipment in a nation's development, and e-waste as toxic companion of digital era, I: Let's understand e-waste, II: E-waste statistics: quantities, collection and recycling, E-waste categories and harmonising statistics, III: An overview on status of e-waste related legislation across the globe; IV: UN initiatives for e-waste management: creating partnerships and achieving Agenda 2030; V: Indian scenario: e-waste generation, collection and recycling.

Teaching-Learning Process	Chalk and talk method, YouTube videos. **RBT Level:** L1, L2

Module-2

Extended producer responsibility: a mainstay for e-waste management: Evolution of concept of 'extended producer responsibility', EPR applied for waste management and extended for e-waste

management, EPR: goals, implementation, and challenges for e-waste management, EPR implemented for e-waste management under the existing regulatory frameworks in different countries, Role of a PRO prescribed in regulatory framework, Considerations for successful implementation of EPR, Challenges in implementation of EPR for e-waste management, Impact of EPR, EPR and e-waste management in India. **Toxicity and impacts on environment and human health**: Toxicity, recycling, and regulations, I: Environmental concerns, II: Human health concerns.	
Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, More examples relating to applications. **RBT Level:** L1, L2, L3
Module-3	
Treating e-waste, resource efficiency, and circular economy: Safe environment, resource use, and circular economy, Circular economy: recycling, resource recovery, and resource efficiency, Potentials of urban mining in circular economy, Recycling and resource efficiency related challenges to the circular economy, Urban mining, recycling, resource use, resource efficiency, and circular economy in India. **E-waste management through legislations in India**: I: Historical backdrop of regulatory regime for e-waste in India, II: E-waste (management) Rules, 2016 and E-waste (management) Amendment Rules, 2018, III: Analysing performance of EPR and CPCB as regulatory mechanisms, IV: Legal cases and judicial directives.	
Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation **RBT Level:** L1, L2, L3
Module-4	
Strategies and initiatives for dealing with e-waste in India: I: Overview of pan-India initiatives for dealing with e-waste during 2000 and 2012, II: Law-driven e-waste management – initiatives by the government, non-government agencies, and judiciary.	
Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation. **RBT Level:** L1, L2, L3
Module-5	
Moving towards horizons: I: Legal and judicial domain, II: Economic concerns, III: Environment concerns, IV: Recycling culture/recycling society.	
Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, More examples relating to applications. **RBT Level:** L1, L2, L3

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

1. Understand the existing discourse on e-waste and its management, statistics across the world, opportunities, and challenges w.r.t. regulatory framework, SDGs, CE, and LCIA (Life Cycle Impact Assessment) and MFA (Material Flow Analysis), Indian scenario.
2. Describe EPR, a regulatory framework for achieving specified goals across different countries and impacts on environment and human health.
3. Explain themes in the context of resource use and sustainable development. Urban mining, informal sector operations and need for resource use policy, financial support for recycling infrastructure building, etc. in Indian context and also explain to what extent – different aspects of e-waste management have been incorporated in the existing regulatory framework in comparison with international legislatures.
4. Identify and infer pan-Indian initiatives dealing with e-waste management, ranging from building knowledge base through research and social action by different stakeholders to technological and legal advancements, and industrial initiatives. Analyse roadmap for the Agenda 2030.
5. Use opportunities and challenges around four domains: legal and judicial domain; economic concerns; recycling culture/society; and environment concerns.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module. Marks scored out of 100 shall be reduced proportionally to 50 marks

Suggested Learning Resources:

Text Book:

Varsha Bhagat Gangulay, 'E-Waste Management', Taylor and Francis, 2022.

Web links and Video Lectures (e-Resources)

•https://link.springer.com/book/10.1007/978-3-030-14184-4
•https://rajyasabha.nic.in/rsnew/publication_electronic/E-Waste_in_india.pdf
•https://greene.gov.in/wp-content/uploads/2018/01/E-waste-Vol-II-E-waste-Management-Manual.pdf
•https://nptel.ac.in/courses/105105169

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

• Groups can be made to conduct a survey on the present scenario of India and top 5 countries facing ewaste management challenges.
• Industry visits to give an exposure of the e waste management process and also business.
• Case studies to develop e-waste management models.
• Survey of few e-waste management companies can be carried out and submit report.

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VII Semester

Advanced Design Tools for VLSI			
Course Code	**21EC721**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	3:0:0:1	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course objectives:

- Impart knowledge of EDA tools and methodology for FPGA
- Learn principles of IP core for FPGA and embedded systems
- Infer the concept of machine learning in fabrication and physical design

Teaching-Learning Process (General Instructions)

The sample strategies, which the teacher can use to accelerate the attainment of the various course outcomes are listed in the following:

1. Lecture method (L) does not mean only the traditional lecture method, but a different type of teaching method may be adopted to develop the outcomes.
2. Arrange visits to nearby PSUs and small-scale communication industries.
3. Show Video/animation films to explain the functioning of various techniques.
4. Encourage collaborative (Group) Learning in the class
5. Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking
6. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
7. Topics will be introduced in multiple representations.
8. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
9. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Introduction: Introduction, Prologue, EDA: From Methodologies, Algorithms, Tools to Integrated Circuits and Systems, EDA from Halcyon's Days to the Blooming Paradigm of Chip Industry, Categories of the EDA Tools, Quo Vadis, EDA? The Challenges and Opportunities, Designing the System as SoC Using the Soft IP Cores, Types of IP Cores, Design Issues Pertaining to the Soft IP Cores
Text Book1: 1.1 to 1.5, 1.7 to 1.10

Development of FPGA Based Network on Chip for Circumventing Spam: Introduction, Conception of the Spam Mail, FPGA Based Network on Chip for Circumventing Spam, Tools Infrastructure and Design Flow, Introducing Hardware-Software Co-design, Hardware Software Co-design, Framework Proposed in the Present Case Study, Description of System at Higher Level, Resolving the System a Step Down, System Design, Development of Soft IP Core of Bloom Filter, Presenting System Design of Purely Software Modules, Integrating of the Hardware-Software Modules Using EDK
Text Book1: 2.1 to 2.13

Teaching-Learning Process	Chalk and talk method, , PowerPoint Presentation, YouTube videos **RBT Level:** L1, L2, L3

Module-2

Analog Front End and FPGA Based Soft IP Core for ECG Logger: Prior Art, The Very Rationale of the System, Analog Front End of the Setup, VHDL Implementation of the ECG Soft IP Core, ModelSim Simulation Results, Synthesis Results Using Mentor Graphics Tool, Monitoring the ECG Using MODEM

Based Setup, ECG Signal Reconstruction Mechanism at the Hospital End, VHDL Listing for Driving the Analog Demultiplexer and Serial DAC from Spartan-3E FPGA, Discussion Regarding the VHDL Implementation, ModelSim Simulation Results, Synthesis Results Using Mentor Graphics Tool: Leonardo Spectrum. Text Book1: 3.1 to 3.12	
Teaching-Learning Process	Chalk and talk method/Power point presentation **RBT Level:** L1, L2, L3
Module-3	
FPGA Based Multifunction Interface for Embedded Applications: Introduction, Universal FPGA Based Interface for High End Embedded Applications, Soft IP Core for the LCD Interface, Soft IP Core for the DAC Interface, Handel C Listing of the Soft IP Core for the DAC Interface, Soft IP Core for the Linear Tech LTC6912-1 Dual Amp, Soft IP Core for the ADC Interface, Soft IP Core for the VGA Interface, Soft IP Core for the Keyboard Interface, Triangular Wave Generator Using DAC Text Book1: 4.1 - 4.10	
Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2, L3
Module-4	
Machine Learning for Compact Lithographic Process Models: Introduction, The Lithographic Patterning Process, Machine Learning of Compact Process Models, Neural Network Compact Patterning Models. Text Book2: 2.1 to 2.4 **Machine Learning for Mask Synthesis**: Introduction, Machine Learning-Guided OPC, Machine Learning-Guided EPC. Text Book2: 3.1 to 3.4	
Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2, L3
Module-5	
Machine Learning in Physical Verification, Mask Synthesis, and Physical Design: Introduction, Machine Learning in Physical Verification, Machine Learning in Mask Synthesis, Machine Learning in Physical Design. Text Book2: 4.1 to 4.4	
Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2, L3

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

1. Demonstrate the EDA methodologies and Tools for FPGA based NoC
2. Interpretation of soft core for ECG logger
3. Interfacing of DAC for embedded Application
4. Interpretation of Machine Learning for fabrication
5. Interpretation of ML in physical design

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester

2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module. Marks scored out of 100 shall be reduced proportionally to 50 marks

Suggested Learning Resources:

Text Books:

1. Rajanish K Kamat, Santosh A Shinde, Pawan K Gaikwad, Hansraj Guhilot, 'Harnessing VLSI System Design with EDA Tools', Springer, 2012.
2. Ibrahim (Abe) M Elfadel, Duane S Boning, Xin Li, 'Machine Learning in VLSI Computer-Aided Design', Springer, 2011.

Web links and Video Lectures (e-Resources)

- https://www.digimat.in/nptel/courses/video/117101004/L01.html
- https://www.youtube.com/watch?v=zC5b5_7oRKk

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VII Semester

Digital Image Processing			
Course Code	**21EC722**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	3:0:0:1	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course objectives:

- Understand the fundamentals of digital image processing.
- Understand the image transform used in digital image processing.
- Understand the image enhancement techniques in spatial domain used in digital image processing.
- Understand the Color Image Processing and frequency domain enhancement techniques in digital image processing.
- Understand the image restoration techniques and methods used in digital image processing.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Show Video/animation films to explain the functioning of various image processing concepts.
2. Encourage cooperative (Group) Learning through puzzles, diagrams, coding etc., in the class.
3. Encourage students to ask questions and investigate their own ideas helps improve their problem-solving skills as well as gain a deeper understanding of academic concepts.
4. Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking
5. Students are encouraged to do coding based projects to gain knowledge in image processing.
6. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
7. Topics will be introduced in multiple representations.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding
9. Arrange visits to nearby PSUs such as CAIR (DRDO), NAL, BEL, ISRO, etc., and small-scale software industries to give industry exposure.

Module-1

Digital Image Fundamentals: What is Digital Image Processing?, Origins of Digital Image Processing, Examples of fields that use DIP, Fundamental Steps in Digital Image Processing, Components of an Image Processing System, Elements of Visual Perception, Image Sensing and Acquisition, Image Sampling and Quantization, Some Basic Relationships Between Pixels.
[Text 1: Chapter 1, Chapter 2: Sections 2.1 to 2.5]

Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, YouTube videos, Videos on Image processing applications Self-study topics: Arithmetic and Logical operations Practical topics: Problems on Basic Relationships Between Pixels. **RBT Level:** L1, L2, L3

Module-2	
Image Transforms: Introduction, Two-Dimensional Orthogonal and Unitary Transforms, Properties of Unitary Transforms, Two-Dimensional DFT, cosine Transform, Haar Transform. Text 2: Chapter 5: Sections 5.1 to 5.3, 5.5, 5.6, 5.9]	
Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, YouTube videos of various transformation techniques and related applications. Self-study topics: Sine transforms, Hadamard transforms, KL transform, Slant transform. Practical topics: Problems on DFT and DCT **RBT Level:** L1, L2, L3
Module-3	
Spatial Domain: Some Basic Intensity Transformation Functions, Histogram Processing, Fundamentals of Spatial Filtering, Smoothing Spatial Filters, Sharpening Spatial Filters [Text: Chapter 3: Sections 3.2 to 3.6]	
Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, YouTube videos and animations of Intensity Transformation Functions, Histogram Processing, Spatial domain filters. Self-study topics: Point, line and edge detection. Practical topics: Problems on Intensity Transformation Functions, Histogram, Spatial domain filters **RBT Level:** L1, L2, L3
Module-4	
Frequency Domain: Basics of Filtering in the Frequency Domain, Image Smoothing and Image Sharpening Using Frequency Domain Filters. **Color Image Processing:** Color Fundamentals, Color Models, Pseudo-color Image Processing. [Text 1: Chapter 4: Sections 4.7 to 4.9 and Chapter 6: Sections 6.1 to 6.3]	
Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, YouTube videos on frequency domain filtering, Color image processing. Self-study topics: Basic concept of segmentation. Practical topics: Problems on Pseudo-color Image Processing **RBT Level:** L1, L2, L3
Module-5	
Restoration: A model of the Image Degradation/Restoration Process, Noise models, Restoration in the Presence of Noise Only using Spatial Filtering and Frequency Domain Filtering, Inverse Filtering, Minimum Mean Square Error (Wiener) Filtering. [Text 1: Chapter 5: Sections 5.1, to 5.4.3, 5.7, 5.8]	
Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, YouTube videos on Noise models, filters and its applications. Self-study topics: Linear position invariant degradation, Estimation of degradation function. **RBT Level:** L1, L2, L3

Course outcomes (Course Skill Set)

At the end of the course the student will be able to:

1. Understand image formation and the role of human visual system plays in perception of gray and color image data.
2. Compute various transforms on digital images.
3. Conduct independent study and analysis of Image Enhancement techniques.
4. Apply image processing techniques in frequency (Fourier) domain.
5. Design image restoration techniques.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module. Marks scored out of 100 shall be reduced proportionally to 50 marks

Suggested Learning Resources:

Text Books:

1. Digital Image Processing- Rafael C Gonzalez and Richard E Woods, PHI, 3rd Edition 2010.
2. Fundamentals of Digital Image Processing- A K Jain, PHI Learning Private Limited 2014.

Reference Book:

Digital Image Processing- S Jayaraman, S Esakkirajan, T Veerakumar, Tata McGraw Hill, 2014.

Web links and Video Lectures (e-Resources)

- Image databases, https://imageprocessingplace.com/root_files_V3/image_databases.htm
- Student support materials, https://imageprocessingplace.com/root_files_V3/students/students.htm
- NPTEL Course, Introduction to Digital Image Processing, https://nptel.ac.in/courses/117105079
- Computer Vision and Image Processing, https://nptel.ac.in/courses/108103174
- Image Processing and Computer Vision – Matlab and Simulink,
- https://in.mathworks.com/solutions/image-video-processing.html

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Verilog /VHDL coding for Image manipulation.
- Simulink models for Image processing.

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VII Semester

DSP Algorithms & Architecture			
Course Code	**21EC723**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	3:0:0:1	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course objectives:

This course will enable the students to

- Understand the concepts of digital signal processing techniques.
- Understand the computational building blocks of DSP processors and its speed issues.
- Understand the various addressing modes, peripherals, interrupts and pipelining structure of the TMS320C54xx processor.
- Learn how to interface the external devices to the TMS320C54xx processor in various modes.
- Understand DSP algorithms and applications with their implementation using TMS320C54xx processor.

Teaching-Learning Process (General Instructions)

The sample strategies, which the teacher can use to accelerate the attainment of the various course outcomes are listed in the following:

1. Lecture method (L) does not mean only the traditional lecture method, but a different type of teaching method may be adopted to develop the outcomes.
2. Show Video/animation films to explain the functioning of various techniques.
3. Encourage collaborative (Group) Learning in the class
4. Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
6. Topics will be introduced in multiple representations.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Introduction to Digital Signal Processing: Introduction, A Digital Signal – Processing system, Major features of programmable Digital signal processors, The Sampling Process, Discrete Time Sequences, Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT), Linear Time-Invariant Systems, Digital Filters, Decimation and Interpolation.
Section 1.3, 2.1 to 2.8 of Text 1

Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2, L3

Module-2

Architectures for Programmable Digital Signal Processing Devices: Introduction, Basic Architectural Features, DSP Computational Building Blocks, Bus Architecture and Memory, Data Addressing Capabilities, Address Generation Unit, Programmability and Program Execution, Speed Issues, Features for External Interfacing.
Section 4.1 to 4.9 of Text 1

Teaching-Learning	Chalk and talk method, Power point presentation

Process	**RBT Level:** L1, L2, L3
Module-3	
Programmable Digital Signal Processors: Introduction, Commercial Digital Signal-processing Devices, Data Addressing Modes of TMS32OC54XX, Memory Space of TMS32OC54xx Processors, Program Control. Detail Study of TMS320C54X & 54xx Instructions and Programming, On – Chip Peripherals, Interrupts of TMS32OC54XX Processors, Pipeline Operation of TMS32OC54xx Processor. Section 5.1 to 5.10 of Text 1	
Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2, L3
Module-4	
Implementation of Basic DSP Algorithms: Introduction, The Q – notation, FIR Filters, IIR Filters, Interpolation and Decimation Filters (one example in each case). **Implementation of FFT Algorithms**: Introduction, An FFT Algorithm for DFT Computation, Overflow and Scaling, Bit – Reversed Index. Generation & Implementation on the TMS32OC54xx. Section 7.1 to 7.6 and 8.1 to 8.6 of Text 1	
Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2, L3
Module-5	
Interfacing Memory and Parallel I/O Peripherals to Programmable DSP Devices: Introduction, Memory Space Organization, External Bus Interfacing Signals. Memory Interface, Parallel I/O Interface, Programmed I/O, Interrupts and I/O Direct Memory Access (DMA). **Interfacing and Applications of DSP Processors**: Introduction, Synchronous Serial Interface, A CODEC Interface Circuit, DSP Based Bio-telemetry Receiver, A Speech Processing System, An Image Processing System. Section 9.1 to 9.8, 10.1 to 10.5 and11.1 to 11.5 of Text 1	
Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2, L3

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

1. Comprehend the knowledge & concepts of digital signal processing techniques.
2. Apply knowledge of various types of addressing modes, interrupts, peripherals and pipelining structure of TMS320C54xx processor.
3. Develop assembly language programs to implement FIR, IIR filters and FFT algorithms.
4. Build the Applications on Programmable DSP devices.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20**

Marks (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module. Marks scored out of 100 shall be reduced proportionally to 50 marks

Suggested Learning Resources:

Text Book:

"Digital Signal Processing", Avatar Singh and S Srinivasan, Thomson Learning, 2004

Reference Books:

1. "Digital Signal Processing: A practical approach", Ifeachor E C, Jervis B. W Pearson-Education, PHI, 2002.
2. "Digital Signal Processors", B Venkataramani and M Bhaskar, TMH, 2nd Ed., 2010
3. "Architectures for Digital Signal Processing", Peter Pirsch, John Wiley.

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VII Semester

Biomedical Signal Processing			
Course Code	**21EC724**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	3:0:0:1	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course objectives:

This course will enable students to:

- Possess the basic mathematical, scientific and computational skills necessary to analyse ECG and EEG signals.
- Apply classical and modern filtering and compression techniques for ECG and EEG signals.
- Develop a thorough understanding on basics of ECG and EEG feature extraction.

Teaching-Learning Process (General Instructions)

The sample strategies, which the teacher can use to accelerate the attainment of the various course outcomes are listed in the following:

1. Lecture method (L) does not mean only the traditional lecture method, but a different type of teaching method may be adopted to develop the outcomes.
2. Show Video/animation films to explain the functioning of various techniques.
3. Encourage collaborative (Group) Learning in the class
4. Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking
5. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Introduction to Biomedical Signals: The nature of Biomedical Signals, Examples of Biomedical Signals, Objectives of Biomedical Signal analysis, Difficulties in Biomedical Signal analysis.
(Text-1: 1.1, 1.2, 1.3, 1.4)

Electrocardiography: Techniques used in electrocardiography, ECG Electrodes, the cardiac equivalent generator, genesis of the ECG, the standard and augmented limb leads, 12 lead ECG, the vectorcardiogram, ECG signal characteristics.
(Text-2: 2.1, 2.1.1, 2.1.2, 2.1.3, 2.1.4, 2.1.5, 2.2.1, 2.2.2, 2.3)

Signal Conversion: Simple signal conversion systems, Conversion requirements for biomedical signals, Signal converter characteristics, D to A converters, A to D converters, Sample and Hold circuit, Analog Multiplexer, Amplifiers
(Text-2: 3.2, 3.3, 3.4.1, 3.4.2, 3.4.3, 3.4.4, 3.4.5, 3.4.6).

Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, YouTube videos **RBT Level:** L1, L2, L3

Module-2

Signal Averaging: Basics of signal averaging, Signal averaging as a digital filter, a typical averager, Software for signal averaging, Limitations of signal averaging.
(Text-2: 9.1, 9.2, 9.3, 9.4, 9.5).

Adaptive Filters: Principal noise canceller model, 60-Hz adaptive cancelling using a sine wave model, Applications: Maternal ECG in fetal ECG, Cardiogenic artifact, detection of ventricular fibrillation and tachycardia. (Text-2: 8.1, 8.2, 8.3.1, 8.3.2, 8.3.3).

Teaching-Learning	Chalk and talk method, PowerPoint Presentation, YouTube videos

Process	**RBT Level:** L1, L2, L3
Module-3	
Data Reduction Techniques: Introduction, Turning point algorithm, AZTEC algorithm, Fano algorithm, Huffman coding: Static coding, Modified coding, Adaptive coding, Residual differencing, Runlength coding. (Text-2: 10.1, 10.2, 10.3, 10.4.1, 10.4.2, 10.4.3, 10.4.4, 10.4.5). **Time and Frequency domain techniques:** The Fourier transform for a discrete nonperiodic and periodic signals, the Fast Fourier transform, Correlation in time domain and in frequency domain, Convolution in time domain and in frequency domain, Power spectrum estimation: Parseval's theorem (Text-2: 11.1.1, 11.1.2, 11.1.3, 11.2.1, 11.2.2, 11.2.3, 11.3.1, 11.3.2, 11.3.3, 11.4.1)	
Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, YouTube videos **RBT Level:** L1, L2, L3
Module-4	
ECG QRS detection: Power spectrum of the ECG, Bandpass filtering techniques, Differentiation techniques, Template matching techniques: Template cross correlation, template subtraction, automata based template matching, a QRS detection algorithm. **ECG Analysis Systems:** Interpretation of the 12 lead ECG, ST segment analyzer, Portable arrhythmia monitor: Holter recording, software and hardware design, arrhythmia analysis (Text -2)	
Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, YouTube videos **RBT Level:** L1, L2, L3
Module-5	
Neurological signal processing: The brain and its potentials, origin of brain waves, the EEG signal and its characteristics, EEG analysis, Linear prediction theory, The Autoregressive method, Recursive estimation of AR parameters, Spectral error measure. (Text-3: 4.1, 4.2, 4.3 4.4, 4.5, 4.6, 4.7, 4.8) **Event detection and waveform analysis:** EEG rhythms, waves and transients, Detection of EEG rhythms, Template matching for EEG spike and wave detection, the matched filter (Text-1: 4.2.4, 4.4.1, 4.4.2, 4.6)	
Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2, L3

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

1. Describe the origin, properties and suitable models of important biological signals such as ECG and EEG.
2. Know the basic signal processing techniques in analysing biological signals.
3. Acquire mathematical and computational skills relevant to the field of biomedical signal processing.
4. Describe the basics of ECG signal compression algorithms.
5. Know the complexity of various biological phenomena.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester

3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module. Marks scored out of 100 shall be reduced proportionally to 50 marks

Suggested Learning Resources:

Books:

1. Biomedical Signal Analysis-Rangaraj M Rangayyan, John Wiley & Sons 2002
2. Biomedical Digital Signal Processing- Willis J Tompkins, PHI2001.
3. Biomedical Signal Processing Principles and Techniques-D C Reddy, McGraw-Hill publications, 2005.

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VII Semester

Speech Signal Processing			
Course Code	**21EC725**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course objectives:

- Introduce the models for speech production
- Develop Time domain and frequency domain speech processing techniques
- Introduce a predictive technique for speech compression
- Provide fundamental knowledge required to understand and analyze speech recognition, synthesis and speaker identification systems.

Teaching-Learning Process (General Instructions)

The sample strategies, which the teacher can use to accelerate the attainment of the various course outcomes are listed in the following:

1. Lecture method (L) does not mean only the traditional lecture method, but a different type of teaching method may be adopted to develop the outcomes.
2. Show Video/animation films to explain the functioning of various techniques.
3. Encourage collaborative (Group) Learning in the class
4. Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
6. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Fundamentals of Human Speech Production: The Process of Speech Production, Short-Time Fourier representation of Speech, The Acoustic Theory of Speech production, Digital Models for Sampled Speech Signals.

Teaching-Learning Process	Chalk and talk method, Power point presentations, Animation of process of speech production **RBT Level:** L1, L2, L3

Module-2

Time-Domain Methods for Speech Processing: Introduction to Short-Time Analysis of Speech, Short-Time Energy and Short-Time Magnitude, Short-Time Zero-Crossing Rate, The Short-Time Autocorrelation Function, Speech vs Silence detection.

Teaching-Learning Process	Chalk and talk method, Power point presentation Simulation of Short Time analysis algorithm using tools like Matlab/simulink **RBT Level:** L1, L2, L3

Module-3

Frequency Domain Representations: Discrete-Time Fourier Analysis, Short-Time Fourier Analysis, Overlap Addition (OLA) and Filter Bank Summation (FBS) Method of Synthesis, Time-Decimated Filter Banks, Two-Channel Filter Banks, Modifications of the STFT.

Teaching-Learning Process	Chalk and talk method, Power point presentation Visualization of speech using spectrogram **RBT Level:** L1, L2, L3

Module-4	
The Cepstrum and Homomorphic Speech Processing: Introduction, Homomorphic Systems for Convolution, Homomorphic Analysis of the Speech Model, Computing the Short-Time Cepstrum and Complex Cepstrum of Speech, Homomorphic Filtering of Natural Speech, Cepstrum Analysis of All-Pole Models, Cepstrum Distance Measures.	
Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2, L3
Module-5	
Linear Predictive Analysis of Speech Signals: Introduction to Basic Principles of Linear Predictive Analysis, Computation of the Gain for the Model, Frequency Domain Interpretations of Linear Predictive Analysis, Solution of the LPC Equations, The Prediction Error Signal.	
Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2, L3

Course outcomes (Course Skill Set)

At the end of the course the student will be able to:

1. Model speech production system and describe the fundamentals of speech.
2. Apply time domain and frequency domain algorithms, on speech to find, enhance and modify speech parameters.
3. Choose an appropriate processing technique for a given application.
4. Analyse speech recognition, synthesis and speaker identification systems

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question

papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module. Marks scored out of 100 shall be reduced proportionally to 50 marks

Suggested Learning Resources:

Text Books

1. **Digital Processing of Speech Signals** - L R Rabiner and R W Schafer, Pearson Education Asia, 2004.
2. **Theory and Applications of Digital Speech Processing**-Rabiner and Schafer, Pearson Education 2011.

Reference Books

1. **Fundamentals of Speech Recognition**- Lawrence Rabiner and Biing-Hwang Juang, Pearson Education, 2003.
2. **Speech and Language Processing**–An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition- Daniel Jurafsky and James H Martin, Pearson Prentice Hall, 2009.

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VII Semester

IoT & Wireless Sensor Networks			
Course Code	**21EC731**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course objectives:

- To provide an exposure to the broad perspective of Internet of Things with respect to the characteristics, design, technologies and applications.
- To provide a basic understanding of the important aspects of Wireless sensor networks covering applications, sensor and transmission technology & systems, middleware, performance and traffic management.

Teaching-Learning Process (General Instructions)

The sample strategies, which the teacher can use to accelerate the attainment of the various course outcomes are listed in the following:

1. Lecture method (L) does not mean only the traditional lecture method, but a different type of teaching method may be adopted to develop the outcomes.
2. Show Video/animation films to explain the various concepts.
3. Encourage collaborative (Group) Learning in the class
4. Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
6. Topics will be introduced in multiple representations.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Internet of Things: Introduction, Physical design, Logical design, Enabling technologies, Levels & deployment templates.
Text 1: Chapter 1

Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2, L3

Module-2

Domain Specific IoTs: Home automation, cities, environment, energy, retail, logistics, agriculture, industry, health & lifestyle.
Text 1: Chapter 2

Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2, L3

Module-3

Wireless Sensor Networks: Introduction, applications of sensor networks, basic overview of the technology, basic sensor network architectural elements, present day sensor network research, challenges and hurdles, examples of Category 2 WSN applications, examples of Category 1 WSN applications

Text 2: Chapter 1 – 1.1, 1.1.2, 1.2, 1.2.1, 1.2.2 (phase 4), 1.2.3 Chapter 2: 2.4, 2.5	
Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2, L3
Module-4	
Wireless sensor technology: Introduction, sensor node technology – overview, hardware and software, sensor taxonomy, WN operating environment, WN trends. **Wireless Transmission technology and systems:** Introduction, Campus applications, MAN/WAN applications. Text 2: Chapter 3: 3.1, 3.2 – 3.2.1, 3.2.2, 3.3, 3.4, 3.5 Chapter 4: 4.1, 4.3.1, 4.3.2	
Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2, L3
Module-5	
Middleware for WSNs: Introduction, principles, architecture, data related functions **Performance and traffic management:** background, WSN Design issues, performance modelling of WSNs. Text 2: Chapter 8: 8.1, 8.2, 8.3, 8.3.1 Chapter 11: 11.2, 11.3, 11.4	
Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2, L3

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

1. Understand the characteristics, building blocks, enabling technologies of the IoT systems
2. Describe the characteristics and applications of domain specific IoTs.
3. Discuss the overview of the Wireless sensor networks characteristics and applications.
4. Present the sensor, transmission technology and systems associated with WSN.
5. Understand the concepts of middleware, performance evaluation and traffic management in WSN.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per

the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module. Marks scored out of 100 shall be reduced proportionally to 50 marks

Suggested Learning Resources:

Text Books:

1. 'Internet of Things', Arshdeep Bagha and Vijay Madisetti, Universities Press, 2015
2. 'Wireless Sensor Networks', Kazem Sohraby, Daniel Minoli and Taieb Znati, Wiley, 2015.

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VII Semester

Network Security			
Course Code	**21EC732**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	3:0:0:1	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course objectives:

- **Preparation**: To prepare students with fundamental knowledge/ overview in the field of Network Security with knowledge of security mechanisms and services.
- **Core Competence**: To equip students with a basic foundation of Network Security by delivering the basics of Transport Level Security, Secure Socket Layer, Internet Protocol security, Intruders, Intrusion detection and Malicious Software, Firewalls, Firewall characteristics, Biasing and Configuration.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecture method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
2. Show Video/animation films to explain the different Network Security Techniques / Algorithms
3. Encourage collaborative (Group) Learning in the class
4. Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
6. Topics will be introduced in a multiple representation.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.
9. Adopt Flipped class technique by sharing the materials / Sample Videos prior to the class and have discussions on the that topic in the succeeding classes
10. Give Programming Assignments

Module-1

Attacks on Computers and Computer Security: Need for Security, Security Approaches, Principles of Security Types of Attacks. **(Text2: Chapter1)**
Security Mechanisms, Services and Attacks, A model for Network security **(Text1: Chapter1: 3, 4, 5, 6)**
Network Access Control, Extensible Authentication Protocol **(Text1: Chapter 16: Section 1,2)**

Teaching-Learning Process	Chalk and talk method, YouTube videos, Flipped Class Technique **RBT Level:** L1, L2, L3

Module-2

Transport Level Security: Web Security Considerations, Secure Sockets Layer, Transport Layer Security, HTTPS, Secure Shell (SSH) **(Text1: Chapter15)**

Teaching-Learning Process	Chalk and talk method YouTube videos, Flipped Class Technique and PPTs. Self-study topics: Block cipher modes, Cryptographic Hash functions and MAC codes **RBT Level:** L1, L2, L3

Module-3	
IP Security: Overview of IP Security (IPSec), IP Security Architecture, Modes of Operation, Security Associations (SA), Authentication Header (AH), Encapsulating Security Payload (ESP), Internet Key Exchange. **(Text1: Chapter19)**	
Teaching-Learning Process	Chalk and talk method, YouTube videos, Flipped Class Technique and PPTs. Self-study topics: OSI Model **RBT Level:** L1, L2, L3
Module-4	
Intruders: Intruders, Intrusion Detection, Password Management. **(Chapter20-Text1)** **MALICIOUS SOFTWARE:** Viruses and Related Threats, Virus Countermeasures, **(Chapter21-Text1)**	
Teaching-Learning Process	Chalk and talk method, YouTube videos, Flipped Class Technique and PPTs. **RBT Level:** L1, L2, L3
Module-5	
Firewalls: The Need for firewalls, Firewall Characteristics, Types of Firewalls, Firewall Biasing, Firewall location and configuration **(Chapter 22-Text 1)**	
Teaching-Learning Process	Chalk and talk method, YouTube videos, Flipped Class Technique and PPTs. **RBT Level:** L1, L2, L3

Course outcomes (Course Skill Set)

At the end of the course the student will be able to:

1. Explain network security services and mechanisms and explain security concepts
2. Understand the concept of Transport Level Security and Secure Socket Layer.
3. Explain Security concerns in Internet Protocol security
4. Explain Intruders, Intrusion detection and Malicious Software
5. Describe Firewalls, Firewall Characteristics, Biasing and Configuration

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per

the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module. Marks scored out of 100 shall be reduced proportionally to 50 marks

Suggested Learning Resources:

Text Books:

1. William Stallings, "Cryptography and Network Security Principles and Practice", Pearson Education Inc., 5th Edition, 2014, ISBN: 978-81-317- 6166-3
2. Atul Kahate, "Cryptography and Network Security", TMH, 2003.

Reference Books:

1. Cryptography and Network Security, Behrouz A Forouzan, TMH, 2007.
2. Introduction to Computer Security, Matt Bishop, Sathyanarayana S V, Pearson Education, 2006, ISBN 81-7758-425/1.

Web links and Video Lectures (e-Resources)

https://nptel.ac.in/courses/106105031
https://nptel.ac.in/courses/128106006

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Programming Assignments / Mini Projects can be given to improve programming skills.

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VII Semester

Fabrication Technology			
Course Code	**21EC733**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	3:0:0:1	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course objectives:

- Familiarise with the concepts of different processes involved in fabrication process and also with packaging issues.
- Apply principles to identify and analyse the various steps for the fabrication of various components.
- Introduce the fundamental concepts relevant to VLSI fabrication.
- Enable the students to understand the various VLSI fabrication techniques.

Teaching-Learning Process (General Instructions)

The sample strategies, which the teacher can use to accelerate the attainment of the various course outcomes are listed in the following:

1. Lecture method (L) does not mean only the traditional lecture method, but a different type of teaching method may be adopted to develop the outcomes.
2. Show Video/animation films to explain the functioning of various techniques.
3. Encourage collaborative (Group) Learning in the class.
4. Topics will be introduced in multiple representations.
5. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Crystal Growth and Wafer Preparation: Introduction, Electronic grade Silicon, Czochralski Crystal Growing, Silicon Shaping

Epitaxy: Introduction, Vapor-Phase Epitaxy

Text Book 1.1 to 1.4, 2.1 to 2.2

Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, Videos on crystal growth process Self-study topics: Mask Preparation **RBT Level:** L1, L2, L3

Module-2

Epitaxy: Molecular beam epitaxy, Epitaxial evaluation

Oxidation: Introduction, Growth mechanism and kinetics, Thin oxides, oxidation techniques, oxide properties, redistribution of dopants, oxidation of polysilicon, oxidation-induced defects

Text Book 2.3 and 2.5, 3.1 to 3.8

Teaching-Learning Process	Chalk and talk method, Power point presentation, videos on Epitaxial process Self-study topics: Advanced oxidation techniques **RBT Level:** L1, L2, L3

Module-3

Lithography: Introduction, Optical Lithography, Electron Lithography, X-ray lithography, Ion Lithography

Text Book 4.1 to 4.5

Teaching-	Chalk and talk method, PowerPoint Presentation, Videos on Lithography

Learning Process	Self-study topics: Sputtering and edge lithography **RBT Level:** L1, L2, L3

Module-4

Diffusion: Introduction, Models of diffusion in solids, fick's 1D diffusion equation, atomic diffusion mechanism, Diffussivities, Measurement techniques, fast diffusants in silicon, diffusion in polycrystalline silicon, diffusion in SiO2

Ion Implantation: Introduction, Implantation equipment

Text Book 7.1 to 7.9, 8.1 and 8.3

Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, Videos on diffusion method Self-study topics: Effect of doping concentration in diffusion process **RBT Level:** L1, L2, L3

Module-5

Ion Implantation: Annealing, Shallow Junctions, High energy implantation

Metallization: Introduction, Metallization applications, metallization choices, Metallization problems, New role of metallization.

Text Book 8.4 to 8.6, 9.1 to 9.7 (except 9.4 and 9.5)

Teaching-Learning Process	Chalk and talk method, Power point presentation, Videos on Annealing process Self-study topics: e-beam evaporation, plasma spray deposition **RBT Level:** L1, L2, L3

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

1. Understanding the process in the field of Fabrication technology.
2. Understand the properties and growth mechanism of oxidation.
3. Relate to the competing methods of various lithographic techniques and their limitations.
4. Analyse the diffusion profiles and models in various materials.
5. Describe the Metallization choices, properties and selection of optimum deposition process.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per

the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module. Marks scored out of 100 shall be reduced proportionally to 50 marks

Suggested Learning Resources:

Text Book:

VLSI Technology, S M Sze, 2nd edition, Mc Graw Hill.

Reference Books:

1. VLSI Fabrication Principles, S K Gandhi, John Willey & Sons.
2. Micromachined transducer, G T A Kovacs, McGraw Hill.

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(Effective from the academic year 2021 – 22)

VII Semester

Machine Learning with Python			
Course Code	**21EC734**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	2:0: 2:1	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course objectives:

- To understand the basic theory underlying machine learning.
- To be able to formulate machine learning problems corresponding to different applications.
- To understand a range of machine learning algorithms along with their strengths and weaknesses.
- To be able to apply machine learning algorithms to solve problems of moderate complexity.
- To apply the algorithms to a real-world problem, optimize the models learned and report on the expected accuracy that can be achieved by applying the models.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. In addition to the traditional lecture method, different types of innovative teaching methods may be adopted so that the delivered lessons shall develop student's theoretical and programming skills.
2. State the need for learning Machine Learning with real-life examples.
3. Support and guide the students for self–study.
4. You will also be responsible for assigning homework, grading assignments and quizzes, and documenting students & progress
5. Encourage the students for group learning to improve their creative and analytical skills.
6. Show short, related video lectures in the following ways:
    - As an introduction to new topics (pre-lecture activity).
    - As a revision of topics (post-lecture activity).
    - As additional examples (post-lecture activity).
    - As an additional material of challenging topics (pre-and post-lecture activity).
    - As a model solution of some real world problems. (post-lecture activity).

Module-1

Introduction:

Introduction to Machine Learning, Building intelligent machines to transform data into knowledge, The three different types of machine learning, An introduction to the basic terminology and notations, A roadmap for building machine learning systems, Using Python for machine learning.

Training Machine Learning Algorithms for Classification

Artificial neurons – a brief glimpse into the early history of machine learning, Implementing a perceptron learning algorithm in Python, Adaptive linear neurons and the convergence of learning.

Textbook 1: Chapters 1, 2

Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2, L3

Module-2

A Tour of Machine Learning Classifiers Using Scikit-Learn

Choosing a classification algorithm, First steps with scikit-learn, Modeling class probabilities via logistic regression, Maximum margin classification with support vector machines, Solving nonlinear problems using a kernel SVM, Decision tree learning, K-nearest neighbors – a lazy learning algorithm

Building Good Training Sets – Data Preprocessing Dealing with missing data, Handling categorical data, Partitioning a dataset in training and test sets, Bringing features onto the same scale, Selecting meaningful features, Assessing feature importance with random forests. Textbook 1: Chapters 3 ,4	
Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2, L3
Module-3	
Compressing Data via Dimensionality Reduction Unsupervised dimensionality reduction via principal component Analysis, Supervised data compression via linear discriminant analysis, Using kernel principal component analysis for nonlinear mappings **Learning Best Practices for Model Evaluation and Hyperparameter Tuning** Streamlining workflows with pipelines, Using k-fold cross-validation to assess model performance, Debugging algorithms with learning and validation curves, Fine-tuning machine learning models via grid search, Looking at different performance evaluation metrics **Applying Machine Learning to Sentiment Analysis** Obtaining the IMDb movie review dataset, Introducing the bag-of-words model, training a logistic regression model for document classification , Working with bigger data – online algorithms and out-of-core learning Textbook 1: Chapters 5,6,8	
Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2, L3
Module-4	
Embedding a Machine Learning Model into a Web Application Serializing fitted scikit-learn estimators, Setting up a SQLite database for data storage, Developing a web application with Flask, Turning the movie classifier into a web application, Deploying the web application to a public server **Predicting Continuous Target Variables with Regression Analysis** Introducing a simple linear regression model, Exploring the Housing Dataset, Implementing an ordinary least squares linear regression model, Fitting a robust regression model using RANSAC, Evaluating the performance of linear regression models, Using regularized methods for regression- Turning a linear regression model into a curve – polynomial regression Textbook 1: Chapters 9,10	
Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2, L3
Module-5	
Working with Unlabeled Data – Clustering Analysis Grouping objects by similarity using k-means, Organizing clusters as a hierarchical tree, **Training Artificial Neural Networks for Image Recognition** Modeling complex functions with artificial neural networks, Classifying handwritten digits, Training an artificial neural network, Other neural network architectures Textbook 1: Chapters 11,12	
Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2, L3

Course outcomes (Course Skill Set)

At the end of the course the student will be able to:

1. Appreciate the importance of visualization in the data analytics solution
2. Apply structured thinking to unstructured problems
3. Understand a very broad collection of machine learning algorithms and problems
4. Learn algorithmic topics of machine learning and mathematically deep enough to introduce the required theory
5. Develop an appreciation for what is involved in learning from data.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module. Marks scored out of 100 shall be reduced proportionally to 50 marks

Suggested Learning Resources:

Text Books:

1. Python Machine Learning by Sebastian Raschka, Published by Packt Publishing Ltd.
2. Machine Learning with Python for Everyone by Mark E Fenner
3. Machine Learning using Python by Manaranjan Pradhan & U Dinesh Kumar
4. Practical Machine Learning with Python by Dipanjan Sarkar, Raghav Bali &Tushar Sharma

Web links and Video Lectures (e-Resources)
• https://www.youtube.com/watch?v=RnFGwxJwx-0 • https://www.youtube.com/watch?v=eq7KF7JTinU
Activity Based Learning (Suggested Activities in Class)/ Practical Based learning • Using IRIS data set implement Adaline rule Classification Algorithm. • Implement Logistic Regression algorithm and generate corresponding graphs for overfitting and under fitting. • Implement linear SVM algorithm with maximum margin intuition. • Implement a kernel SVM to solve nonlinear problems. • Implement KNN Algorithm. • Implement decision tree algorithm. • Implement s rbf_kernel_pca for separating half-moon shapes. • Develop web application using flask.

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI
B.E: Electronics & Communication Engineering / B.E: Electronics & Telecommunication Engineering
NEP, Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
(Effective from the academic year 2021 – 22)

VII Semester

Multimedia Communication			
Course Code	**21EC735**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	3:0:0:1	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course objectives:

This course will enable students to:

- Understand the importance of multimedia in today's online and offline information sources and repositories.
- Understand the how Text, Audio, Image and Video information can be represented digitally in a computer so that it can be processed, transmitted and stored efficiently.
- Understand the Multimedia Transport in Wireless Networks
- Understand the Real-time multimedia network applications.
- Understand the Different network layer based application.

Teaching-Learning Process (General Instructions)

The sample strategies, which the teacher can use to accelerate the attainment of the various course outcomes are listed in the following:

1. Lecture method (L) does not mean only the traditional lecture method, but a different type of teaching method may be adopted to develop the outcomes.
2. Show Video/animation films to explain the functioning of various techniques.
3. Encourage collaborative (Group) Learning in the class
4. Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking
5. Topics will be introduced in multiple representations.
6. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1	
Multimedia Communications: Introduction, Multimedia information representation, Multimedia networks, multimedia applications, Application and networking terminology. (Chapter 1 of Text 1)	
Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2
Module-2	
Information Representation: Introduction, Digitization principles, Text, Images, Audio and Video. (Chapter 2 of Text 1)	
Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2, L3
Module-3	
Text and Image Compression: Introduction, Compression principles, text compression, image Compression. (Chapter 3 of Text 1)	
Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2, L3

Module-4	
Audio and video compression: Introduction, Audio compression, video compression, video compression principles, video compression. (Chapter 4 of Text 1)	
Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2, L3
Module-5	
Multimedia Information Networks: Introduction, LANs, Ethernet, Token ring, Bridges, FDDI High-speed LANs, LAN protocol (Chap. 8 of Text 1).	
Teaching-Learning Process	Chalk and talk method, Power point presentation **RBT Level:** L1, L2

Course outcomes (Course Skill Set)

At the end of the course the student will be able to:

1. Understand basics of different multimedia networks and applications.
2. Understand different compression techniques to compress audio and video.
3. Describe multimedia Communication across Networks.
4. Analyse different media types to represent them in digital form.
5. Compress different types of text and images using different compression techniques.

Assessment Details (both CIE and SEE)

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CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

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Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

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The students have to answer 5 full questions, selecting one full question from each module. Marks scored

out of 100 shall be reduced proportionally to 50 marks

Suggested Learning Resources:

Text Books:

Multimedia Communications- Fred Halsall, Pearson Education, 2001, ISBN -978813170994

Reference Books:

1. Multimedia: Computing, Communications and Applications- Raif Steinmetz, Klara Nahrstedt, Pearson Education, 2002, ISBN-978817758
2. Fundamentals of Multimedia – Ze-Nian Li, Mark S Drew, and Jiangchuan Liu.

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Implementation of compression algorithms using MATLAB/ any open source tools (Python, Scilab, etc.)

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI

B.E. in Civil Engineering

Scheme of Teaching and Examinations2021

Outcome Based Education(OBE) and Choice Based Credit System (CBCS)

(Effective from the academic year 2021 - 22)

III SEMESTER

Sl. No	Course and Course Code	Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
				Theory Lecture	Tutorial	Practical/ Drawing	Self -Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	T	P	S					
1	BSC 21MAT31	Transform Calculus, Fourier Series and Numerical Techniques (Common to all)	TD- Maths PSB-Maths	2	2	0	0	03	50	50	100	3
2	IPCC 21CV32	Geodetic Engineering	TD: Civil Engg PSB: Civil Engg	2	2	2	0	03	50	50	100	4
3	IPCC 21CV33	Strength of Materials	TD: Civil Engg PSB: Civil Engg	2	2	2	0	03	50	50	100	4
4	**PCC 21CV34**	**Earth Resources and Engineering**	**TD: Geology PSB: Geology**	**3**	**0**	**0**	**0**	**03**	**50**	**50**	**100**	**3**
5	PCC 21CVL35	Computer Aided Building Planning and Drawing	TD: Civil Engg PSB: Civil Engg	0	0	2	0	03	50	50	100	1
6	UHV 21UH36	Social Connect and Responsibility	Any Department	0	0	2	0	01	50	50	100	1
7	HSMC 21KSK37/47	Samskrutika Kannada	TD and PSB HSMC	0	2	0	0	01	50	50	100	1
	HSMC 21KBK37/47	Balake Kannada										
	OR											
	HSMC 21CIP37/47	Constitution of India and Professional Ethics										
8	AEC 21CV38X	Ability Enhancement Course - III	TD: Concerned department PSB: Concerned Board	If offered as Theory Course: 0	2	0		01	50	50	100	1
				If offered as lab. course: 0	0	2		02				
								Total	**400**	**400**	**800**	**18**
9	**Scheduled activities for III to VIII semesters**	NCMC 21NS83	National Service Scheme (NSS)	NSS	All students have to register for any one of the courses namely National Service Scheme, Physical Education (PE)(Sports and Athletics),and Yoga with the concerned coordinator of the course during the first week of III semester.The activities shall be carried out between III semester to VIII semester (for 5 semesters). SEE in the above courses shall be conducted during VIII semester examinations and the accumulated CIE marks shall be added to the SEE marks. Successful completion of the registered course is mandatory for the award of the degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the calendar prepared for the NSS, PE, and Yoga activities.								
		NCMC 21PE83	Physical Education (PE)(Sports and Athletics)	PE								
		NCMC 21YO83	Yoga	Yoga								

Course prescribed to lateral entry Diploma holders admitted to III semester B.E./B.Tech programs

1	NCMC 21MATDIP31	Additional Mathematics - I	Maths	02	02	--	--	---	100	---	100	0

Note:BSC: Basic Science Course, **IPCC:** Integrated Professional Core Course, **PCC:** Professional Core Course,**INT** –Internship, **HSMC:** Humanity and Social Science & Management Courses, **AEC**–Ability Enhancement Courses. **UHV:** Universal Human Value Course.

L –Lecture, **T –** Tutorial, P- Practical/ Drawing, **S –** Self Study Component, **CIE:** Continuous Internal Evaluation, **SEE:** Semester End Examination.**TD-**Teaching Department, **PSB**: Paper Setting department

21KSK37/47 Samskrutika Kannada is for students who speak, read and write Kannada and **21KBK37/47** Balake Kannada is for non-Kannada speaking, reading, and writing students.

Integrated Professional Core Course (IPCC): Refers to Professional Theory Core Course Integrated with practical of the same course. Credit for IPCC can be 04 and its Teaching–Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the

SEE question paper.For more details, the regulation governing the Degree of Bachelor of Engineering /Technology (B.E./B.Tech.) 2021-22 may be referred.

21INT49Inter/Intra Institutional Internship: All the students admitted to engineering programs under the lateral entry category shall have to undergo a mandatory 21INT49 Inter/Intra Institutional Internshipof 03 weeks during the intervening period of III and IV semesters. The internship shall be slated for CIE only and will not have SEE. The letter grade earned through CIE shall be included in the IV semester grade card.The internship shall be considered as a head of passing and shall be considered for vertical progression and for the award of degree. Those, who do not take up / complete the internship shall be declared fail and shall have to complete during subsequently after satisfying the internship requirements. The faculty coordinator or mentor shall monitor the students' internship progress and interact with them for the successful completion of the internship.

Non–credit mandatory courses (NCMC):

(A)Additional Mathematics I and II:

(1) These courses are prescribed for III and IV semesters respectively to lateral entry Diploma holders admitted to III semester of B.E./B.Tech., programs. They shall attend the classes during the respective semesters to complete all the formalities of the course and appear for the Continuous Internal Evaluation (CIE). In case, any student fails to register for the said course/fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have secured an F grade. In such a case, the student has to fulfill the course requirements during subsequent semester/s to earn the qualifying CIE marks. These courses are slated for CIE only and have no SEE.

(2) Additional Mathematics I and II shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses shall be mandatory for the award of degree.

(3) Successful completion of the coursesAdditional Mathematics I and IIshall be indicated as satisfactory in the grade card. Non-completion of the coursesAdditional Mathematics I and IIshall be indicated as Unsatisfactory.

(B) National Service Scheme/Physical Education (Sport and Athletics)/ Yoga:

(1) Securing 40 % or more in CIE,35 % or more marks in SEE, nd 40 % or more in the sum total of CIE + SEE leads to successful completion of the registered course.

(2) In case, students fail to secure 35 % marks in SEE, they have to appear for SEE during the subsequent examinations conducted by the University.

(3) In case, any student fails to register for NSS, PE or Yoga/fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have not completed the requirements of the course. In such a case, the student has to fulfill the course requirements during subsequent semester/s to earn the qualifying CIE marks.

(4) Successful completion of the course shall be indicated as satisfactory in the grade card. Non-completion of the course shall be indicated as Unsatisfactory.

(5) These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses shall be mandatory for the award of degree.

Ability Enhancement Course - III			
21CV381	Problem Solving using Python	21CV384	Infrastructure Finance
21CV382	Microsoft Excel and Visual Basic for Application	21CV385	Fire Safety in Buildings
21CV383	Personality Development and Soft Skills		

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI

B.E. in Civil Engineering

Scheme of Teaching and Examinations 2021

Outcome-Based Education(OBE) and Choice Based Credit System (CBCS)

(Effective from the academic year 2021 - 22)

IV SEMESTER

Sl. No	Course and Course Code	Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
				Theory Lecture	Tutorial	Practical/ Drawing	Self -Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	T	P	S					
1	BSC **21MAT41**	Complex Analysis, Probability and Statistical Methods.	TD, PSB-Maths	2	2	0	0	03	50	50	100	3
2	IPCC 21CV42	Fluid Mechanics and Hydraulics	TD: Civil Engg PSB: Civil Engg	2	2	2	0	03	50	50	100	4
3	IPCC 21CV43	Public Health Engineering	TD: Civil Engg PSB: Civil Engg	2	2	2	0	03	50	50	100	4
4	PCC 21CV44	Analysis of Structures	TD: Civil Engg PSB: Civil Engg	2	2	0	0	03	50	50	100	3
5	AEC 21BE45	Biology for Engineers	BT, CHE, PHY	1	2	0	0	02	50	50	100	2
6	PCC 21CVL46	Earth Resources and Engineering Lab	TD: Geology PSB: Geology	0	0	2	0	03	50	50	100	1
7	HSMC 21KSK37/47	Samskrutika Kannada	HSMC	0	2	0	0	01	50	50	100	1
	HSMC 21KBK37/47	Balake Kannada										
	OR											
	HSMC 21CIP37/47	Constitution of India & Professional Ethics										
8	AEC 21CV48X	Ability Enhancement Course- IV	TD and PSB: Concerned department	If offered as theory Course: 0	2	0		01	50	50	100	1
				If offered as lab. course: 0	0	2		02				
9	UHV 21UH49	UniversalHumanValues	Any Department	0	2	0		01	50	50	100	1
10	INT 21INT49	Inter/Intra Institutional Internship	Evaluation By the appropriate authorities	Completed during the intervening period ofII and III semesters by students admitted to first year of BE./B.Tech and during the intervening period of III and IV semesters by Lateral entry students admitted to III semester.				3	100	--	100	2
								Total	**550**	**450**	**1000**	**22**

Course prescribed to lateral entry Diploma holders admitted to III semester of Engineering programs

1	NCMC 21MATDIP41	Additional Mathematics - II	Maths	02	02	--	--	--	100	--	100	0

Note: BSC: Basic Science Course, IPCC: Integrated Professional Core Course, PCC: Professional Core Course, AEC –Ability Enhancement Courses, HSMC: Humanity and Social Science and Management Courses, UHV- Universal Human Value Courses.

L –Lecture, T – Tutorial, P- Practical/ Drawing, S – Self Study Component, CIE: Continuous Internal Evaluation, SEE: Semester End Examination.

21KSK37/47 Samskrutika Kannada is for students who speak, read and write Kannada and 21KBK37/47 Balake Kannada is for non-Kannada speaking, reading, and writing students.

Integrated Professional Core Course (IPCC): Refers to Professional Theory Core Course Integrated with Practical of the same course. Credit for IPCC can be 04 and its Teaching–Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCCshall be included in the SEE question paper.For more details, the regulation governing the Degree of Bachelor of Engineering /Technology (BE/B.Tech.) 2021-22 may be referred.

Non – credit mandatory course (NCMC):

Additional Mathematics - II:

(1) Lateral entry Diploma holders admitted to III semester of B.E./B.Tech., shall attend the classes during the IV semester to complete all the formalities of the course and appear for the Continuous Internal Evaluation (CIE). In case, any student fails to register for the said course/fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have secured an F grade. In such a case, the student has to fulfill the course requirements during subsequent semester/s to earn the qualifying CIE marks. These courses are slated for CIE only and have no SEE.

(2) Additional Mathematics I and II shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses shall be mandatory for the award of degree.

(3) Successful completion of the course Additional Mathematics IIshall be indicated as satisfactory in the grade card. Non-completion of the courses. Additional Mathematics IIshall be indicated as Unsatisfactory.

Ability Enhancement Course - IV			
21CV481	Data Cleaning and Preparation with Python Pandas	21CV484	Project Finance
21CV482	GIS with Quantum GIS	21CV485	Green Buildings
21CV483	Technical Writing Skills		

Internship of 04 weeks during the intervening period of IV and V semesters; 21INT68Innovation/ Entrepreneurship/ Societal Internship.

(1) All the students shall have to undergo a mandatory internship of 04 weeks during the intervening period of IV and V semesters. The internship shall be slated for CIE only and will not have SEE. The letter grade earned through CIE shall be included in the VI semester grade card.The internship shall be considered as a head of passing and shall be considered for vertical progression and for the award of degree. Those, who do not take up / complete the internship shall be considered under F (fail) grade and shall have to complete it subsequently after satisfying the internship requirements.

(2)Innovation/ Entrepreneurship Internshipshall be carried out at industry, State and Central Government /Non-government organizations (NGOs), micro, small and medium enterprises (MSME), Innovation centres, or Incubation centers etc. Innovation need not be a single major breakthrough; it can also be a series of small or incremental changes. Innovation of any kind can also happen outside of the business world.

Entrepreneurship internships offer a chance to gain hands-on experience in the world of entrepreneurship and help to learn what it takes to run a small entrepreneurial business by performing intern duties with an established company. This experience can then be applied to future business endeavors.Start-ups and small companies are a preferred places to learn the business tactics for future entrepreneurs as earning how a small business operates will serve the intern well when he/she manages his/her own company. Entrepreneurship acts as a catalyst to open minds to creativity and innovation.Entrepreneurship internships can be from several sectors, including technology, small and medium-sized sector, and the service sector.

(3) **Societal or Social internship.**Urbanization is increasing on a global scale; and yet, half the world's population still resides in rural areas and is devoid of many things that urban population enjoys. The rural internship is a work-based activity in which students will have a chance to solve/reduce the problems of the rural place for better living.

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(Effective from the academic year 2021 - 22)

V SEMESTER

Sl. No	Course and Course Code	Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
				Theory Lecture	Tutorial	Practical/ Drawing	Self -Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	T	P	S					
1	BSC 21CV51	Hydrology and Water Resources Engineering	TD: Civil Engg PSB: Civil Engg	3	0	0		03	50	50	100	3
2	IPCC 21CV52	Transportation Engineering	TD: Civil Engg PSB: Civil Engg	2	2	2		03	50	50	100	4
3	PCC 21CV53	Design of RC Structural Elements	TD: Civil Engg PSB: Civil Engg	2	2	0		03	50	50	100	3
4	PCC 21CV54	Geotechnical Engineering	TD: Civil Engg PSB: Civil Engg	2	2	0		03	50	50	100	3
5	PCC 21CVL55	Geotechnical Engineering Lab	TD: Civil Engg PSB: Civil Engg	0	0	2		03	50	50	100	1
6	AEC 21CV56	Research Methodology & Intellectual Property Rights	TD: Any Department PSB: As identified by University	1	2	0		02	50	50	100	2
7	HSMC 21CIV57	Environmental Studies	TD: Civil/ Environmental /Chemistry/ Biotech. PSB: Civil Engg	0	2	0		1	50	50	100	1
8	AEC 21CV58X	Ability Enhancement Course-V	Concerned Board	If offered as Theory courses				01	50	50	100	1
				0	2	0						
				If offered as lab. courses				02				
				0	0	2						
								Total	**400**	**400**	**800**	**18**

Ability Enhancement Course - V

21CV581	Data Analysis with Python	21CV584	Quality Control and Quality Assurance
21CV582	Software Applications	21CV585	Offshore Structures
21CV583	Gender Sensitization		

Note: BSC: Basic Science Course, PCC: Professional Core Course, IPCC: Integrated Professional Core Course, AEC –Ability Enhancement Course INT – Internship, HSMC: Humanity and Social Science & Management Courses.

L –Lecture, T – Tutorial, P- Practical/ Drawing, S – Self Study Component, CIE: Continuous Internal Evaluation, SEE: Semester End Examination.

Integrated Professional Core Course (IPCC): refers to Professional Theory Core Course Integrated with Practical of the same course. Credit for IPCC can be 04 and its Teaching – Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by CIE only and there shall be no SEE. For more details, the regulation governing the Degree of Bachelor of Engineering /Technology (BE/B.Tech.) 2021-22 may be referred.

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VI SEMESTER

Sl. No	Course and Course Code	Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
				Theory Lecture	Tutorial	Practical/ Drawing	Self -Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	T	P	S					
1	HSMC 21CV61	Construction Management and Entrepreneurship	TD: Civil Engg PSB: Civil Engg	3	0	0		03	50	50	100	3
2	IPCC 21CV62	Concrete Technology	TD: Civil Engg PSB: Civil Engg	2	2	2		03	50	50	100	4
3	PCC 21CV63	Design of Steel structure	TD: Civil Engg PSB: Civil Engg	2	2	0		03	50	50	100	3
4	PEC 21CV64x	Professional Elective Course-I	TD: Civil Engg PSB: Civil Engg	3	0	0		03	50	50	100	3
5	OEC 21CV65x	Open Elective Course-I	Concerned Department	3	0	0		03	50	50	100	3
6	PCC 21CVL66	Computer Aided Detailing of Structure	TD: Civil Engg PSB: Civil Engg	0	0	2		03	50	50	100	1
7	MP 21CVMP67	Mini Project - Extensive survey project	TD: Civil Engg PSB: Civil Engg	Two contact hours /week for interaction between the faculty and students.				--	100	--	100	2
8	INT 21INT68	Innovation/Entrepreneurship /Societal Internship	Completed during the intervening period of IV and V semesters.					--	100	--	100	3
								Total	**500**	**300**	**800**	**22**

Professional Elective - I

21CV641	Design of Prestressed Concrete Structures	21CV644	Design Concept in Building Services
21CV642	Applied Geotechnical Engineering	21CV645	Ground Water Hydraulics
21CV643	Railways, Harbours, Tunnelling and Airports	21CV646	Alternative Building Materials

Open Electives – I offered by the Department to other Department students

21CV651	Remote Sensing and GIS	21CV653	Occupational Health and Safety
21CV652	Traffic Engineering	21CV654	Conservation of Natural Resources

Note:HSMC: Humanity and Social Science & Management Courses, **IPCC:** Integrated Professional Core Course, **PCC:** Professional Core Course, **PEC:** Professional Elective Courses, O**EC**–Open Elective Course, **MP** –Mini Project, INT –Internship.
L –Lecture, **T** – Tutorial, **P** - Practical / Drawing, **S** – Self Study Component, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Examination.

Integrated Professional Core Course (IPCC): Refers to Professional Theory Core Course Integrated with Practical of the same course. Credit for IPCC can be 04 and its Teaching – Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by CIE only and there shall be no SEE. For more details, the regulation governing the Degree of Bachelor of Engineering /Technology (BE/B.Tech) 2021-22 may be referred.

Professional Elective Courses(PEC):
A professional elective (PEC) course is intended to enhance the depth and breadth of educational experience in the Engineering and Technology curriculum. Multidisciplinary courses that are added supplement the latest trend and advanced technology in the selected stream of engineering. Each group will provide an option to select one course. The minimum number of students' strengths for offering professional electives is 10. However, this conditional shall not be applicable to cases where the admission to the program is less than 10.

Open Elective Courses:
Students belonging to a particular stream of Engineering and Technology are not entitled to the open electives offered by their parent Department. However, they can opt for an elective offered by other Departments, provided they satisfy the prerequisite condition if any. Registration to open electives shall be documented under the guidance of the Program Coordinator/ Advisor/Mentor.
Selection of an open elective shall **not be allowed** if,

(i) The candidate has studied the same course during the previous semesters of the program.

(ii) The syllabus content of open electives is similar to that of the Departmental core courses or professional electives.

(iii) A similar course, under any category, is prescribed in the higher semesters of the program.

In case, any college is desirous of offering a course (not included in the Open Elective List of the University) from streams such as Law, Business (MBA), Medicine, Arts, Commerce, etc., can seek permission, at least one month before the commencement of the semester, from the University by submitting a copy of the syllabus along with the details of expertise available to teach the same in the college.

The minimum students' strength for offering open electives is 10. However, this conditional shall not be applicable to cases where the admission to the programme is less than 10.

Mini-project work – Extensive Survey Project: Mini Project is a laboratory-oriented course which will provide a platform to students to enhance their practical knowledge and skills by the development of small systems/applications.

Based on the ability/abilities of the student/s and recommendations of the mentor Mini- project can be assigned to a group having not more than 10 students.

CIE procedure for Mini-project – Extensive Survey Project:

The CIE marks shall be awarded by a committee consisting of the Head of the Department and two faculty members of the Department, one of them being the Guide. The CIE marks awarded for the Mini-project work shall be based on the evaluation of project report, project presentation skill, and question and answer session in the ratio of 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

No SEE component for Mini-Project.

VII semester Class work and Research Internship /Industry Internship (21INT82)

Swapping Facility

Institutions can swap VII and VIII Semester Scheme of Teaching and Examinations to accommodate research internship/ industry internship after the VI semester**.**

(2) Credits earned for the courses of VII and VIII Semester Scheme of Teaching and Examinations shall be counted against the corresponding semesters whether VII or VIII semester is completed during the beginning of IV year or later part of IV year of the program.

Elucidation:

At the beginning of IV years of the program i.e., after VI semester, VII semester classwork and VIII semester Research Internship /Industrial Internship shall be permitted to be operated simultaneously by the University so that students have ample opportunity for an internship. In other words, a good percentage of the class shall attend VII semester classwork and a similar percentage of others shall attend to Research Internship or Industrial Internship.

Research/Industrial Internship shall be carried out at an Industry, NGO, MSME, Innovation center, Incubation center, Start-up, center of Excellence (CoE), Study Centre established in the parent institute and /or at reputed research organizations/institutes.

The mandatory Research internship /Industry internship is for 24 weeks. The internship shall be considered as a head of passing and shall be considered for the award of a degree. Those, who do not take up/complete the internship shall be declared to fail and shall have to complete it during the subsequent University examination after satisfying the internship requirements.

INT21INT82Research Internship/ Industry Internship/Rural Internship

Research internship:A research internship is intended to offer the flavor of current research going on in the research field. It helps students get familiarized with the field and imparts the skill required for carrying out research.

Industryinternship: Isan extended period of work experience undertaken by students to supplement their degree for professional development. It also helps them learn to overcome unexpected obstacles and successfully navigate organizations, perspectives, and cultures. Dealing with contingencies helps students recognize, appreciate, and adapt to organizational realities by tempering their knowledge with practical constraints.

The faculty coordinator or mentor has to monitor the students' internship progress and interact with them to guide for the successful completion of the internship.

The students are permitted to carry out the internship anywhere in India or abroad. University shall not bear any expenses incurred in respect of internship.

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Swappable VII and VIII SEMESTER

VII SEMESTER

Sl. No	Course and Course Code	Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
				Theory Lecture	Tutorial	Practical/ Drawing	Self -Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	T	P	S					
1	PCC 21CV71	Quantity Survey and Contract Management	TD: Civil Engg PSB: Civil Engg	2	2	0		3	50	50	100	3
2	PCC 21CV72	Construction Technology for Substructure and Super Structures	TD: Civil Engg PSB: Civil Engg	2	0	0		3	50	50	100	2
3	PEC 21CV73X	Professional elective Course-II	TD: Civil Engg PSB: Civil Engg	3	0	0		3	50	50	100	3
4	PEC 21CV74X	Professional elective Course-III	TD: Civil Engg PSB: Civil Engg	3	0	0		3	50	50	100	3
5	OEC 21CV75X	Open elective Course-II	Concerned Department	3	0	0		3	50	50	100	3
6	Project 21CVP76	Project work	TD: Civil Engg PSB: Civil Engg	Two contact hours /week for interaction between the faculty and students.				3	100	100	200	10
								Total	**350**	**350**	**700**	**24**

VIII SEMESTER

Sl. No	Course and Course Code		Course Title	Teaching Department	Teaching Hours /Week				Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Self -Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	Seminar 21CV81		Technical Seminar	TD: Civil Engg PSB: Civil Engg	One contact hour /week for interaction between the faculty and students.				--	100	--	100	01
2	INT 21INT82		Research Internship/ Industry Internship	TD: Civil Engg PSB: Civil Engg	Two contact hours /week for interaction between the faculty and students.				03 (Batch wise)	100	100	200	15
3	NCMC	21NS83	National Service Scheme (NSS)	NSS	Completed during the intervening period of III semester toVIII semester.				--	50	50	100	0
		21PE83	Physical Education (PE) (Sports and Athletics)	PE									
		21YO83	Yoga	Yoga									
									Total	**250**	**150**	**400**	**16**

Professional Elective - II

21CV721	Advanced Design of RCC and Steel Structures	21CV724	Solid Waste Management
21CV722	Advanced Geotechnical Engineering	21CV725	Design of Hydraulic Structures
21CV723	Pavement Materials and Construction	21CV726	Repair, Retrofitting and Rehabilitation of Structures

Professional Elective - III

21CV731	Earthquake Engineering	21CV734	Air Pollution and Control
21CV732	Ground Improvement Techniques	21CV735	Open Channel Hydraulics
21CV733	Pavement Design	21CV736	Design of Masonry Structures

Open Electives - II offered by the Department to other Department students			
21CV741	Finite Element Method	21CV744	Intelligent Transportation Systems
21CV742	Numerical Methods and Applications		
21CV743	Environmental Protection and Management		

Note: PCC: Professional Core Course, **PEC:** Professional Elective Courses, **OEC**–Open Elective Course, **AEC** –Ability Enhancement Courses.
L –Lecture, T – Tutorial, P- Practical / Drawing, S – Self Study Component, CIE: Continuous Internal Evaluation, SEE: Semester End Examination.

Note: VII and VIII semesters of IV year of the programme

(1) Institutions can swap VII and VIII Semester Scheme of Teaching and Examinations to accommodate research internship/ industry internship after the VI semester**.**

(2) Credits earned for the courses of VII and VIII Semester Scheme of Teaching and Examinations shall be counted against the corresponding semesters whether VII or VIII semester is completed during the beginning of IV year or later part of IV year of the program.

PROJECT WORK (21XXP75): The objective of the Project work is

(i) To encourage independent learning and the innovative attitude of the students.
(ii) To develop interactive attitude, communication skills, organization, time management, and presentation skills.
(iii) To impart flexibility and adaptability.
(iv) To inspire team working.
(v) To expand intellectual capacity, credibility, judgment and intuition.
(vi) To adhere to punctuality, setting and meeting deadlines.
(vii) To install responsibilities to oneself and others.
(viii) To train students to present the topic of project work in a seminar without any fear, face the audience confidently, enhance communication skills, involve in group discussion to present and exchange ideas.

CIE procedure for Project Work:

(1) Single discipline: The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide.

The CIE marks awarded for the project work, shall be based on the evaluation of the project work Report, project presentation skill, and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

(2) Interdisciplinary: Continuous Internal Evaluation shall be group-wise at the college level with the participation of all guides of the college. Participation of external guide/s, if any, is desirable. The CIE marks awarded for the project work, shall be based on the evaluation of project work Report, project presentation skill, and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

SEE procedure for Project Work: SEE for project work will be conducted by the two examiners appointed by the University. The SEE marks awarded for the project work shall be based on the evaluation of project work Report, project presentation skill, and question and answer session in the ratio 50:25:25.

TECHNICAL SEMINAR (21XXS81): The objective of the seminar is to inculcate self-learning, present the seminar topic confidently, enhance communication skill, involve in group discussion for the exchange of ideas. Each student, under the guidance of a Faculty, shall choose, preferably, a recent topic of his/her interest relevant to the program of Specialization.

(i) Carry out a literature survey, and systematically organize the content. **(ii)** Prepare the report with your own sentences, avoiding a cut and paste act. **(iii)**Type the matter to acquaint with the use of Micro-soft equation and drawing tools or any such facilities. **(iv)** Present the seminar topic orally and/or through PowerPoint slides. **(v)** Answer the queries and involve in debate/discussion. (**vi)** Submit a typed report with a list of references.

The participants shall take part in the discussion to foster a friendly and stimulating environment in which the students are motivated to reach high standards and become self-confident.

Evaluation Procedure:

The CIE marks for the seminar shall be awarded (based on the relevance of the topic, presentation skill, participation in the question and answer session, and quality of report) by the committee constituted for the purpose by the Head of the Department. The committee shall consist of three teachers from the department with the senior-most acting as the Chairman.

Marks distribution for CIE of the course:

Seminar Report:50 marks
Presentation skill:25 marks
Question and Answer: 25 marks. ■No SEE component for Technical Seminar

Non–credit mandatory courses (NCMC):

National Service Scheme/Physical Education (Sport and Athletics)/ Yoga:

(1) Securing 40 % or more in CIE,35 % or more marks in SEE, and 40 % or more in the sum total of CIE + SEE leads to successful completion of the registered course.

(2) In case, students fail to secure 35 % marks in SEE, they have to appear for SEE during the subsequent examinations conducted by the University.

(3) In case, any student fails to register for NSS, PE or Yoga/fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have not completed the requirements of the course. In such a case, the student has to fulfill the course requirements during subsequently to earn the qualifying CIE marks subject to the maximum program period.

(4) Successful completion of the course shall be indicated as satisfactory in the grade card. Non-completion of the course shall be indicated as Unsatisfactory.

(5) These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses shall be mandatory for the award of a degree.

B. E. (Common to all branches)

Choice Based Credit System (CBCS) and Outcome-Based Education (OBE)

SEMESTER - III

TRANSFORM CALCULUS, FOURIER SERIES AND NUMERICAL TECHNIQUES			
Course Code	**21MAT 31**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	2:2:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course objectives: The goal of the course Transform Calculus, Fourier series and Numerical techniques 21MAT 31 is

- To have an insight into solving ordinary differential equations by using Laplace transform techniques
- Learn to use the Fourier series to represent periodical physical phenomena in engineering analysis.
- To enable the students to study Fourier Transforms and concepts of infinite Fourier Sine and Cosine transforms and to learn the method of solving difference equations by the z-transform method.
- To develop proficiency in solving ordinary and partial differential equations arising in engineering applications, using numerical methods

Teaching-Learning Process (General Instructions):

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. In addition to the traditional lecture method, different types of innovative teaching methods may be adopted so that the delivered lessons shall develop students' theoretical and applied mathematical skills.
2. State the need for Mathematics with Engineering Studies and Provide real-life examples.
3. Support and guide the students for self–study.
4. You will also be responsible for assigning homework, grading assignments and quizzes, and documenting students' progress.
5. Encourage the students for group learning to improve their creative and analytical skills.
6. Show short related video lectures in the following ways:
   - As an introduction to new topics (pre-lecture activity).
   - As a revision of topics (post-lecture activity).
   - As additional examples (post-lecture activity).
   - As an additional material of challenging topics (pre-and post-lecture activity).
   - As a model solution for some exercises (post-lecture activity).

Module-1: Laplace Transform

Definition and Laplace transforms of elementary functions (statements only). Problems on Laplace's Transform of $e^{at}f(t)$, $t^n f(t)$, $\frac{f(t)}{t}$. Laplace transforms of Periodic functions (statement only) and unit-step function – problems.

Inverse Laplace transforms definition and problems, Convolution theorem to find the inverse Laplace transforms (without Proof) problems. Laplace transforms of derivatives, solution of differential equations. **(8 Hours)**

Self-study: Solution of simultaneous first-order differential equations. **(RBT Levels: L1, L2 and L3)**	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-2: Fourier Series

Introduction to infinite series, convergence and divergence. Periodic functions, Dirichlet's condition. Fourier series of periodic functions with period 2π and arbitrary period. Half range Fourier series. Practical harmonic analysis. **(8 Hours)**

Self-study: Convergence of series by D'Alembert's Ratio test and, Cauchy's root test.

(RBT Levels: L1, L2 and L3)

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-3: Infinite Fourier Transforms and Z-Transforms

Infinite Fourier transforms definition, Fourier sine and cosine transforms. Inverse Fourier transforms, Inverse Fourier cosine and sine transforms. Problems.

Difference equations, z-transform-definition, Standard z-transforms, Damping and shifting rules, Problems. Inverse z-transform and applications to solve difference equations. **(8 Hours)**

Self Study: Initial value and final value theorems, problems.

(RBT Levels: L1, L2 and L3)

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-4: Numerical Solution of Partial Differential Equations

Classifications of second-order partial differential equations, finite difference approximations to derivatives, Solution of Laplace's equation using standard five-point formula. Solution of heat equation by Schmidt explicit formula and Crank- Nicholson method, Solution of the Wave equation. Problems. **(8 Hours)**

Self Study: Solution of Poisson equations using standard five-point formula.

(RBT Levels: L1, L2 and L3)

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-5: Numerical Solution of Second-Order ODEs and Calculus of Variations

Second-order differential equations - Runge-Kutta method and Milne's predictor and corrector method. (No derivations of formulae).

Calculus of Variations: Functionals, Euler's equation, Problems on extremals of functional. Geodesics on a plane, Variational problems. **(8 Hours)**

Self Study: Hanging chain problem

(RBT Levels: L1, L2 and L3)

Course outcomes: After successfully completing the course, the students will be able :

- To solve ordinary differential equations using Laplace transform.
- Demonstrate the Fourier series to study the behaviour of periodic functions and their applications in system communications, digital signal processing and field theory.
- To use Fourier transforms to analyze problems involving continuous-time signals and to apply Z-Transform techniques to solve difference equations
- To solve mathematical models represented by initial or boundary value problems involving partial differential equations
- Determine the extremals of functionals using calculus of variations and solve problems arising in dynamics of rigid bodies and vibrational analysis.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

First test at the end of 5th week of the semester

Second test at the end of the 10th week of the semester

Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

First assignment at the end of 4th week of the semester

Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

The question paper will have ten questions. Each question is set for 20 marks. Marks scored shall be proportionally reduced to 50 marks

There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

Suggested Learning Resources:

Text Books:

1. **B. S. Grewal**: "Higher Engineering Mathematics", Khanna publishers, 44th Ed.2018
2. **E. Kreyszig**: "Advanced Engineering Mathematics", John Wiley & Sons, 10th Ed. (Reprint), 2016.

Reference Books

1. **V. Ramana:** "Higher Engineering Mathematics" McGraw-Hill Education, 11th Ed.
2. **Srimanta Pal & Subodh C. Bhunia:** "Engineering Mathematics" Oxford University Press, 3rd Reprint, 2016.
3. **N.P Bali and Manish Goyal**: "A textbook of Engineering Mathematics" Laxmi Publications, Latest edition.
4. **C. Ray Wylie, Louis C. Barrett:** "Advanced Engineering Mathematics" McGraw – Hill Book Co.Newyork, Latest ed.
5. **Gupta C.B, Sing S.R and Mukesh Kumar:** "Engineering Mathematic for Semester I and II", Mc-Graw Hill Education(India) Pvt. Ltd 2015.
6. **H.K.Dass and Er. Rajnish Verma:** "Higher Engineering Mathematics" S.Chand Publication (2014).
7. **James Stewart: "**Calculus" Cengage publications, 7th edition, 4th Reprint 2019.

Web links and Video Lectures (e-Resources):
• http://.ac.in/courses.php?disciplineID=111 • http://www.class-central.com/subject/math(MOOCs) • http://academicearth.org/ • http://www.bookstreet.in. • VTU e-Shikshana Program • VTU EDUSAT Program
Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning • Quizzes • Assignments • Seminars

III Semester

Geodetic Engineering			
Course Code	**21CV32**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	2:2:2:0	SEE Marks	50
Total Hours of Pedagogy	50	Total Marks	100
Credits	4	Exam Hours	03

Course objectives:

- Provide basic knowledge about principles of surveying for location, design and construction of engineering projects
- Develop skills for using surveying instruments including, levelling instruments, plane tables, theodolite, compass
- Make students to familiar with cooperative efforts required in acquiring surveying data and applying fundamental concepts to eliminate errors and set out the works
- Provide information about new technologies that are used to abstracting the information of earth surface

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. The survey of India topomap has to be shared with students and few exercise must be given
2. The satellite imagery has to be procured and shared with students
3. The manual for conducting field survey has to be provided
4. The online courses available should be shared with students
5. YouTube videos
6. Power point presentations

Module-1

Introduction to Surveying: Importance of surveying in Civil Engineering, Concepts of plane and geodetic surveying Principles of surveying –Plans and maps – Surveying equipment's, Meridians, Bearings, Dip, Declination, Local attraction, Calculation of bearings and included angles. Compass surveying and Plane Table Surveying

Compass surveying: Prismatic and surveyor's compasses, temporary adjustments.

Plane Table Surveying: plane table and accessories, advantages and disadvantages of plane table survey, method of plotting - radiation, intersection, traversing, resection, two point and three point method

Teaching-Learning Process	Chalk and talk, PowerPoint Presentation, YouTube videos

Module-2

Levelling – Principles and basic definitions – Types of Levels – Types of adjustments and objectives – Types of levelling – Simple, Differential, Fly, Reciprocal, Profile, Cross sectioning – Booking of levels – Rise & fall and H. I methods (Numerical)

Areas and volumes: Measurement of area – by dividing the area into geometrical figures, area from offsets, mid ordinate rule, trapezoidal and Simpsons one third rule, area from co-ordinates, introduction to planimeter, digital planimeter. Measurement of volumes-trapezoidal and prismoidal formula.

Teaching-Learning	Chalk and talk, PowerPoint Presentation, YouTube videos

Process	

Module-3

Theodolite Surveying: Theodolite and types, fundamental axes and parts of theodolite, temporary adjustments of transit theodolite, Horizontal and Vertical angle measurements by repetition and reiteration Trigonometric levelling: Single and Double plane for finding elevation of objects Computation of distances and elevations using Tacheometric method.

Teaching-Learning Process	Chalk and talk, PowerPoint Presentation, YouTube videos

Module-4

Curve Surveying: Curves – Necessity – Types, Simple curves, Elements , Designation of curves, Setting out simple curves by linear methods (numerical problems on offsets from long chord & chord produced method), Setting out curves by Rankine's deflection angle method (numerical problems). Compound curves, Elements, Design of compound curves, Setting out of compound curves (numerical problems). Reverse curve between two parallel straights (numerical problems on Equal radius and unequal radius). Transition curves Characteristics, numerical problems on Length of Transition curve, Vertical curves –Types – (theory).

Teaching-Learning Process	Chalk and talk, PowerPoint Presentation, YouTube videos

Module-5

Photogrammetry and aerial survey: Introduction, definitions, basics principles, methods, importance of scale, height, applications.

Remote sensing: Introduction, Principle of Remote sensing, EMR, types, resolutions, types of satellites, type of sensors, LIDAR, visual and digital image processing and its applications. **Global Positioning System:** Definition, Principles of GPS and applications. Geographical Information System: Introduction and principle of Geographical Information System, components of GIS, applications

Advanced instrumentation in surveying: classification, measuring principles, Electronic theodolite, EDM, Total Station, Drones

Teaching-Learning Process	Chalk and talk, PowerPoint Presentation, YouTube videos

LABORATORY EXPERIMENTS

1.	Study of various instruments used for surveying, namely chain, tape, Compass,
2.	Dumpy level, Auto-level, Theodolite, Tacheometer, Total station and GPS. To find the distance between two points shown in the field using method of pacing, chaining and taping.
3.	To set regular geometric figures (Hexagon and Pentagon) using chain tape and accessories.
4.	To set regular geometric figures (Hexagon and Pentagon) using prismatic compass, given the bearing of one line.
5.	Study of use of Dumpy level and to determine the different in elevation between two points by differential levelling using Dumpy level
6.	To find the true difference in elevation between two points situated far apart by using Reciprocal levelling.

7.	Trigonometrical levelling: Single plane method and Double plane method
8.	Measurement of horizontal angle using theodolite by: i) Method of Repetition and ii) Reiteration method.
9.	Setting simple circular curve-Instrumental method,
10.	Setting compound curve using theodolite
11.	Plane table : Setting, orientation, radiation, intersection
12.	Demo: Total station, GPS

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

1. Execute survey using compass and plane table
2. Find the level of ground surface and Calculation of area and volumes
3. Operate theodolite for field execution
4. Estimate the capacity of reservoir
5. Interpret satellite imageries

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

CIE for the theory component of IPCC

Two Tests each of **20 Marks (duration 01 hour**)

- First test at the end of 5th week of the semester
- Second test at the end of the 10th week of the semester

Two assignments each of **10 Marks**

- First assignment at the end of 4th week of the semester
- Second assignment at the end of 9th week of the semester

Scaled-down marks of two tests and two assignments added will be CIE marks for the theory component of IPCC for **30 marks**.

CIE for the practical component of IPCC

- On completion of every experiment/program in the laboratory, the students shall be evaluated and marks shall be awarded on the same day. The**15 marks** are for conducting the experiment and preparation of the laboratory record, the other **05 marks shall be for the test** conducted at the end of the semester.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to 15 marks.
- The laboratory test **(duration 02/03 hours)** at the end of the 15th week of the semester /after completion of all the experiments (whichever is early) shall be conducted for 50 marks and scaled down to 05 marks**.**

Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **20 marks**.

SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (duration 03 hours)

1. The question paper will have ten questions. Each question is set for 20 marks. Marks scored shall be proportionally scaled down to 50 Marks
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.

Suggested Learning Resources:

Books

1. Surveying & levelling Vol. I ,II & III, B. C. Punmia, Laxmi Publications; seventeenth edition (2016)
2. Advanced Surveying: Total Station, GPS, GIS & Remote Sensing by Pearson 2017 by GopiSatheesh, R.Sathikumar, N. Madhu
3. Surveying Vol.I& II, S. K. Duggal, McGraw Hill Education; Fourth edition (2017)

4. Surveying and Levelling, R. Subramanian , second edition, 2012, Oxford University Press; 5. Engineering Surveying, Schofield and Breach, 6th edition, Butterworth-Heinemann (Elsevier publication, 2007) 6. Surveying , A Banister, S Raymond, R Baker, 7th edition, Pearson , New Delhi	
Web links and Video Lectures (e-Resources):	
• NPTEL courses	
Activity Based Learning (Suggested Activities in Class)/ Practical Based learning	

III Semester

STRENGTH OF MATERIALS			
Course Code	**21CV33**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	2+2+2+0	SEE Marks	50
Total Hours of Pedagogy	50	Total Marks	100
Credits	4	Exam Hours	03 hrs

Course objectives: This course will enable students

1. To understand the basic concepts of the stresses and strains for different materials and strength of structural elements.
2. To know the development of internal forces and resistance mechanism for one dimensional and two-dimensional structural elements.
3. To analyse and understand different internal forces and stresses induced due to representative loads on structural elements.
4. To determine slope and deflections of beams.
5. To evaluate the behaviour of torsion members, columns and struts.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Blackboard teaching/PowerPoint presentations (if needed)
2. Regular review of students by asking questions based on topics covered in the class.

Module-1

Simple Stresses and Strains: Introduction, Properties of Materials, Stress, Strain, Hook's law, Poisson's Ratio, Stress – Strain Diagram for structural steel, Principles of superposition, Total elongation of tapering bars of circular and rectangular cross sections. Composite section, Volumetric strain, expression for volumetric strain, Elastic constants, relationship among elastic constants (No Numerical), Thermal stress and strains

Compound stresses: Introduction, Stress components on inclined planes, General two-dimensional stress system, Principal planes and stresses, maximum shear stresses and their planes (shear planes). Compound stress using Mohr's circle method.

Teaching-Learning Process	1.Blackboard teaching/PowerPoint presentations (if needed) 2.Regular review of students by asking questions based on topics covered in the class.

Module-2

Bending moment and shear force diagrams in beams: Definition of shear force and bending moment, Sign convention, Relationship between loading, shear force and bending moment, Shear force and bending moment equations, development of Shear Force Diagram(SFD) and Bending Moment Diagram (BMD) with salient values for cantilever, simply supported and overhanging beams for point loads, UDL(Uniformly Distributed Load), UVL(Uniformly Varying Load) and Couple.

Teaching-Learning Process	1.Blackboard teaching/PowerPoint presentations (if needed) 2.Regular review of students by asking questions based on topics covered in the class.

Module-3

	Bending stress in beams: Introduction – Bending stress in beam, Pure bending, Assumptions in simple bending theory, derivation of Simple bending equation (Bernoulli's equation), modulus of rupture, section modulus, Flexural rigidity, Problems **Shear stress in beams:** Derivation of Shear stress intensity equations, Derivation of Expressions of the shear stress intensity for rectangular, triangular and circular cross sections of the beams. Problems on calculation of the shear stress intensities at various critical levels of T, I and Hollow rectangular cross sections of the beam.	
	Teaching-Learning Process	1.Blackboard teaching/PowerPoint presentations (if needed) 2.Regular review of students by asking questions based on topics covered in the class.
	Module-4	
	Torsion: Twisting moment in shafts, simple torque theory, derivation of torsion equation, tensional rigidity, polar modulus, shear stress variation across solid circular and hollow circular sections, Problems **Thin cylinders:** Introduction: Longitudinal, circumferential (hoop) stress in thin cylinders. Expressions for longitudinal and circumferential stresses. Efficiency of longitudinal and circumferential joints. Problems on estimation of change in length, diameter and volume when the thin cylinder subjected to internal fluid pressure. **Thick cylinders:** Concept of Thick cylinders Lame's equationsapplicable to thick cylinders with usual notations, calculation of longitudinal, circumferential and radial stresses – simple numerical examples. Sketching the variation of radial stress (pressure) and circumferential stress across the wall of thick cylinder. U	
	Teaching-Learning Process	1.Blackboard teaching/PowerPoint presentations (if needed) 2.Regular review of students by asking questions based on topics covered in the class.
	Module-5	
	Elastic stability of columns: Introduction – Short and long columns, Euler's theory on columns, Effective length, slenderness ratio, radii of gyration, buckling load, Assumptions, derivations of Euler's Buckling load for different boundary conditions, Limitations of Euler's theory, Rankine's formula and related problems. **Deflection of determinate Beams:** Introduction, Elastic curve –Derivation of differential equation of flexure, Sign convention, Slope and deflection using Macaulay's method for statically determinate beams subjected to various vertical loads, moment, couple and their combinations. Numerical problems.	
	Teaching-Learning Process	1.Blackboard teaching/PowerPoint presentations (if needed) 2.Regular review of students by asking questions based on topics covered in the class.

LABORATORY

1. Dimensionality of bricks, Water absorption, Initial rate of absorption
2. Specific gravity of coarse and fine aggregate
3. Fineness modulus of Fine and Coarse aggregate
4. Compressive strength tests on building blocks (brick, solid blocks and hollow blocks)
5. Tension test on Mild steel and HYSD bars
6. Compression test on HYSD, Cast iron
7. Bending Test on Wood under two-point loading.

8. Shear Test on Mild steel – single and double shear
9. Impact test on Mild Steel (Charpy& Izod)

Course outcome (Course Skill Set)

After completion of the course, students will be able to

1. Evaluate the behaviour when a solid material is subjected to various types of forces (namely Compressive, Tensile, Thermal, Shear, flexure, Torque, internal fluid pressure) and estimate stresses and corresponding strain developed. (L3)
2. Estimate the forces developed and draw schematic diagram for stresses, forces, moments for simple beams with different types of support and are subjected to various types of loads (L3).
3. Evaluate the behaviour when a solid material is subjected to Torque and internal fluid pressure and estimate stresses and corresponding strain developed. (L3)
4. Distinguish the behaviour of short and long column and calculate load at failure & explain the behaviour of spring to estimate deflection and stiffness (L3)
5. Examine and Evaluate the mechanical properties of various materials under different loading conditions

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

CIE for the theory component of IPCC

Two Tests each of **20 Marks (duration 01 hour**)

- First test at the end of 5th week of the semester
- Second test at the end of the 10th week of the semester

Two assignments each of **10 Marks**

- First assignment at the end of 4th week of the semester
- Second assignment at the end of 9th week of the semester

Scaled-down marks of two tests and two assignments added will be CIE marks for the theory component of IPCC for **30 marks**.

CIE for the practical component of IPCC

- On completion of every experiment/program in the laboratory, the students shall be evaluated and marks shall be awarded on the same day. The**15 marks** are for conducting the experiment and preparation of the laboratory record, the other **05 marks shall be for the test** conducted at the end of the semester.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to 15 marks.
- The laboratory test **(duration 02/03 hours)** at the end of the 15th week of the semester /after completion of all the experiments (whichever is early) shall be conducted for 50 marks and scaled down to 05 marks**.**

Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory

component of IPCC for **20 marks**.

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SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (duration 03 hours)

1. The question paper will have ten questions. Each question is set for 20 marks. Marks scorded shall be proportionally scaled down to 50 Marks
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper shall include questions from the practical component).

- The minimum marks to be secured in CIE to appear for SEE shall be the 12 (40% of maximum marks-30) in the theory component and 08 (40% of maximum marks -20) in the practical component. The laboratory component of the IPCC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be included**.** The maximum of 04/05 questions to be set from the practical component of IPCC, the total marks of all questions should not be more than the 20 marks.

SEE will be conducted for 100 marks and students shall secure 35% of the maximum marks to qualify in the SEE. Marks secured will be scaled down to 50.

Suggested Learning Resources:

Books

1.Timoshenko and Young, “Elements of Strength of Materials” ,EastWest Press, 5t edition 2003

2.R. Subramanyam, “Strength of Materials”, Oxford University Press, 3rd Edition -2016

3.B.C Punmia Ashok Jain, Arun Jain, “Strength of Materials”, Laxmi - 2018-22 Publications, 10th Edition-2018

Web links and Video Lectures (e-Resources):

1.Strength of Materials web course by IIT Roorkee https://nptel.ac.in/courses/112107146/

2.Strength of Materials video course by IIT Kharagpur https://nptel.ac.in/courses/105105108/

3.Strength of Materials video course by IIT Roorkee https://nptel.ac.in/courses/112107147/18

4.All contents organized http://www.nptelvideos.in/2012/11/strengthof-materials-prof.html

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Seminars/Quizz(To assist in GATE Preparations
- Demonstrations in Lab
- Self Study on simple topics
- Simple problems solving using Excel
- Virtual Lab Experiments

Semester III

: **Earth Resources and Engineering**			
Course Code	21CV34	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course objectives:

- This course will enable students;

  1. To understand the importance of earth's dynamic interior in civil engineering and Geo Hazard mitigation and management
  2. To analyse the physical characteristics of the rocks and Minerals for its suitable application in Engineering
  3. To evaluate earth Process for providing sustainable management and Development through Geoengineering.
  4. Subsurface Exploration for providing safe and suitable site condition and Earth Resources for Reengineering activities
  5. To application of modern tools and techniques in Earth Resources Management and.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

- Chalk and Talk method.
- Show Video/animation films to explain earth dyanamics and influence of geology in prime civil constructions
- Encourage collaborative (Group Learning) Learning in the class
- Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking
- Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking process such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
- Topics will be introduced in a multiple representation.
- Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
- Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Module /unit – 01 – Introduction, scope of earth science in Engineering, 8 hrs
Geohazards and disasters, Mitigation and management

Earths internal dynamics ,Plate tectonics, Earth quakes types, causes iso-seismal line, seismic zonation map, seismic proof structures, Numerical problems on location of epicenter; volcanic eruption, types, causes, ; landslides, causes types, preventive measures; tsunamis causes consequences, mitigation;cyclones, causes management

Teaching-Learning Process	• chalk and talk method, • power point presentation. • Case studies • Field visits

Module-2	
Earth Resources **8hrs** Minerals -Industrial, rock forming and ore minerals. Physical properties, composition and uses Rocks as a construction materials- physical properties, texture, composition, applications for aggregate, decorative (facing/polishing), railway ballast, rocks for masonry work, monumental/architecture, rocks as aquifers, water bearing properties igneous, sedimentary	
Teaching-Learning Process	• Chalk and talk method, • Power point presentation and Animated vedeos • Case studies • Field visits experience the real world examples
Module-3	
Surface investigation for Civil Engineering projects **8hrs** Weathering, type, causes, soil insitu, drifted soil, soil profile, soil mineralogy , structure, types of soil, Black cotton soil v/s Lateritic soil; effects of weathering on monumental rocks, River morphology and basin investigation for engineering Projects like earthen dam, gravity dam, arch dam, features of river erosion, deposition and their influences on river valley projects, morphometric analysis of river basin, selection of site for artificial recharge,, interlinking of river basins, coastal process and landforms, sedimentation /siltation, erosion	
Teaching-Learning Process	• Chalk and talk method, • Power point presentation and Animated vedeos • Case studies • Field visits experience the real world examples
Module-4	
Subsurface investigation for deep foundation **8hrs** Borehole data(and problems), Dip and strike, and outcrop problems(numerical problem geometrical/ simple trigonometry based), Electrical Resistivity meter, depth of water table, (numerical problems) seismic studies, faults, folds, unconformity, joints types, recognitionand their significance in Civil engineering projects like tunnel project, dam project, , Ground improvements like rock bolting, rock jointing, grouting	
Teaching-Learning Process	• Chalk and talk method, • Power point presentation and Animated vedeos • Case studies • Field visits experience the real world examples
Module-5	
Geo-tools and techniques for civil Engineering Applications **7hrs** Toposheets , Remote sensing and GIS. Photogrammetry (scale, flight planning, overlap, elevation effects, interpretation keys, numericals on flight, planning scale , elevation, flyimg height, ….), GPS,, Ground Penetrating Radas (GPR), Drone, and their applications	
Teaching-Learning Process	• Chalk and talk method, • Power point presentation and Animated videos • Case studies • Field visits and research institutes experience the real world examples

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

1. Apply geological knowledge in different civil engineering practice.
2. Students will acquire knowledge on durability and competence of foundation rocks, and confidence enough to use the best building materials.
3. competent enough to provide services for the safety, stability, economy and life of the structures that they construct
4. Able to solve various issues related to ground water exploration, build up dams, bridges, tunnels which are often confronted with ground water problems
5. Intelligent enough to apply GIS, GPS and remote sensing as a latest tool in different civil engineering for safe and solid construction.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks. Marks scored out of 100, shall be proportionally reduced to 50 marks
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=aTVDiRtRook&list=PLDF5162B475DD915F
- https://www.youtube.com/watch?v=EBiLLJAxBuU&index=2&list=PLDF5162B475DD915F
- https://www.youtube.com/watch?v=sTY-ao4RZck&list=PLDF5162B475DD915F&index=3
- https://nptel.ac.in/courses
- https://youtu.be/fvoYHzAhvVM
- https://youtu.be/aTVDiRtRook

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- https://www.earthsciweek.org/classroom-activities
- Field Visits
- https://serc.carleton.edu/NAGTWorkshops/hazards/events/12262004.html?serc_source=recommendation
- https://serc.carleton.edu/NAGTWorkshops/visualization/examples/CBezanson.html?serc_source=recommendation
- https://serc.carleton.edu/NAGTWorkshops/coursedesign/goalsdb/14712.html

Textbooks -

1. Engineering Geology, by Parthasarathy et al, Wiley publications
2. A textbook of Engineering Geology by Chenna Kesavulu, Mac Millan India Ltd
3. Principle of Engineering Geology, by K.M. Bangar, Standard publishers
4. Physical and Engineering Geology, by S.K. Garg, Khanna publishers
5. Principles of Engineering Geology, by KVGK Gokhale, BS Publications

Reference books –

1. Introduction to Environmental Geology by Edward A Keller, Pearson publications.
2. Engineering Geology and Rock Mechanics B. P. Verma, Khanna publishers
3. Principles of Engineering Geology and Geotechnics, Krynine and Judd, CBS Publications

COMPUTER AIDED BUILDING PLANNING AND DRAWING			
Course Code	**21CVL35**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0+0+2+0	SEE Marks	50
Credits	01	Exam Hours	03 hrs

Course objectives:

Provide students with understanding

1. Gain skill set to prepare Computer Aided Engineering Drawings
2. Understanding the details of construction of different building elements
3. Visualize the completed form of the building and the intricacies of construction based on the engineering drawings
4. Get familiarization of practices used in Industry

Sl.NO	Experiments
	Module 1
1	**Drawing Basics:** Selection of scales for various drawings, thickness of lines, dimensioning, abbreviations and conventional representations as per IS:962.
2	**Simple Engineering Drawings with CAD** Drawing Tools**:** Lines Circle, Arc, Poly line, Multiline, Polygon, Rectangle, Spline, Ellipse, Modify tools: Erase, Copy, Mirror, Offset, Array, Move, Rotate, Scale, Stretch, Lengthen, Trim, Extend, Break, Chamfer and Fillet, Using Text: Single line text, Multiline text, Spelling, Edit text, Special Features: View tools, Layers concept, Dimension tools, Hatching, Customizing Toolbars, Working with multiple drawings.
	Module 2
3	**Drawings of Different Building Elements:** Following drawings are to be prepared for the data given using CAD Software a) Cross section of Foundation, masonry wall, RCC columns with isolated & combined footings. b) Different types of bonds in brick masonry. c) Different types of staircases – Dog legged, Open well, d) Lintel and chajja. e) RCC Slabs and beams. f) Cross section of a pavement. g) Septic Tank and sedimentation Tank. h) Layout plan of Rainwater recharging and harvesting system. i) Cross sectional details of a road for a Residential area with provision for all services. j) Steel truss (connections Bolted). **Note:**Students should sketch to dimension the above in a sketch book before doing the computer drawing.

Module 3	
4	**Building Drawings :** Principles of planning, Planning regulations and building bye-laws, factors affecting site selection, Functional planning of residential and public buildings, design aspects for different public buildings. Recommendations of NBC. Drawing of plan, elevation and sectional elevation including electrical, plumbing and sanitary services using CAD software for 1. Single and double story residential building. 2. Hostel building. 3. Hospital building. 4. School building. Submission drawing (sanction drawing)of two storied residential building with access to terrace including all details and statements as per the local bye-laws Industry Applications : 3D Modelling and Rendering, 2D Animation, Construction site Simulation **Note:** . Students should sketch to dimension the above in a sketch book before doing the computer drawing . One compulsory field visit/exercise to be carried out. . Single line diagrams to be given in the examination.

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

1. Prepare, read and interpret the drawings in a professional set up.
2. Know the procedures of submission of drawings and Develop working and submission drawings for building.
3. Plan and design of residential or public building as per the given requirements.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 35% (18 Marks out of 50) in the semester-end examination(SEE).

Continuous Internal Evaluation (CIE):

CIE marks for the practical course is **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment to be evaluated for conduction with observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled downed to 30 marks (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8th week of the semester and the second test shall be conducted after the 14th week of the semester.
- In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability. Rubrics suggested in Annexure-II of Regulation book
- The average of 02 tests is scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and average marks of two tests is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

SEE marks for the practical course is 50 Marks.

SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University

All laboratory experiments are to be included for practical examination.

(Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.

Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.

Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly

by examiners.
General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)
Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.
The duration of SEE is 03 hours

Rubrics suggested in Annexure-II of Regulation book

Question paper pattern:

- There will be four full questions with sub divisions if necessary from Module2 with each full question carrying twenty five marks. Students have to answer any two questions.
- There will be two full questions from Modulus 3 with each full question carrying fifty marks. Students have to answer any one question. The conduction of examination and question paper format of should be in line of 1st year CAED drawing. It's drawing paper but the exam will be conducted by batches in the computer labs. Question paper should be given in batches.

Suggested Learning Resources:

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Textbook:

1. MG Shah, CM Kale, SY Patki, "Building drawing with an integrated approach to Built Environment Drawing", Tata McGraw Hill Publishing co. Ltd, New Delhi.
2. Gurucharan Singh, "Building Construction", Standard Publishers, & distributors, New Delhi.
3. Malik RS and a Meo GS, "Civil Engineering Drawing", Asian Publishers/Computech Publication Pvt Ltd

Reference Books:

1. Time Saver Standard by Dodge F.W, F.W Dodge Corp.
2. IS: 962-1989 (Code of practice for architectural and building drawing).
3. National Building Code, BIS, New Delhi.

SAMPLE TEMPLATE

III/IV Semester

Constitution of India and Professional Ethics (CIP)

Course Code	**21CIP37/47**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0:2:0:0	SEE Marks	50
Total Hours of Pedagogy	15 Hours	Total Marks	100
Credits	01	Exam Hours	01 Hour

Course objectives: This course will enable the students

- To know the fundamental political structure & codes, procedures, powers, and duties of Indian government institutions, fundamental rights, directive principles, and the duties of citizens.
- To understand engineering ethics and their responsibilities, identify their individual roles and ethical responsibilities towards society.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

- ✓ Teachers shall adopt suitable pedagogy for effective teaching - learning process. The pedagogy shall involve the combination of different methodologies which suit modern technological tools and software's to meet the present requirements of the Global employment market.
  - (i) Direct instructional method (Low /Old Technology),
  - (ii) Flipped classrooms (High/advanced Technological tools),
  - (iii) Blended learning (combination of both),
  - (iv) Enquiry and evaluation based learning,
  - (v) Personalized learning,
  - (vi) Problems based learning through discussion,
  - (vii) Following the method of expeditionary learning Tools and techniques,
- **1.** Apart from conventional lecture methods, various types of innovative teaching techniques through videos, animation films may be adapted so that the delivered lesson can enhance the students in theoretical applied and practical skills in teaching of 21CIP39/49 in general.

Module - 1

Introduction to Indian Constitution: Definition of Constitution, Necessity of the Constitution, Societies before and after the Constitution adoption. Introduction to the Indian constitution, Making of the Constitution, Role of the Constituent Assembly. Preamble of Indian Constitution & Key concepts of the Preamble. Salient features of India Constitution.

Teaching-Learning Process	Chalk and talk method, Videos, Power Point presentation to teach. Creating real time stations in classroom discussions, Giving activities and assignments (Connecting Campus & community with administration real time situations).

Module - 2

Fundamental Rights (FR's), Directive Principles of State Policy (DPSP's) and Fundamental Duties (FD's) : Fundamental Rights and its Restriction and limitations in different Complex Situations. DPSP's and its present relevance in Indian society. Fundamental Duties and its Scope and significance in Nation building.

Teaching-Learning Process	Chalk and talk method, Videos, Power Point presentation to teach. Creating real time stations in classroom discussions, Giving activities and assignments (Connecting Campus & community with administration real time situations).

Module - 3

Union Executive : Parliamentary System, Union Executive – President, Prime Minister, Union Cabinet, Parliament - LS and RS, Parliamentary Committees, Important Parliamentary Terminologies. Supreme Court of India, Judicial Reviews and Judicial Activism.

Teaching-Learning Process	Chalk and talk method, Videos, Power Point presentation to teach. Creating real time stations in classroom discussions, Giving activities and assignments (Connecting Campus & community with administration real time situations).

Module - 4	
State Executive & Elections, Amendments and Emergency Provisions: State Executive, Election Commission, Elections & Electoral Process. Amendment to Constitution (Why and How) and Important Constitutional Amendments till today. Emergency Provisions.	
Teaching-Learning Process	Chalk and talk method, Videos, Power Point presentation to teach. Creating real time stations in classroom discussions, Giving activities and assignments (Connecting Campus & community with administration real time situations).
Module-5	
Professional Ethics: Definition of Ethics & Values. Professional & Engineering Ethics. Positive and Negative aspects of Engineering Ethics. Clash of Ethics, Conflicts of Interest. The impediments to Responsibility. Professional Risks, Professional Safety and liability in Engineering. Trust & Reliability in Engineering, Intellectual Property Rights (IPR's).	
Teaching-Learning Process	Chalk and talk method, Videos, Power Point presentation to teach. Creating real time stations in classroom discussions, Giving activities and assignments (Connecting Campus & community with administration real time situations).

Course outcome (Course Skill Set)

At the end of the course the student should :

CO 1: Have constitutional knowledge and legal literacy.

CO 2: Understand Engineering and Professional ethics and responsibilities of Engineers.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks that is 20 marks. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE and SEE taken together

Continuous Internal Evaluation:

Three Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject.

- The question paper will have 50 questions. Each question is set for 01 mark.
- SEE Pattern will be in MCQ Model (Multiple Choice Questions) for 50 marks. Duration of the examination is 01 Hour.

Textbook:

1. **"Constitution of India & Professional Ethics"** Published by Prasaranga or published on VTU website with the consent of the university authorities VTU Belagavi.

SAMPLE TEMPLATE

BE - **III/IV Semester – Common to all**

[illegible]			
[illegible] (Course Code)	21KSK39/49	[illegible]ದ [illegible]	50
[illegible] (Teaching Hours / Week (L:T:P: S)	0:2:0:1	[illegible]	50
[illegible] Total Hours of Pedagogy	25 [illegible]	[illegible]	100
[illegible] (Credits)	01	[illegible]	01 [illegible]

[illegible]:

1. [illegible], [illegible].
2. [illegible].
3. [illegible].
4. [illegible].

[illegible] **(Teaching-Learning Process - General Instructions) :**

These are sample Strategies, which teacher can use to accelerate the attainment of the course outcomes.

1. [illegible]. [illegible].
2. [illegible] - [illegible]-[illegible], [illegible], [illegible], [illegible].
3. [illegible].

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SAMPLE TEMPLATE

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□□□□□□□□□□ □□□□□ **(Assessment Details- both CIE and SEE) :**

(methods of CIE - MCQ, Quizzes, Open book test, Seminar or micro project)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The student has to obtain a minimum of 40% marks individually both in CIE and 35% marks in SEE to pass. Theory Semester End Exam (SEE) is conducted for 50 marks (01 hour duration). Based on this grading will be awarded.

Continuous Internal Evaluation:

Three Tests each of **20 Marks (duration 01 hour**)

a. First test at the end of 5th week of the semester
b. Second test at the end of the 10th week of the semester
c. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks : 1.** First assignment at the end of 4th week of the semester

2. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

3. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

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SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject.

1. The question paper will have 50 questions. Each question is set for 01 mark.

SEE Pattern will be in MCQ Model for 50 marks. Duration of the exam is 01 Hour.

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BE - III / IV Semester – Common to All

[illegible] – baLake Kannada (Kannada for Usage)

[illegible] – (Prescribed Textbook to Learn Kannada)

[illegible] (Course Code)	21KBK39/49	[illegible] (Continuous Internal Evaluation Marks)	50
[illegible] (Teaching Hours / Week (L:T:P: S)	0:2:0:1	[illegible] (Semester End Examination Marks)	50
[illegible] Total Hours of Pedagogy	25 [illegible]	[illegible] (Total Marks)	100
[illegible] (Credits)	01	[illegible] (Exam Hours)	01 [illegible]

[illegible] **(Course Learning Objectives):**

- To Create the awareness regarding the necessity of learning local language for comfortable and healthy life.
- To enable learners to Listen and understand the Kannada language properly.
- To speak, read and write Kannada language as per requirement.
- To train the learners for correct and polite conservation.

[illegible] **(Teaching-Learning Process - General Instructions) :**

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. [illegible].
2. [illegible].
3. [illegible].
1. [illegible].
2. [illegible].

Module-1

1. Introduction, Necessity of learning a local language. Methods to learn the Kannada language.
2. Easy learning of a Kannada Language: A few tips. Hints for correct and polite conservation, Listening and Speaking Activities
3. Key to Transcription.
4. [illegible], [illegible]/[illegible] [illegible] – **Personal Pronouns, Possessive Forms, Interrogative words**

[illegible]	[illegible], [illegible], [illegible], [illegible].

Module-2

1. □□□□□□□□ □□□□□□□□□□□ □□□□□□□, □□□□□□□□□□□ □□□□□□□□□□□ □□□□□□ □□□□□□□□□□ □□□□□□□□□ - **Possessive forms of nouns, dubitive question and Relative nouns**
2. □□□□, □□□□□□□ □□□□□□ □□□□□□□□□ □□□□□□□□□□, □□□□□□□□□□□□□□□ **Qualitative, Quantitative and Colour Adjectives, Numerals**
3. **PÁgÀPÀ gÀÆ¥ÀUÀ¼ÀÄ ªÀÄvÀÄÛ «¨sÀQÛ ¥ÀævÀåAiÀÄUÀ¼ÀÄ – ¸À¥ÀÛ«Ä «¨sÀQÛ ¥ÀævÀåAiÀÄ – (D, CzÀÄ, CªÀÅ, C°è) Predictive Forms, Locative Case**

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Module-3

1. **ZÀvÀÄyð «¨sÀQÛ ¥ÀævÀåAiÀÄzÀ §¼ÀPÉ ªÀÄvÀÄÛ ¸ÀASÁåªÁZÀPÀUÀ¼ÀÄ - Dative Cases, and Numerals**
4. **¸ÀASÁåUÀÄtªÁZÀPÀUÀ¼ÀÄ ªÀÄvÀÄÛ §ºÀÄªÀZÀ£À £ÁªÀÄgÀÆ¥ÀUÀ¼ÀÄ - Ordinal numerals and Plural markers**
5. **£ÀÆå£À / ¤µÉÃzsÁxÀðPÀ QæAiÀiÁ¥ÀzÀUÀ¼ÀÄ ªÀÄvÀÄÛ ªÀtð UÀÄtªÁZÀPÀUÀ¼ÀÄ**
   Defective / Negative Verbs and Colour Adjectives

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Module-4

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Permission, Commands, encouraging and Urging words (Imperative words and sentences)

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Accusative Cases and Potential Forms used in General Communication

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   "iru and iralla", Corresponding Future and Negation Verbs
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Module-5

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2. □□, -□□,- □□,- □□□,- □□□□,- □□□□□,- □□,-□□, □□□□, □□□□□□□ □□□□□□□□□□□□□□□□□□ □□□□, □□□□□□□□□ □□□□□□ □□□□□□□□ □□□□ □□□□□□ □□□□□ - Formation of Past, Future and Present Tense Sentences with Verb Forms
3. **Kannada Vocabulary List :** □□□□□□□□□□□□□□ □□□□□□□□□□ □□□□□□ □□□□□□ - **Kannada Words in Conversation**

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□□□□□ □□□□□□□□□□: **course Outcomes (Course Skill** Set): At the end of the Course, The Students will be able

1. To understand the necessity of learning of local language for comfortable life.
2. To Listen and understand the Kannada language properly.
3. To speak, read and write Kannada language as per requirement.
4. To communicate (converse) in Kannada language in their daily life with kannada speakers.
5. To speak in polite conservation.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Tests each of **20 Marks (duration 01 hour**)

a. First test at the end of 5th week of the semester
b. Second test at the end of the 10th week of the semester
c. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks : 1.** First assignment at the end of 4th week of the semester

7. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

8. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

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SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject.

2. The question paper will have 50 questions. Each question is set for 01 mark.
3. SEE Pattern will be in MCQ Model for 50 marks. Duration of the exam is 01 Hour.

Textbook :

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Semester III

Problem Solving with Python			
Course Code	21CV381	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0:2:0:0	SEE Marks	50
Total Hours of Pedagogy	15	Total Marks	100
Credits	1	Exam Hours	1 hr

Course objectives:

- To understand why Python is a useful scripting language for developers.
- To read and write simple Python programs
- To learn how to identify Python object types.
- To learn how to write functions and pass arguments in Python.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Introduction to Python: Installing Python and Python packages, Managing virtual environments with venv module

Introduction to NumPy arrays:Array creation, indexing, data types, broadcasting, copies and views, universal functions, I/O with NumPy

Teaching-Learning Process	Chalk and talk, PowerPoint Presentation, YouTube videos

Module-2

Introduction to NumPy and SciPy:NumPy subpackages– linalg, fft, random, polynomials, SciPy subpackages– linalg, fftpack, integrate, interpolate, optimize

Introduction to Matplotlib: Plotting 2D graphs with Matplotlib, annotations, legend, saving plots to file, bar and pie charts, line plots.

Teaching-Learning Process	Chalk and talk, PowerPoint Presentation, YouTube videos

Module-3

Linear algebra using NumPy and SciPy:Solving linear simultaneous equations using NumPy and SciPy using numpy.linalg and scipy.linalg – solve, inverse, determinant, least square solution,

Linear algebra using NumPy and SciPy (continued): Decomposition using lu and cholesky.

Solving eigenvalue problems using NumPy and SciPy:Using numpy.linalg and scipy.linalg – eig, eigvals.

Teaching-Learning Process	Chalk and talk, PowerPoint Presentation, YouTube videos

Module-4	
Solving initial value problems for ODE systems using scipy.integrate subpackage – solve_ivp, RK45, LSODA. Numerical integration of functions using SciPy:Using scipy.integratesubpackage– Definite integral using Gaussian quadrature – quad and quadrature Numerical integration of fixed samples using scipy.integratesubpackage– Trapezoidal rule trapezoid, Simpson's 1/3 rule using Simpson, Romberg integration romb.	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation, YouTube videos
Module-5	
Determining roots of equations using SciPyusing scipy.optimizesubpackage– Bisection method bisect, Brent's method brentq, Newton-Raphson method newton. Symbolic computing using SymPy and solving civil engineering problems using SymPy: Introduction, defining symbols, derivatives, integrals, limits, expression evaluation, expression simplification, solving equations, solving differential equations.	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation, YouTube videos

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

1. Understand Python syntax and semantics and be fluent in the use of Python flow control and functions.
2. Demonstrate proficiency in handling Strings and File Systems.
3. Represent compound data using Python lists, tuples, Strings, dictionaries.
4. Read and write data from/to files in Python Programs

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous internal Examination (CIE)

Three Tests (preferably in MCQ pattern with 20 questions) each of 20 Marks (duration 01 hour)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of 10 Marks

1. First assignment at the end of 4th week of the semester
2. Second assignment at the end of 9th week of the semester

Quiz/Group discussion/Seminar, any two of three suitably planned to attain the COs and POs for 20 Marks (duration 01 hours)

The sum of total marks of three tests, two assignments, and quiz /seminar/ group discussion will be out of 100 marks and shall be scaled down to 50 marks

Semester End Examinations (SEE)

SEE paper shall be set for 50 questions, each of 01 mark. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is 01 hour. The student has to secure minimum of 35% of the maximum marks meant for SEE.

Suggested Learning Resources:

Books

1. R. Nageswara Rao, "Core Python Programming", dreamtech

2. Python Programming: A Modern Approach, Vamsi Kurama, Pearson
3. Python Programming , Reema theraja, OXFORD publication

Web links and Video Lectures (e-Resources):

1. NumPy documentation at https://numpy.org/doc/
2. SciPy documentation at https://docs.scipy.org/doc/scipy/
3. Matplotlib documentation at https://matplotlib.org/stable/users/index
4. SymPy documentation at https://docs.sympy.org/latest/index.html

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Real world problem solving: Demonstration of projects developed using python language

Semester III

Microsoft Excel and Visual Basic for Applications			
Course Code	21CV382	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0:2:0:0	SEE Marks	50
Total Hours of Pedagogy	15	Total Marks	100
Credits	1	Exam Hours	01 hr

Course objectives:

- To learn basic operations using excel
- To solve problems using functions in excel
- To design structural elements using excel and VB as a tool

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. The online courses available should be shared with students
2. YouTube videos
3. Power point presentations
4. Assignments to solve all the problems using excel and VB.

Module-1

Introduction to Microsoft Excel, Workbooks, Worksheets, User Interface – navigating the interface, entering data, implicit data types, setting cell data types, Basic operations – copy/cut, paste, paste special, row and cell references, using cell names, Simple built-in formulae, Copying and pasting formulae

Built-in formulae – Trigonometric, Logarithmic, Exponential, Statistical, Matrix operations such as transpose, multiplication, inverse etc.

Plotting charts of different types, bar and pie charts, scatter plots, legend, Using Log and Semilog scales, Customizing chart axes, Using multiple axes, Preparing contour plots, Annotating charts.

Teaching-Learning Process	Chalk and talk, PowerPoint Presentation, YouTube videos

Module-2

Introduction to Visual Basic for Applications, User Interface – VBA Editor, VBA toolbar, Developing simple functions in VBA – area of a circle, minimum cover to reinforcement in a beam as per IS 456, Calling user defined functions, Organizing code into modules.

Debugging VBA code using built-in debugger – breakpoints, watch variables, trace lines of code with run to cursor, step into, step over and step out.

Developing subroutines, calling subroutines, Differences between functions and subroutines, Scope of subroutines – Public and Private, Calling a subroutine

Teaching-Learning Process	Chalk and talk, PowerPoint Presentation, YouTube videos

Module-3

VBA data types, Working with data types, Enforcing defining types with Option Explicit, Defining, initializing and using arrays within functions/subroutines.

Commenting code, Long statements spanning multiple lines, Program flow control – Branching and looping, using conditional statements, Calling Worksheet functions in VBA.

Develop functions for simple civil engineering applications – Stability of gravity dams, analysis of

rectangular footings subjected to axial compression and bending about both axes, etc.

Teaching-Learning Process	Chalk and talk, PowerPoint Presentation, YouTube videos

Module-4

Table lookup – Lookup, Vlookup, Hlookup, Match, Index, VBA Object model, creating and using user defined objects.

Building forms, triggering subroutines by pressing a button on a form

Interacting with other applications with support for VBA, such as, SAP2000/ETABS or any other software used by civil engineers.

Teaching-Learning Process	Chalk and talk, PowerPoint Presentation, YouTube videos

Module-5

Using Python to manipulate Microsoft Excel files, creating, editing and saving Microsoft Excel files from Python, Interacting with Microsoft Excel using Python xl wings package, Calling Python from VBA.

Developing functions and subroutine for a comprehensive civil engineering application – RC design, Steel design, or other similar problems from other fields of Civil Engineering.

Teaching-Learning Process	Chalk and talk, PowerPoint Presentation, YouTube videos

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

1. Solve Trigonometric, Logarithmic, Exponential, Statistical problems and perform Matrix operations
2. Solve civil engineering problems using VB as a tool
3. Design structural elements by integrating excel and VB

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous internal Examination (CIE)

Three Tests (preferably in MCQ pattern with 20 questions) each of 20 Marks (duration 01 hour)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of 10 Marks

1. First assignment at the end of 4th week of the semester
2. Second assignment at the end of 9th week of the semester

Quiz/Group discussion/Seminar, any two of three suitably planned to attain the COs and POs for 20 Marks (duration 01 hours)

1. The sum of total marks of three tests, two assignments, and quiz /seminar/ group discussion will be out of 100 marks and shall be scaled down to 50 marks

Semester End Examinations (SEE)

SEE paper shall be set for 50 questions, each of 01 mark. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is 01 hour. The student has to secure minimum of 35% of the maximum marks meant for SEE.

Suggested Learning Resources:
Books

1. Bourg, D.M., Excel Scientific and Engineering Cookbook, O'Reilly Media Inc., 2006.
2. Bilio, E.J., Excel for Scientists and Engineers – Numerical Methods, Wiley-Interscience, 2007.
3. Documentation for xlwingshttps://docs.xlwings.org/en/stable/

Web links and Video Lectures (e-Resources):

- https://freepdf-books.com/excel/
- https://jobscaptain.com/ms-excel-book-pdf/

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Assignments to understand the operations in Excel and VB may be given to students

IIISemester

Personality Development and Soft skills (AEC)			
Course Code	**21CV383**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	1:0:0:0	SEE Marks	50
Total Hours of Pedagogy	15	Total Marks	100
Credits	1	Exam Hours	2

Course objectives: Enable the students to

1. Experience self-fulfilment and overall development of one's own personality by developing personal skills.
2. Develop awareness about the significance of soft skills and impactful personality in professional life.
3. Improve the soft skills like effective communication, business correspondence, impressive presentation, leadership qualities, team-work, Time management leading to successful performance in interviews and group discussions.
4. Identify opportunities in career building and enhancement with proper time management and stress management.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Chalk and talk
2. Power point Presentation, video
3. Group discussion
4. Enacting, Demonstration
5. Industry interaction

Module-1	
Introduction to Soft-Skills-Personal Skills: Knowing Oneself/Self-Discovery-Confidence Building-Defining Strengths- Developing Positive Attitude- Thinking Creatively-Improving Perceptions - Forming Values.	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation
Module-2	
Interpersonal and Social Skills: Understanding others-Developing Inter-personal relationship Team Building-Group dynamics-Networking-Problem-solving.	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation.
Module-3	
Communication Skills: Art of Listening-Art of Speaking-Art of Reading-Art of Writing-Art of Writing E-mails: Email etiquette	
Teaching-Learning Process	Chalk and talk, Enacting, Demonstration.
Module-4	
Presentation skills: Group discussion- mock Group Discussion using video recording - public speaking.	
Teaching-Learning Process	Chalk and talk, Enacting, Demonstration, Activity

Module-5	
Corporate Skills: Working with others- Developing a proper body language-behavioural etiquettes and mannerism- Time Management –Stress Management	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

1. Develop effective communication skills (spoken and written) and effective presentation skills. Actively participate in group discussion / meetings / interviews and prepare & deliver presentations
2. Conduct effective business correspondence and prepare business reports which produce results.
3. Develop an understanding of and practice personal and professional responsibility.
4. Function effectively in multi-disciplinary and heterogeneous teams through the knowledge of team work, Inter-personal relationships, conflict management and leadership quality.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous internal Examination (CIE)

Three Tests (preferably in MCQ pattern with 20 questions) each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

1. First assignment at the end of 4th week of the semester
2. Second assignment at the end of 9th week of the semester

Quiz/Group discussion/Seminar, any two of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

The sum of total marks of three tests, two assignments, and quiz /seminar/ group discussion will be out of 100 marks and shall be **scaled down to 50 marks**

Semester End Examinations (SEE)

SEE paper shall be set for 50 questions, each of 01 mark. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is **01 hour.** The student has to secure minimum of 35% of the maximum marks meant for SEE.

Suggested Learning Resources:

Books

1. Meena K and V. Ayothi (2013) A Book on Development of Soft Skills (Soft Skills: A Road Map to Success), P. R. Publishers & Distributors, No. B-20 & 21, V. M. M Complex, Chatiram Bus Stand, Tiruchirappalli-620002. (Phone No: 0431-2702824Mobile No.: 9443370597, 9843074472)
2. Alex K. (2012) Soft Skills-Know Yourself & Know the World, S. Chand & Company LTD, Ram Nagar, New Delhi-110055. Mobile No.: 9442514814 (Dr.K.Alex

Web links and Video Lectures (e-Resources):

-

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Demonstrations of Videos
- Group Discussion
- Presentation on any social issues
- Quizzes

Semester III

Infrastructure Finance			
Course Code	21CV384	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0:2:0:0	SEE Marks	50
Total Hours of Pedagogy	15	Total Marks	100
Credits	01	Exam Hours	1 hr

Course objectives:

- To understand the infrastructure components
- Opportunities in infrastructure development
- Financial sources and investment for infrastructure

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. The online courses available should be shared with students
2. YouTube videos
3. Power point presentations
4. Visit to government, public and private organizations to understand infrastructure projects planning and execution procedures

Module-1

An Introduction to Infrastructure Finance

What is Infrastructure Business? Infrastructure then and now, Sector Structure and Size, Estimating the per capita cost.

Models of the Infrastructure Sectors

Classification system, Infrastructure and Service Organization, Business Models of Infrastructure Subsystems, Matrix of Owners and users of Infrastructure systems

Teaching-Learning Process	Chalk and talk, PowerPoint Presentation, YouTube videos

Module-2

Infrastructure and services:

How Infrastructure systems serve the built environment, , Services Structures and Equipment, Infrastructure support sector.

Investor and Business Opportunities in Infrastructure

Introduction, Bond Market, Stocks of Infrastructure Companies, infrastructure Funds, Infrastructure Indices, Commodity markets, Mortgage-Backed Securities, Private Equity and Infrastructure, The Infrastructure Support Sector, Infrastructure Investment Media, Corruption in Infrastructure Business, International Spending Plans.

Teaching-Learning Process	Chalk and talk, PowerPoint Presentation, YouTube videos

Module-3

Infrastructure Performance

Tracking Infrastructure Performance, Systems to measure, Performance Standards, Infrastructure scorecard.

Financial Models for Infrastructure Organisations

General Management Model, General Financing Model, Sector Financing Models, Public Private Partnerships, Regulations.

Teaching-Learning	Chalk and talk, PowerPoint Presentation, YouTube videos

Process	

Module-4

Capital Markets for Infrastructure

Capital Requirement of Sectors, Capital flows of Infrastructure, Capital structure of Infrstructure sectors, Sources of Capital, Investment Banking.

Teaching-Learning Process	Chalk and talk, PowerPoint Presentation, YouTube videos

Module-5

Revenues for the Infrastructure Sectors

Flow of Revenues, Rate Regulation, Revenue and cost of service analysis, Infrastructure revenue by Sector.

Opportunities and Risks for Infrastructure

Infrastructure as a policy sector, Infrastructure Policy elements, Sector Issues, Transformational Issues.

Teaching-Learning Process	Chalk and talk, PowerPoint Presentation, YouTube videos

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

1. Prepare a comprehensive development plan for infrastructure projects
2. Plan funding required and procedure to be adopted for infrastructure development
3. Estimate revenue generation and implement investment plans
4. Understand risk involved and policy issues related to infrastructure projects

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous internal Examination (CIE)

Three Tests (preferably in MCQ pattern with 20 questions) each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

1. First assignment at the end of 4th week of the semester
2. Second assignment at the end of 9th week of the semester

Quiz/Group discussion/Seminar, any two of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

The sum of total marks of three tests, two assignments, and quiz /seminar/ group discussion

will be out of 100 marks and shall be **scaled down to 50 marks**

Semester End Examinations (SEE)

SEE paper shall be set for 50 questions, each of 01 mark. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is **01 hour.** The student has to secure minimum of 35% of the maximum marks meant for SEE.

Suggested Learning Resources:

Books

1. Infrastructure Finance, Dr. K B Singh, Dr. Ajay Pratap Yadav, ISBN: 9788195248070, First edition, 2021, Raj Publications
2. Project and Infrastructure Finance: Corporate Banking Perspective, Vikas Srivastava , V. Rajaraman, Oxford University press, ISBN-13 978-0199465002, 2017

Web links and Video Lectures (e-Resources):

- https://www.pdfdrive.com/project-finance-e40552174.html
- https://www.yumpu.com/en/document/view/63829168/e-book-download-principles-of-project-finance-full-free-collection

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Assignments on new planning and design of an infrastructure facility may be given

Semester III

Fire Safety in Buildings			
Course Code	21CV385	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0:2:0:0	SEE Marks	50
Total Hours of Pedagogy	15	Total Marks	100
Credits	01	Exam Hours	1 hr

Course objectives:

- To understand the importance fire safety
- To learn various techniques involved in fire safety
- To design fire resistant buildings using proper materials and methods

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. The online courses available should be shared with students
2. YouTube videos
3. Power point presentations
4. Visit to fire stations and understand various fire accidents

Module-1

Fire: Introduction, Basic concepts of fire protection, Fire as a process of combustion, planning for fire protection, fire resistance

Ventilation and fuel controlled fire, process of combustion: flashover condition, effect of fire on construction material, design of fire resistance steel structure, concrete structure

Teaching-Learning Process	Chalk and talk, PowerPoint Presentation, YouTube videos

Module-2

Fire safety: urban planning, escape and refuge, internal planning, detection and suppression

Introduction to lift design, design of lift system, expected stop and floor of reversal, different cases, simulation, arrangements and escalators

Teaching-Learning Process	Chalk and talk, PowerPoint Presentation, YouTube videos

Module-3

Introduction to flow system: water supply, constant demand, variable demand and diversity factor, control systems

Flow in pipe networks and fixture units, design of water supply distribution system, flow in waste water pipes

Teaching-Learning Process	Chalk and talk, PowerPoint Presentation, YouTube videos

Module-4

Introduction to HVAC: governing equations to HVAC process, numerical problem on HVAC system, psychometric chart, equation based approach

Electrical systems: design of electrical systems, intelligent building, life cycle cost and basics of building maintenance, stages of maintenance management, planning for building maintenance, periodicity of maintenance management, estimation of repair cycle, cost profile of maintenance, lamp replacement, building inspection, planned and Ad-hoc maintenance

Teaching-Learning Process	Chalk and talk, PowerPoint Presentation, YouTube videos

Module-5	
Condition survey and health evaluation of buildings, diagnosis of building by visual survey, case studies of visual survey, effect of corrosion and alkali aggregate reaction, sampling and choice of test location Non-destructive testing, core strength test, carbonation and chloride measurement, electrical method of progress measurement Repair, rehabilitation, retrofit, periodicity and economics of condition survey, interpretation of test results	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation, YouTube videos

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

1. Understand types of fire, combustion process and fire resistance
2. Plan for fire safety and design of lifts
3. Design flow network in buildings
4. Design of electrical systems and maintenance
5. Perform health evaluation of buildings and suggest remedies

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous internal Examination (CIE)

Three Tests (preferably in MCQ pattern with 20 questions) each of 20 Marks (duration 01 hour)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of 10 Marks

1. First assignment at the end of 4th week of the semester
2. Second assignment at the end of 9th week of the semester

Quiz/Group discussion/Seminar, any two of three suitably planned to attain the COs and POs for 20 Marks (duration 01 hours)

The sum of total marks of three tests, two assignments, and quiz /seminar/ group discussion will be out of 100 marks and shall be scaled down to 50 marks

Semester End Examinations (SEE)

SEE paper shall be set for 50 questions, each of 01 mark. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is 01 hour. The student has to secure minimum of 35% of the maximum marks meant for SEE.

Suggested Learning Resources:

Books

1. J A Purkiss, Fire Safety Engineering: Design of Structures, ISBN 13 978-8131220085, Elsevier, 2009
2. V K Jain, Fire Safety in Buildings, ISBN-13 978-938980219, New Age International Private Limited; Third edition, 2020
3. Fire protection, services and maintenance management of building, NPTEL video lecture, IIT, Delhi
4. Bureau of Indian Standards, " HAND BOOK OF FUNCTIONAL REQUIREMENTS OF BUILDINGS, (SP-41 & SP- 32)", BIS 1987 and 1989.
5. Markus,T.A. & Morris, E.N., "BUILDING CLIMATE AND ENERGY" Pitman publishing limited. 1980.
6. Croome,J.D.&Roberts,B.M.,"AIRCONDITIONING AND VENTILATION OF BUILDINGS VOL-1".Pergamon press.
7. Building Services Design - T.W.MEVER
8. Building Engineering & System Design - F.S.MERRIT & J. AMBROSE
9. SP-35 (1987): Handbook of Water supply & drainage-BIS
10. N.B.C.-2007 BIS
11. Concept of building fire safety - D.EGAN.
12. Design of fire resisting structures - H.L. MALHOTRA.

List of reference materials/books/

1. An introduction to fire dynamics -D.DRYSDALE
2. Structural fire protection Edt by T.T.LIE
3. Elevator technology - G.C.BARNEY
4. HEATING VENTILATING AND AIR CONDITIONING Analysis and Design - Faye C. McQuiston and Jerald D. Parker.
5. Building Maintenance Management-R.LEE
6. Developments In Building Maintenance -I.EJ. GIBSON
7. ConcreteStructures:materials,Maintenance And Repair D.CAMPBELL,ALLEN & H.ROPER

Web links and Video Lectures (e-Resources):

- https://archive.nptel.ac.in/courses/105/102/105102176/

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Assignment students: A case study of fire hazard in building and restoration procedure adopted

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III SEMESTER

Sl. No	Course and Course Code	Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
				Theory Lecture	Tutorial	Practical/ Drawing	Self -Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	T	P	S					
1	BSC 21MAT31	Transform Calculus, Fourier Series and Numerical Techniques	Maths	3	0	0		03	50	50	100	3
2	IPCC 21CS32	Data Structures and Applications	Any CS Board Department	3	0	2		03	50	50	100	4
3	IPCC 21CS33	Analog and Digital Electronics		3	0	2		03	50	50	100	4
4	PCC 21CS34	Computer Organization and Architecture		3	0	0		03	50	50	100	3
5	PCC 21CSL35	Object Oriented Programming with JAVA Laboratory		0	0	2		03	50	50	100	1
6	UHV 21UH36	Social Connect and Responsibility	Any Department	0	0	1		01	50	50	100	1
7	HSMC 21KSK37/47	Samskrutika Kannada	TD and PSB: HSMC	1	0	0		01	50	50	100	1
	HSMC 21KBK37/47	Balake Kannada										
	OR											
	HSMC 21CIP37/47	Constitution of India and Professional Ethics										
8	AEC 21CS38X/21 CSL38X	Ability Enhancement Course - III	TD: Concerned department PSB: Concerned Board	If offered as Theory Course: 1	0	0		01	50	50	100	1
				If offered as lab. course: 0	0	2		02				
								Total	**400**	**400**	**800**	**18**

9	**Scheduled activities for III to VIII semesters**	NMDC 21NS83	National Service Scheme (NSS)	NSS	All students have to register for any one of the course namely National Service Scheme, Physical Education (PE)(Sports and Athletics) and Yoga with the concerned coordinator of the course during the first week of III semester. The activities shall be carried out from (for 5 semesters) between III semester to VIII semester. SEE in the above courses shall be conducted during VIII semester examinations and the accumulated CIE marks shall be added to the SEE marks. Successful completion of the registered course is mandatory for the award of the degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the colander prepared for the NSS, PE and Yoga activities.
		NMDC 21PE83	Physical Education (PE) (Sports and Athletics)	PE	
		NMDC 21YO83	Yoga	Yoga	

Course prescribed to lateral entry Diploma holders admitted to III semester B.E./B.Tech programs

1	NCMC 21MATDIP31	Additional Mathematics - I	Maths	02	02	--	--	---	100	---	100	0

Note: BSC: Basic Science Course, **IPCC:** Integrated Professional Core Course, **PCC:** Professional Core Course, **INT** –Internship, **HSMC:** Humanity and Social Science & Management Courses, **AEC**–Ability Enhancement Courses. **UHV:** Universal Human Value Course.
L –Lecture, **T –** Tutorial, P- Practical/ Drawing, **S –** Self Study Component, **CIE:** Continuous Internal Evaluation, **SEE:** Semester End Examination. **TD-**Teaching Department, **PSB**: Paper Setting department

21KSK37/47 Samskrutika Kannada is for students who speak, read and write Kannada and **21KBK37/47** Balake Kannada is for non-Kannada speaking, reading, and writing students.

Integrated Professional Core Course (IPCC): Refers to Professional Theory Core Course Integrated with Practical's of the same course. Credit for IPCC can be 04 and its Teaching–Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper. For more details, the regulation governing the Degree of Bachelor of Engineering /Technology (BE/B.Tech.) 2021-22 may be referred.

21INT49 Inter/Intra Institutional Internship: All the students admitted to engineering programs under the lateral entry category shall have to undergo a mandatory 21INT49 Inter/Intra Institutional Internship of 03 weeks during the intervening period of III and IV semesters. The internship shall be slated for CIE only and will not have SEE. The letter grade earned through CIE shall be included in the IV semester grade card. The internship shall be considered as a head of passing and shall be considered for vertical progression and for the award of degree. Those, who do not take up / complete the internship shall be declared fail and shall have to complete during subsequently after satisfying the internship requirements. The faculty coordinator or mentor shall monitor the students' internship progress and interact with them for the successful completion of the internship.

Non–credit mandatory courses (NCMC):

(A) Additional Mathematics I and II:

(1) These courses are prescribed for III and IV semesters respectively to lateral entry Diploma holders admitted to III semester of B.E./B.Tech., programs. They shall attend the classes during the respective semesters to complete all the formalities of the course and appear for the Continuous Internal Evaluation (CIE). In case, any student fails to register for the said course/fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have secured an F grade. In such a case, the student has to fulfill the course requirements during subsequent semester/s to earn the qualifying CIE marks. These courses are slated for CIE only and has no SEE.

(2) Additional Mathematics I and II shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses shall be mandatory for the award of degree.

(3) Successful completion of the courses Additional Mathematics I and II shall be indicated as satisfactory in the grade card. Non-completion of the courses Additional Mathematics I and II shall be indicated as Unsatisfactory.

(B) National Service Scheme/Physical Education (Sport and Athletics)/ Yoga:

(1) Securing 40 % or more in CIE,35 % or more marks in SEE and 40 % or more in the sum total of CIE + SEE leads to successful completion of the registered course.

(2) In case, students fail to secure 35 % marks in SEE, they have to appear for SEE during the subsequent examinations conducted by the University.

(3) In case, any student fails to register for NSS, PE or Yoga/fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have not completed the requirements of the course. In such a case, the student has to fulfill the course requirements during subsequent semester/s to earn the qualifying CIE marks.

(4) Successful completion of the course shall be indicated as satisfactory in the grade card. Non-completion of the course shall be indicated as Unsatisfactory.

(5) These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses shall be mandatory for the award of degree.

Ability Enhancement Course - III			
21CSL381	Mastering Office	21CS383	
21CS382	C++ Programming	21CS384	

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IV SEMESTER

Sl. No	Course and Course Code	Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
				Theory Lecture	Tutorial	Practical/ Drawing	Self -Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	T	P	S					
1	BSC 21CS41	Mathematical Foundations for Computing	Maths	2	2	0		03	50	50	100	3
2	IPCC 21CS42	Design and Analysis of Algorithms	Any CS Board Department	3	0	2		03	50	50	100	4
3	IPCC 21CS43	Microcontroller and Embedded System		3	0	2		03	50	50	100	4
4	PCC 21CS44	Operating System		2	2	0		03	50	50	100	3
5	AEC 21BE45	Biology For Engineers	BT, CHE, PHY	2	0	0		02	50	50	100	2
6	PCC 21CSL46	Python Programming Laboratory	Any CS Board Department	0	0	2		03	50	50	100	1
7	HSMC 21KSK37/47	Samskrutika Kannada	HSMC	1	0	0		01	50	50	100	1
	HSMC 21KBK37/47	Balake Kannada										
	OR											
	HSMC 21CIP37/47	Constitution of India & Professional Ethics										
8	AEC 21CS48X/21CS48LX	Ability Enhancement Course- IV	TD and PSB: Concerned department	If offered as theory Course: 1	0	0		01	50	50	100	1
				If offered as lab. course: 0	0	2		02				
9	UHV 21UH49	Universal Human Values	Any Department	1	0	0		01	50	50	100	1
10	INT 21INT49	Inter/Intra Institutional Internship	Evaluation By the appropriate authorities	Completed during the intervening period of II and III semesters by students admitted to first year of BE./B.Tech and during the intervening period of III and IV semesters by Lateral entry students admitted to III semester.				3	100	--	100	2
								Total	**550**	**450**	**1000**	**22**

Course prescribed to lateral entry Diploma holders admitted to III semester of Engineering programs

1	NCMC 21MATDIP41	Additional Mathematics - II	Maths	02	02	--	--	--	100	--	100	0

Note: BSC: Basic Science Course, IPCC: Integrated Professional Core Course, PCC: Professional Core Course, AEC –Ability Enhancement Courses, HSMC: Humanity and Social Science and Management Courses, UHV- Universal Human Value Courses.

L –Lecture, T – Tutorial, P- Practical/ Drawing, S – Self Study Component, CIE: Continuous Internal Evaluation, SEE: Semester End Examination.

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Integrated Professional Core Course (IPCC): Refers to Professional Theory Core Course Integrated with Practical's of the same course. Credit for IPCC can be 04 and its Teaching – Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from practical part of IPCC shall be included in the SEE question paper. For more details the regulation governing the Degree of Bachelor of Engineering /Technology (BE/B.Tech.) 2021-22 may be referred.

Non – credit mandatory course (NCMC):

Additional Mathematics - II:

(1) Lateral entry Diploma holders admitted to III semester of B.E./B.Tech., shall attend the classes during the IV semester to complete all the formalities of the course and appear for the Continuous Internal Evaluation (CIE). In case, any student fails to register for the said course/fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have secured an F grade. In such a case, the student has to fulfil the course requirements during subsequent semester/s to earn the qualifying CIE marks. These courses are slated for CIE only and has no SEE.

(2) Additional Mathematics I and II shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses shall be mandatory for the award of degree.

(3) Successful completion of the course Additional Mathematics II shall be indicated as satisfactory in the grade card. Non-completion of the courses Additional Mathematics II shall be indicated as Unsatisfactory.

Ability Enhancement Course - IV

21CSL481	Web Programming	21CSL483	R Programming
21CS482	Unix Shell Programming	21CS484	

Internship of 04 weeks during the intervening period of IV and V semesters; 21INT68 Innovation/ Entrepreneurship/ Societal based Internship.

(1) All the students shall have to undergo a mandatory internship of 04 weeks during the intervening period of IV and V semesters. The internship shall be slated for CIE only and will not have SEE. The letter grade earned through CIE shall be included in the VI semester grade card. The internship shall be considered as a head of passing and shall be considered for vertical progression and for the award of degree. Those, who do not take up / complete the internship shall be considered under F (fail) grade and shall have to complete during subsequently after satisfying the internship requirements.

(2) Innovation/ Entrepreneurship Internship shall be carried out at industry, State and Central Government /Non-government organizations (NGOs), micro, small and medium enterprise (MSME), Innovation centers or Incubation centers. Innovation need not be a single major breakthrough; it can also be a series of small or incremental changes. Innovation of any kind can also happen outside of the business world.

Entrepreneurship internships offers a chance to gain hands on experience in the world of entrepreneurship and helps to learn what it takes to run a small entrepreneurial business by performing intern duties with an established company. This experience can then be applied to future business endeavours. Start-ups and small companies are a preferred place to learn the business tack ticks for future entrepreneurs as learning how a small business operates will serve the intern well when he/she manages his/her own company. Entrepreneurship acts as a catalyst to open the minds to creativity and innovation. Entrepreneurship internship can be from several sectors, including technology, small and medium-sized, and the service sector.

(3) Societal or social internship.

Urbanization is increasing on a global scale; and yet, half the world's population still resides in rural areas and is devoid of many things that urban population enjoy. Rural internship, is a work-based activity in which students will have a chance to solve/reduce the problems of the rural place for better living.

As proposed under the AICTE rural internship programme, activities under Societal or social internship, particularly in rural areas, shall be considered for 40 points under AICTE activity point programme.

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V SEMESTER

Sl. No	Course and Course Code	Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
				Theory Lecture	Tutorial	Practical/ Drawing	Self -Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	T	P	S					
1	BSC 21CS51	Automata Theory and compiler Design	Any CS Board Department	3	0	0		03	50	50	100	3
2	IPCC 21CS52	Computer Networks		3	0	2		03	50	50	100	4
3	PCC 21CS53	Database Management Systems		3	0	0		03	50	50	100	3
4	PCC 21CS54	Artificial Intelligence and Machine Learning		3	0	0		03	50	50	100	3
5	PCC 21CSL55	Database Management Systems Laboratory with Mini Project		0	0	2		03	50	50	100	1
6	AEC 21XX56	Research Methodology & Intellectual Property Rights	TD: Any Department PSB: As identified by university	2	0	0		02	50	50	100	2
7	HSMC 21CIV57	Environmental Studies	TD: Civil/ Environmental /Chemistry/ Biotech. PSB: Civil Engg	1	0	0		1	50	50	100	1
8	AEC 21CS58X/21 CSL58X	Ability Enhancement Course-V	Concerned Board	If offered as Theory courses				01	50	50	100	1
				1	0	0						
				If offered as lab. courses				02				
				0	0	2						
								Total	**400**	**400**	**800**	**18**

Ability Enhancement Course - IV

21CSL581	Angular JS and Node JS	21CS583	
21CS582	C# and .Net Framework	21CS584	

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L –Lecture, T – Tutorial, P- Practical/ Drawing, S – Self Study Component, CIE: Continuous Internal Evaluation, SEE: Semester End Examination.

Integrated Professional Core Course (IPCC): refers to Professional Theory Core Course Integrated with Practical of the same course. Credit for IPCC can be 04 and its Teaching – Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). Theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by CIE only and there shall be no SEE. For more details the regulation governing the Degree of Bachelor of Engineering /Technology (BE/B.Tech.) 2021-22 may be referred.

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VI SEMESTER

Sl. No	Course and Course Code	Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
				Theory Lecture	Tutorial	Practical/ Drawing	Self -Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	T	P	S					
1	HSMC 21CS61	Software Engineering and Project Management	Any CS Board Department	2	2	0		03	50	50	100	3
2	IPCC 21CS62	Fullstack Development		3	0	2		03	50	50	100	4
3	PCC 21IS63	Software Testing		3	0	0		03	50	50	100	3
4	PEC 21XX64x	Professional Elective Course-I		3	0	0		03	50	50	100	3
5	OEC 21XX65x	Open Elective Course-I	Concerned Department	3	0	0		03	50	50	100	3
6	PCC 21ISL66	Software Testing Laboratory	Any CS Board Department	0	0	2		03	50	50	100	1
7	MP 21ISMP67	Mini Project		Two contact hours /week for interaction between the faculty and students.				--	100	--	100	2
8	INT 21INT68	Innovation/Entrepreneurship /Societal Internship	Completed during the intervening period of IV and V semesters.					--	100	--	100	3
								Total	**500**	**300**	**800**	**22**

Professional Elective - I

21CS641	Agile Technology	21IS643	Data Mining and Data warehousing
21CS642	Advanced JAVA Programming	21CS644	Data science and Visualization

Open Electives – I offered by the Department to other Department students

21CS651	Introduction to Data Structures	21CS653	Introduction to Cyber Security
21CS652	Introduction to Database Management Systems	21CS654	Programming in JAVA

Note: HSMC: Humanity and Social Science & Management Courses, **IPCC:** Integrated Professional Core Course, **PCC:** Professional Core Course, **PEC:** Professional Elective Courses, OEC–Open Elective Course, **MP** –Mini Project, INT –Internship.
L –Lecture, T – Tutorial, P - Practical / Drawing, S – Self Study Component, CIE: Continuous Internal Evaluation, SEE: Semester End Examination.

Integrated Professional Core Course (IPCC): Refers to Professional Theory Core Course Integrated with Practical of the same course. Credit for IPCC can be 04 and its Teaching – Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by CIE only and there shall be no SEE. For more details, the regulation governing the Degree of Bachelor of Engineering /Technology (BE/B.Tech) 2021-22 may be referred.

Professional Elective Courses (PEC):
A professional elective (PEC) course is intended to enhance the depth and breadth of educational experience in the Engineering and Technology curriculum. Multidisciplinary courses that are added supplement the latest trend and advanced technology in the selected stream of engineering. Each group will provide an option to select one course out of five courses. The minimum students' strength for offering professional electives is 10. However, this conditional shall not be applicable to cases where the admission to the programme is less than 10.

Open Elective Courses:
Students belonging to a particular stream of Engineering and Technology are not entitled for the open electives offered by their parent Department. However, they can opt an elective offered by other Departments, provided they satisfy the prerequisite condition if any. Registration to open electives shall be documented under the guidance of the Program Coordinator/ Advisor/Mentor.
Selection of an open elective shall **not be allowed** if,

(i) The candidate has studied the same course during the previous semesters of the program.
(ii) The syllabus content of open electives is similar to that of the Departmental core courses or professional electives.
(iii) A similar course, under any category, is prescribed in the higher semesters of the program.

In case, any college is desirous of offering a course (not included in the Open Elective List of the University) from streams such as Law, Business (MBA), Medicine, Arts, Commerce, etc., can seek permission, at least one month before the commencement of the semester, from the University by

submitting a copy of the syllabus along with the details of expertise available to teach the same in the college.
The minimum students' strength for offering open electives is 10. However, this conditional shall not be applicable to cases where the admission to the programme is less than 10.

Mini-project work: Mini Project is a laboratory-oriented course which will provide a platform to students to enhance their practical knowledge and skills by the development of small systems/applications.
Based on the ability/abilities of the student/s and recommendations of the mentor, a single discipline or a multidisciplinary Mini- project can be assigned to an individual student or to a group having not more than 4 students.
CIE procedure for Mini-project:
(i) Single discipline: The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two faculty members of the Department, one of them being the Guide. The CIE marks awarded for the Mini-project work shall be based on the evaluation of project report, project presentation skill, and question and answer session in the ratio of 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.
(ii) Interdisciplinary: Continuous Internal Evaluation shall be group-wise at the college level with the participation of all the guides of the project.
The CIE marks awarded for the Mini-project, shall be based on the evaluation of project report, project presentation skill, and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.
No SEE component for Mini-Project.

VII semester Classwork and Research Internship /Industry Internship (21INT82)

Swapping Facility
Institutions can swap VII and VIII Semester Scheme of Teaching and Examinations to accommodate research internship/ industry internship after the VI semester**.**
(2) Credits earned for the courses of VII and VIII Semester Scheme of Teaching and Examinations shall be counted against the corresponding semesters whether VII or VIII semester is completed during the beginning of IV year or later part of IV year of the program.
Elucidation:
At the beginning of IV year of the programme i.e., after VI semester, VII semester classwork and VIII semester Research Internship /Industrial Internship shall be permitted to be operated simultaneously by the University so that students have ample opportunity for internship. In other words, a good percentage of the class shall attend VII semester classwork and similar percentage of others shall attend to Research Internship or Industrial Internship.
Research/Industrial Internship shall be carried out at an Industry, NGO, MSME, Innovation centre, Incubation centre, Start-up, Centers of Excellence (CoE), Study Centre established in the parent institute and /or at reputed research organizations / institutes. The internship can also be rural internship.
The mandatory Research internship /Industry internship is for 24 weeks. The internship shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not take up/complete the internship shall be declared fail and shall have to complete during the subsequent University examination after satisfying the internship requirements.

INT21INT82 Research Internship/ Industry Internship/Rural Internship
Research internship: A research internship is intended to offer the flavour of current research going on in the research field. It helps students get familiarized with the field and imparts the skill required for carrying out research.
Industry internship: Is an extended period of work experience undertaken by students to supplement their degree for professional development. It also helps them learn to overcome unexpected obstacles and successfully navigate organizations, perspectives, and cultures. Dealing with contingencies helps students recognize, appreciate, and adapt to organizational realities by tempering their knowledge with practical constraints.
Rural internship: A long-term goal, as proposed under the AICTE rural internship programme, shall be counted as rural internship activity.
The student can take up Interdisciplinary Research Internship or Industry Internship.
The faculty coordinator or mentor has to monitor the students' internship progress and interact with them to guide for the successful completion of the internship.
The students are permitted to carry out the internship anywhere in India or abroad. University shall not bear any expenses incurred in respect of internship.

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI

B.E. in Information Science and Engineering

Scheme of Teaching and Examinations 2021

Outcome-Based Education (OBE) and Choice Based Credit System (CBCS)

(Effective from the academic year 2021 - 22)

Swappable VII and VIII SEMESTER

VII SEMESTER

Sl. No	Course and Course Code	Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
				Theory Lecture	Tutorial	Practical/ Drawing	Self -Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	T	P	S					
1	PCC 21IS71	Cryptography and Network Security	Any CS Board Department	3	0	0		3	50	50	100	3
2	PCC 21CS72	Cloud Computing		2	0	0		3	50	50	100	2
3	PEC 21XX73X	Professional elective Course-II		3	0	0		3	50	50	100	3
4	PEC 21XX74X	Professional elective Course-III		3	0	0		3	50	50	100	3
5	OEC 21XX75X	Open elective Course-II	Concerned Department	3	0	0		3	50	50	100	3
6	Project 21ISP76	Project work		Two contact hours /week for interaction between the faculty and students.				3	100	100	200	10
								Total	**350**	**350**	**700**	**24**

VIII SEMESTER

Sl. No	Course and Course Code		Course Title	Teaching Department	Teaching Hours /Week				Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Self -Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	Seminar 21IS81		Technical Seminar		One contact hour /week for interaction between the faculty and students.				--	100	--	100	01
2	INT 21INT82		Research Internship/ Industry Internship		Two contact hours /week for interaction between the faculty and students.				03 (Batch wise)	100	100	200	15
3	NCMC	21NS83	National Service Scheme (NSS)	NSS	Completed during the intervening period of III semester to VIII semester.				--	50	50	100	0
		21PE83	Physical Education (PE) (Sports and Athletics)	PE									
		21YO83	Yoga	Yoga									
									Total	**250**	**150**	**400**	**16**

Professional Elective - II

21CS731	Object oriented Modelling and Design	21CS734	Blockchain Technology
21CS732	Digital Image Processing	21CS735	Internet of Things
21IS733	User Interface Design		

Professional Elective - III

21CS741	Software Architecture and Design Patterns	21CS744	Robotic Process Automation Design and Development
21IS742	File structures	21CS745	NOSQL Database
21CS743	Deep Learning		

Open Electives - II offered by the Department to other Department students			
21CS751	Programming in Python	21CS754	Introduction to Data Science
21CS752	Introduction to AI and ML	21CS755	
21CS753	Introduction to BigData		

Note: PCC: Professional Core Course, **PEC:** Professional Elective Courses, **OEC**–Open Elective Course, **AEC** –Ability Enhancement Courses.
L –Lecture, T – Tutorial, P- Practical / Drawing, S – Self Study Component, CIE: Continuous Internal Evaluation, SEE: Semester End Examination.

Note: VII and VIII semesters of IV year of the programme

(1) Institutions can swap VII and VIII Semester Scheme of Teaching and Examinations to accommodate research internship/ industry internship after the VI semester**.**

(2) Credits earned for the courses of VII and VIII Semester Scheme of Teaching and Examinations shall be counted against the corresponding semesters whether VII or VIII semester is completed during the beginning of IV year or later part of IV year of the programme.

PROJECT WORK (21XXP76): The objective of the Project work is

(i) To encourage independent learning and the innovative attitude of the students.
(ii) To develop interactive attitude, communication skills, organization, time management, and presentation skills.
(iii) To impart flexibility and adaptability.
(iv) To inspire team working.
(v) To expand intellectual capacity, credibility, judgment and intuition.
(vi) To adhere to punctuality, setting and meeting deadlines.
(vii) To instil responsibilities to oneself and others.
(viii) To train students to present the topic of project work in a seminar without any fear, face the audience confidently, enhance communication skills, involve in group discussion to present and exchange ideas.

CIE procedure for Project Work:

(1) Single discipline: The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide.

The CIE marks awarded for the project work, shall be based on the evaluation of project work Report, project presentation skill, and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

(2) Interdisciplinary: Continuous Internal Evaluation shall be group-wise at the college level with the participation of all guides of the college. Participation of external guide/s, if any, is desirable. The CIE marks awarded for the project work, shall be based on the evaluation of project work Report, project presentation skill, and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

SEE procedure for Project Work: SEE for project work will be conducted by the two examiners appointed by the University. The SEE marks awarded for the project work, shall be based on the evaluation of project work Report, project presentation skill, and question and answer session in the ratio 50:25:25.

TECHNICAL SEMINAR (21XXS81): The objective of the seminar is to inculcate self-learning, present the seminar topic confidently, enhance communication skill, involve in group discussion for exchange of ideas. Each student, under the guidance of a Faculty, shall choose, preferably, a recent topic of his/her interest relevant to the programme of Specialization.

(i) Carry out literature survey, systematically organize the content.
(ii) Prepare the report with own sentences, avoiding a cut and paste act.
(iii) Type the matter to acquaint with the use of Micro-soft equation and drawing tools or any such facilities.
(iv) Present the seminar topic orally and/or through PowerPoint slides.
(v) Answer the queries and involve in debate/discussion.
(**vi)** Submit a typed report with a list of references.

The participants shall take part in the discussion to foster a friendly and stimulating environment in which the students are motivated to reach high standards and become self-confident.

Evaluation Procedure:

The CIE marks for the seminar shall be awarded (based on the relevance of the topic, presentation skill, participation in the question and answer session, and quality of report) by the committee constituted for the purpose by the Head of the Department. The committee shall consist of three teachers from the department with the senior-most acting as the Chairman.

Marks distribution for CIE of the course:

Seminar Report:50 marks
Presentation skill:25 marks
Question and Answer: 25 marks. ■ No SEE component for Technical Seminar

Non – credit mandatory courses (NCMC):

National Service Scheme/Physical Education (Sport and Athletics)/ Yoga:

(1) Securing 40 % or more in CIE,35 % or more marks in SEE and 40 % or more in the sum total of CIE + SEE leads to successful completion of the registered course.

(2) In case, students fail to secure 35 % marks in SEE, they has to appear for SEE during the subsequent examinations conducted by the University.

(3) In case, any student fails to register for NSS, PE or Yoga/fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have not completed the requirements of the course. In such a case, the student has to fulfill the course requirements during subsequently to earn the qualifying CIE marks subject to the maximum programme period.

(4) Successful completion of the course shall be indicated as satisfactory in the grade card. Non-completion of the course shall be indicated as Unsatisfactory.

(5) These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses shall be mandatory for the award of degree.

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI

B.E. in Civil Engineering

Scheme of Teaching and Examinations2021

Outcome Based Education(OBE) and Choice Based Credit System (CBCS)

(Effective from the academic year 2021 - 22)

III SEMESTER

Sl. No	Course and Course Code	Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
				Theory Lecture	Tutorial	Practical/ Drawing	Self -Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	T	P	S					
1	BSC 21MAT31	Transform Calculus, Fourier Series and Numerical Techniques (Common to all)	TD- Maths PSB-Maths	2	2	0	0	03	50	50	100	3
2	IPCC 21CV32	Geodetic Engineering	TD: Civil Engg PSB: Civil Engg	2	2	2	0	03	50	50	100	4
3	IPCC 21CV33	Strength of Materials	TD: Civil Engg PSB: Civil Engg	2	2	2	0	03	50	50	100	4
4	**PCC 21CV34**	**Earth Resources and Engineering**	**TD: Geology PSB: Geology**	**3**	**0**	**0**	**0**	**03**	**50**	**50**	**100**	**3**
5	PCC 21CVL35	Computer Aided Building Planning and Drawing	TD: Civil Engg PSB: Civil Engg	0	0	2	0	03	50	50	100	1
6	UHV 21UH36	Social Connect and Responsibility	Any Department	0	0	2	0	01	50	50	100	1
7	HSMC 21KSK37/47	Samskrutika Kannada	TD and PSB HSMC	0	2	0	0	01	50	50	100	1
	HSMC 21KBK37/47	Balake Kannada										
	OR											
	HSMC 21CIP37/47	Constitution of India and Professional Ethics										
8	AEC 21CV38X	Ability Enhancement Course - III	TD: Concerned department PSB: Concerned Board	If offered as Theory Course: 0	2	0		01	50	50	100	1
				If offered as lab. course: 0	0	2		02				
								Total	**400**	**400**	**800**	**18**
9	**Scheduled activities for III to VIII semesters**	NCMC 21NS83	National Service Scheme (NSS)	NSS	All students have to register for any one of the courses namely National Service Scheme, Physical Education (PE)(Sports and Athletics),and Yoga with the concerned coordinator of the course during the first week of III semester.The activities shall be carried out between III semester to VIII semester (for 5 semesters). SEE in the above courses shall be conducted during VIII semester examinations and the accumulated CIE marks shall be added to the SEE marks. Successful completion of the registered course is mandatory for the award of the degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the calendar prepared for the NSS, PE, and Yoga activities.								
		NCMC 21PE83	Physical Education (PE)(Sports and Athletics)	PE								
		NCMC 21YO83	Yoga	Yoga								

Course prescribed to lateral entry Diploma holders admitted to III semester B.E./B.Tech programs

1	NCMC 21MATDIP31	Additional Mathematics - I	Maths	02	02	--	--	---	100	---	100	0

Note:BSC: Basic Science Course, **IPCC:** Integrated Professional Core Course, **PCC:** Professional Core Course,**INT** –Internship, **HSMC:** Humanity and Social Science & Management Courses, **AEC**–Ability Enhancement Courses. **UHV:** Universal Human Value Course.

L –Lecture, **T –** Tutorial, P- Practical/ Drawing, **S –** Self Study Component, **CIE:** Continuous Internal Evaluation, **SEE:** Semester End Examination.**TD-**Teaching Department, **PSB**: Paper Setting department

21KSK37/47 Samskrutika Kannada is for students who speak, read and write Kannada and **21KBK37/47** Balake Kannada is for non-Kannada speaking, reading, and writing students.

Integrated Professional Core Course (IPCC): Refers to Professional Theory Core Course Integrated with practical of the same course. Credit for IPCC can be 04 and its Teaching–Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the

SEE question paper.For more details, the regulation governing the Degree of Bachelor of Engineering /Technology (B.E./B.Tech.) 2021-22 may be referred.

21INT49Inter/Intra Institutional Internship: All the students admitted to engineering programs under the lateral entry category shall have to undergo a mandatory 21INT49 Inter/Intra Institutional Internshipof 03 weeks during the intervening period of III and IV semesters. The internship shall be slated for CIE only and will not have SEE. The letter grade earned through CIE shall be included in the IV semester grade card.The internship shall be considered as a head of passing and shall be considered for vertical progression and for the award of degree. Those, who do not take up / complete the internship shall be declared fail and shall have to complete during subsequently after satisfying the internship requirements. The faculty coordinator or mentor shall monitor the students' internship progress and interact with them for the successful completion of the internship.

Non–credit mandatory courses (NCMC):

(A)Additional Mathematics I and II:

(1) These courses are prescribed for III and IV semesters respectively to lateral entry Diploma holders admitted to III semester of B.E./B.Tech., programs. They shall attend the classes during the respective semesters to complete all the formalities of the course and appear for the Continuous Internal Evaluation (CIE). In case, any student fails to register for the said course/fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have secured an F grade. In such a case, the student has to fulfill the course requirements during subsequent semester/s to earn the qualifying CIE marks. These courses are slated for CIE only and have no SEE.

(2) Additional Mathematics I and II shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses shall be mandatory for the award of degree.

(3) Successful completion of the coursesAdditional Mathematics I and IIshall be indicated as satisfactory in the grade card. Non-completion of the coursesAdditional Mathematics I and IIshall be indicated as Unsatisfactory.

(B) National Service Scheme/Physical Education (Sport and Athletics)/ Yoga:

(1) Securing 40 % or more in CIE,35 % or more marks in SEE, nd 40 % or more in the sum total of CIE + SEE leads to successful completion of the registered course.

(2) In case, students fail to secure 35 % marks in SEE, they have to appear for SEE during the subsequent examinations conducted by the University.

(3) In case, any student fails to register for NSS, PE or Yoga/fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have not completed the requirements of the course. In such a case, the student has to fulfill the course requirements during subsequent semester/s to earn the qualifying CIE marks.

(4) Successful completion of the course shall be indicated as satisfactory in the grade card. Non-completion of the course shall be indicated as Unsatisfactory.

(5) These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses shall be mandatory for the award of degree.

Ability Enhancement Course - III			
21CV381	Problem Solving using Python	21CV384	Infrastructure Finance
21CV382	Microsoft Excel and Visual Basic for Application	21CV385	Fire Safety in Buildings
21CV383	Personality Development and Soft Skills		

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IV SEMESTER

Sl. No	Course and Course Code	Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
				Theory Lecture	Tutorial	Practical/ Drawing	Self -Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	T	P	S					
1	BSC **21MAT41**	Complex Analysis, Probability and Statistical Methods.	TD, PSB-Maths	2	2	0	0	03	50	50	100	3
2	IPCC 21CV42	Fluid Mechanics and Hydraulics	TD: Civil Engg PSB: Civil Engg	2	2	2	0	03	50	50	100	4
3	IPCC 21CV43	Public Health Engineering	TD: Civil Engg PSB: Civil Engg	2	2	2	0	03	50	50	100	4
4	PCC 21CV44	Analysis of Structures	TD: Civil Engg PSB: Civil Engg	2	2	0	0	03	50	50	100	3
5	AEC 21BE45	Biology for Engineers	BT, CHE, PHY	1	2	0	0	02	50	50	100	2
6	PCC 21CVL46	Earth Resources and Engineering Lab	TD: Geology PSB: Geology	0	0	2	0	03	50	50	100	1
7	HSMC 21KSK37/47	Samskrutika Kannada	HSMC	0	2	0	0	01	50	50	100	1
	HSMC 21KBK37/47	Balake Kannada										
	OR											
	HSMC 21CIP37/47	Constitution of India & Professional Ethics										
8	AEC 21CV48X	Ability Enhancement Course- IV	TD and PSB: Concerned department	If offered as theory Course: 0	2	0		01	50	50	100	1
				If offered as lab. course: 0	0	2		02				
9	UHV 21UH49	UniversalHumanValues	Any Department	0	2	0		01	50	50	100	1
10	INT 21INT49	Inter/Intra Institutional Internship	Evaluation By the appropriate authorities	Completed during the intervening period ofII and III semesters by students admitted to first year of BE./B.Tech and during the intervening period of III and IV semesters by Lateral entry students admitted to III semester.				3	100	--	100	2
								Total	**550**	**450**	**1000**	**22**

Course prescribed to lateral entry Diploma holders admitted to III semester of Engineering programs

1	NCMC 21MATDIP41	Additional Mathematics - II	Maths	02	02	--	--	--	100	--	100	0

Note: BSC: Basic Science Course, IPCC: Integrated Professional Core Course, PCC: Professional Core Course, AEC –Ability Enhancement Courses, HSMC: Humanity and Social Science and Management Courses, UHV- Universal Human Value Courses.

L –Lecture, T – Tutorial, P- Practical/ Drawing, S – Self Study Component, CIE: Continuous Internal Evaluation, SEE: Semester End Examination.

21KSK37/47 Samskrutika Kannada is for students who speak, read and write Kannada and 21KBK37/47 Balake Kannada is for non-Kannada speaking, reading, and writing students.

Integrated Professional Core Course (IPCC): Refers to Professional Theory Core Course Integrated with Practical of the same course. Credit for IPCC can be 04 and its Teaching–Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCCshall be included in the SEE question paper.For more details, the regulation governing the Degree of Bachelor of Engineering /Technology (BE/B.Tech.) 2021-22 may be referred.

Non – credit mandatory course (NCMC):

Additional Mathematics - II:

(1) Lateral entry Diploma holders admitted to III semester of B.E./B.Tech., shall attend the classes during the IV semester to complete all the formalities of the course and appear for the Continuous Internal Evaluation (CIE). In case, any student fails to register for the said course/fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have secured an F grade. In such a case, the student has to fulfill the course requirements during subsequent semester/s to earn the qualifying CIE marks. These courses are slated for CIE only and have no SEE.

(2) Additional Mathematics I and II shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses shall be mandatory for the award of degree.

(3) Successful completion of the course Additional Mathematics IIshall be indicated as satisfactory in the grade card. Non-completion of the courses. Additional Mathematics IIshall be indicated as Unsatisfactory.

Ability Enhancement Course - IV			
21CV481	Data Cleaning and Preparation with Python Pandas	21CV484	Project Finance
21CV482	GIS with Quantum GIS	21CV485	Green Buildings
21CV483	Technical Writing Skills		

Internship of 04 weeks during the intervening period of IV and V semesters; 21INT68Innovation/ Entrepreneurship/ Societal Internship.

(1) All the students shall have to undergo a mandatory internship of 04 weeks during the intervening period of IV and V semesters. The internship shall be slated for CIE only and will not have SEE. The letter grade earned through CIE shall be included in the VI semester grade card.The internship shall be considered as a head of passing and shall be considered for vertical progression and for the award of degree. Those, who do not take up / complete the internship shall be considered under F (fail) grade and shall have to complete it subsequently after satisfying the internship requirements.

(2)Innovation/ Entrepreneurship Internshipshall be carried out at industry, State and Central Government /Non-government organizations (NGOs), micro, small and medium enterprises (MSME), Innovation centres, or Incubation centers etc. Innovation need not be a single major breakthrough; it can also be a series of small or incremental changes. Innovation of any kind can also happen outside of the business world.

Entrepreneurship internships offer a chance to gain hands-on experience in the world of entrepreneurship and help to learn what it takes to run a small entrepreneurial business by performing intern duties with an established company. This experience can then be applied to future business endeavors.Start-ups and small companies are a preferred places to learn the business tactics for future entrepreneurs as earning how a small business operates will serve the intern well when he/she manages his/her own company. Entrepreneurship acts as a catalyst to open minds to creativity and innovation.Entrepreneurship internships can be from several sectors, including technology, small and medium-sized sector, and the service sector.

(3) **Societal or Social internship.**Urbanization is increasing on a global scale; and yet, half the world's population still resides in rural areas and is devoid of many things that urban population enjoys. The rural internship is a work-based activity in which students will have a chance to solve/reduce the problems of the rural place for better living.

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V SEMESTER

Sl. No	Course and Course Code	Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
				Theory Lecture	Tutorial	Practical/ Drawing	Self -Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	T	P	S					
1	BSC 21CV51	Hydrology and Water Resources Engineering	TD: Civil Engg PSB: Civil Engg	3	0	0		03	50	50	100	3
2	IPCC 21CV52	Transportation Engineering	TD: Civil Engg PSB: Civil Engg	2	2	2		03	50	50	100	4
3	PCC 21CV53	Design of RC Structural Elements	TD: Civil Engg PSB: Civil Engg	2	2	0		03	50	50	100	3
4	PCC 21CV54	Geotechnical Engineering	TD: Civil Engg PSB: Civil Engg	2	2	0		03	50	50	100	3
5	PCC 21CVL55	Geotechnical Engineering Lab	TD: Civil Engg PSB: Civil Engg	0	0	2		03	50	50	100	1
6	AEC 21CV56	Research Methodology & Intellectual Property Rights	TD: Any Department PSB: As identified by University	1	2	0		02	50	50	100	2
7	HSMC 21CIV57	Environmental Studies	TD: Civil/ Environmental /Chemistry/ Biotech. PSB: Civil Engg	0	2	0		1	50	50	100	1
8	AEC 21CV58X	Ability Enhancement Course-V	Concerned Board	If offered as Theory courses				01	50	50	100	1
				0	2	0						
				If offered as lab. courses				02				
				0	0	2						
								Total	**400**	**400**	**800**	**18**

Ability Enhancement Course - V

21CV581	Data Analysis with Python	21CV584	Quality Control and Quality Assurance
21CV582	Software Applications	21CV585	Offshore Structures
21CV583	Gender Sensitization		

Note: BSC: Basic Science Course, PCC: Professional Core Course, IPCC: Integrated Professional Core Course, AEC –Ability Enhancement Course INT – Internship, HSMC: Humanity and Social Science & Management Courses.

L –Lecture, T – Tutorial, P- Practical/ Drawing, S – Self Study Component, CIE: Continuous Internal Evaluation, SEE: Semester End Examination.

Integrated Professional Core Course (IPCC): refers to Professional Theory Core Course Integrated with Practical of the same course. Credit for IPCC can be 04 and its Teaching – Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by CIE only and there shall be no SEE. For more details, the regulation governing the Degree of Bachelor of Engineering /Technology (BE/B.Tech.) 2021-22 may be referred.

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VI SEMESTER

Sl. No	Course and Course Code	Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
				Theory Lecture	Tutorial	Practical/ Drawing	Self -Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	T	P	S					
1	HSMC 21CV61	Construction Management and Entrepreneurship	TD: Civil Engg PSB: Civil Engg	3	0	0		03	50	50	100	3
2	IPCC 21CV62	Concrete Technology	TD: Civil Engg PSB: Civil Engg	2	2	2		03	50	50	100	4
3	PCC 21CV63	Design of Steel structure	TD: Civil Engg PSB: Civil Engg	2	2	0		03	50	50	100	3
4	PEC 21CV64x	Professional Elective Course-I	TD: Civil Engg PSB: Civil Engg	3	0	0		03	50	50	100	3
5	OEC 21CV65x	Open Elective Course-I	Concerned Department	3	0	0		03	50	50	100	3
6	PCC 21CVL66	Computer Aided Detailing of Structure	TD: Civil Engg PSB: Civil Engg	0	0	2		03	50	50	100	1
7	MP 21CVMP67	Mini Project - Extensive survey project	TD: Civil Engg PSB: Civil Engg	Two contact hours /week for interaction between the faculty and students.				--	100	--	100	2
8	INT 21INT68	Innovation/Entrepreneurship /Societal Internship	Completed during the intervening period of IV and V semesters.					--	100	--	100	3
								Total	**500**	**300**	**800**	**22**

Professional Elective - I

21CV641	Design of Prestressed Concrete Structures	21CV644	Design Concept in Building Services
21CV642	Applied Geotechnical Engineering	21CV645	Ground Water Hydraulics
21CV643	Railways, Harbours, Tunnelling and Airports	21CV646	Alternative Building Materials

Open Electives – I offered by the Department to other Department students

21CV651	Remote Sensing and GIS	21CV653	Occupational Health and Safety
21CV652	Traffic Engineering	21CV654	Conservation of Natural Resources

Note:HSMC: Humanity and Social Science & Management Courses, **IPCC:** Integrated Professional Core Course, **PCC:** Professional Core Course, **PEC:** Professional Elective Courses, O**EC**–Open Elective Course, **MP** –Mini Project, INT –Internship.
L –Lecture, **T** – Tutorial, **P** - Practical / Drawing, **S** – Self Study Component, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Examination.

Integrated Professional Core Course (IPCC): Refers to Professional Theory Core Course Integrated with Practical of the same course. Credit for IPCC can be 04 and its Teaching – Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by CIE only and there shall be no SEE. For more details, the regulation governing the Degree of Bachelor of Engineering /Technology (BE/B.Tech) 2021-22 may be referred.

Professional Elective Courses(PEC):
A professional elective (PEC) course is intended to enhance the depth and breadth of educational experience in the Engineering and Technology curriculum. Multidisciplinary courses that are added supplement the latest trend and advanced technology in the selected stream of engineering. Each group will provide an option to select one course. The minimum number of students' strengths for offering professional electives is 10. However, this conditional shall not be applicable to cases where the admission to the program is less than 10.

Open Elective Courses:
Students belonging to a particular stream of Engineering and Technology are not entitled to the open electives offered by their parent Department. However, they can opt for an elective offered by other Departments, provided they satisfy the prerequisite condition if any. Registration to open electives shall be documented under the guidance of the Program Coordinator/ Advisor/Mentor.
Selection of an open elective shall **not be allowed** if,

(i) The candidate has studied the same course during the previous semesters of the program.

(ii) The syllabus content of open electives is similar to that of the Departmental core courses or professional electives.

(iii) A similar course, under any category, is prescribed in the higher semesters of the program.

In case, any college is desirous of offering a course (not included in the Open Elective List of the University) from streams such as Law, Business (MBA), Medicine, Arts, Commerce, etc., can seek permission, at least one month before the commencement of the semester, from the University by submitting a copy of the syllabus along with the details of expertise available to teach the same in the college.

The minimum students' strength for offering open electives is 10. However, this conditional shall not be applicable to cases where the admission to the programme is less than 10.

Mini-project work – Extensive Survey Project: Mini Project is a laboratory-oriented course which will provide a platform to students to enhance their practical knowledge and skills by the development of small systems/applications.

Based on the ability/abilities of the student/s and recommendations of the mentor Mini- project can be assigned to a group having not more than 10 students.

CIE procedure for Mini-project – Extensive Survey Project:

The CIE marks shall be awarded by a committee consisting of the Head of the Department and two faculty members of the Department, one of them being the Guide. The CIE marks awarded for the Mini-project work shall be based on the evaluation of project report, project presentation skill, and question and answer session in the ratio of 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

No SEE component for Mini-Project.

VII semester Class work and Research Internship /Industry Internship (21INT82)

Swapping Facility

Institutions can swap VII and VIII Semester Scheme of Teaching and Examinations to accommodate research internship/ industry internship after the VI semester**.**

(2) Credits earned for the courses of VII and VIII Semester Scheme of Teaching and Examinations shall be counted against the corresponding semesters whether VII or VIII semester is completed during the beginning of IV year or later part of IV year of the program.

Elucidation:

At the beginning of IV years of the program i.e., after VI semester, VII semester classwork and VIII semester Research Internship /Industrial Internship shall be permitted to be operated simultaneously by the University so that students have ample opportunity for an internship. In other words, a good percentage of the class shall attend VII semester classwork and a similar percentage of others shall attend to Research Internship or Industrial Internship.

Research/Industrial Internship shall be carried out at an Industry, NGO, MSME, Innovation center, Incubation center, Start-up, center of Excellence (CoE), Study Centre established in the parent institute and /or at reputed research organizations/institutes.

The mandatory Research internship /Industry internship is for 24 weeks. The internship shall be considered as a head of passing and shall be considered for the award of a degree. Those, who do not take up/complete the internship shall be declared to fail and shall have to complete it during the subsequent University examination after satisfying the internship requirements.

INT21INT82Research Internship/ Industry Internship/Rural Internship

Research internship:A research internship is intended to offer the flavor of current research going on in the research field. It helps students get familiarized with the field and imparts the skill required for carrying out research.

Industryinternship: Isan extended period of work experience undertaken by students to supplement their degree for professional development. It also helps them learn to overcome unexpected obstacles and successfully navigate organizations, perspectives, and cultures. Dealing with contingencies helps students recognize, appreciate, and adapt to organizational realities by tempering their knowledge with practical constraints.

The faculty coordinator or mentor has to monitor the students' internship progress and interact with them to guide for the successful completion of the internship.

The students are permitted to carry out the internship anywhere in India or abroad. University shall not bear any expenses incurred in respect of internship.

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI

B.E. in Civil Engineering

Scheme of Teaching and Examinations 2021

Outcome Based Education(OBE) and Choice Based Credit System (CBCS)

(Effective from the academic year 2021 - 22)

Swappable VII and VIII SEMESTER

VII SEMESTER

Sl. No	Course and Course Code	Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
				Theory Lecture	Tutorial	Practical/ Drawing	Self -Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	T	P	S					
1	PCC 21CV71	Quantity Survey and Contract Management	TD: Civil Engg PSB: Civil Engg	2	2	0		3	50	50	100	3
2	PCC 21CV72	Construction Technology for Substructure and Super Structures	TD: Civil Engg PSB: Civil Engg	2	0	0		3	50	50	100	2
3	PEC 21CV73X	Professional elective Course-II	TD: Civil Engg PSB: Civil Engg	3	0	0		3	50	50	100	3
4	PEC 21CV74X	Professional elective Course-III	TD: Civil Engg PSB: Civil Engg	3	0	0		3	50	50	100	3
5	OEC 21CV75X	Open elective Course-II	Concerned Department	3	0	0		3	50	50	100	3
6	Project 21CVP76	Project work	TD: Civil Engg PSB: Civil Engg	Two contact hours /week for interaction between the faculty and students.				3	100	100	200	10
								Total	**350**	**350**	**700**	**24**

VIII SEMESTER

Sl. No	Course and Course Code		Course Title	Teaching Department	Teaching Hours /Week				Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Self -Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	Seminar 21CV81		Technical Seminar	TD: Civil Engg PSB: Civil Engg	One contact hour /week for interaction between the faculty and students.				--	100	--	100	01
2	INT 21INT82		Research Internship/ Industry Internship	TD: Civil Engg PSB: Civil Engg	Two contact hours /week for interaction between the faculty and students.				03 (Batch wise)	100	100	200	15
3	NCMC	21NS83	National Service Scheme (NSS)	NSS	Completed during the intervening period of III semester toVIII semester.				--	50	50	100	0
		21PE83	Physical Education (PE) (Sports and Athletics)	PE									
		21YO83	Yoga	Yoga									
									Total	**250**	**150**	**400**	**16**

Professional Elective - II

21CV721	Advanced Design of RCC and Steel Structures	21CV724	Solid Waste Management
21CV722	Advanced Geotechnical Engineering	21CV725	Design of Hydraulic Structures
21CV723	Pavement Materials and Construction	21CV726	Repair, Retrofitting and Rehabilitation of Structures

Professional Elective - III

21CV731	Earthquake Engineering	21CV734	Air Pollution and Control
21CV732	Ground Improvement Techniques	21CV735	Open Channel Hydraulics
21CV733	Pavement Design	21CV736	Design of Masonry Structures

Open Electives - II offered by the Department to other Department students			
21CV741	Finite Element Method	21CV744	Intelligent Transportation Systems
21CV742	Numerical Methods and Applications		
21CV743	Environmental Protection and Management		

Note: PCC: Professional Core Course, **PEC:** Professional Elective Courses, **OEC**–Open Elective Course, **AEC** –Ability Enhancement Courses.
L –Lecture, T – Tutorial, P- Practical / Drawing, S – Self Study Component, CIE: Continuous Internal Evaluation, SEE: Semester End Examination.

Note: VII and VIII semesters of IV year of the programme

(1) Institutions can swap VII and VIII Semester Scheme of Teaching and Examinations to accommodate research internship/ industry internship after the VI semester**.**

(2) Credits earned for the courses of VII and VIII Semester Scheme of Teaching and Examinations shall be counted against the corresponding semesters whether VII or VIII semester is completed during the beginning of IV year or later part of IV year of the program.

PROJECT WORK (21XXP75): The objective of the Project work is

(i) To encourage independent learning and the innovative attitude of the students.
(ii) To develop interactive attitude, communication skills, organization, time management, and presentation skills.
(iii) To impart flexibility and adaptability.
(iv) To inspire team working.
(v) To expand intellectual capacity, credibility, judgment and intuition.
(vi) To adhere to punctuality, setting and meeting deadlines.
(vii) To install responsibilities to oneself and others.
(viii) To train students to present the topic of project work in a seminar without any fear, face the audience confidently, enhance communication skills, involve in group discussion to present and exchange ideas.

CIE procedure for Project Work:

(1) Single discipline: The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide.

The CIE marks awarded for the project work, shall be based on the evaluation of the project work Report, project presentation skill, and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

(2) Interdisciplinary: Continuous Internal Evaluation shall be group-wise at the college level with the participation of all guides of the college. Participation of external guide/s, if any, is desirable. The CIE marks awarded for the project work, shall be based on the evaluation of project work Report, project presentation skill, and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

SEE procedure for Project Work: SEE for project work will be conducted by the two examiners appointed by the University. The SEE marks awarded for the project work shall be based on the evaluation of project work Report, project presentation skill, and question and answer session in the ratio 50:25:25.

TECHNICAL SEMINAR (21XXS81): The objective of the seminar is to inculcate self-learning, present the seminar topic confidently, enhance communication skill, involve in group discussion for the exchange of ideas. Each student, under the guidance of a Faculty, shall choose, preferably, a recent topic of his/her interest relevant to the program of Specialization.

(i) Carry out a literature survey, and systematically organize the content. **(ii)** Prepare the report with your own sentences, avoiding a cut and paste act. **(iii)**Type the matter to acquaint with the use of Micro-soft equation and drawing tools or any such facilities. **(iv)** Present the seminar topic orally and/or through PowerPoint slides. **(v)** Answer the queries and involve in debate/discussion. (**vi)** Submit a typed report with a list of references.

The participants shall take part in the discussion to foster a friendly and stimulating environment in which the students are motivated to reach high standards and become self-confident.

Evaluation Procedure:

The CIE marks for the seminar shall be awarded (based on the relevance of the topic, presentation skill, participation in the question and answer session, and quality of report) by the committee constituted for the purpose by the Head of the Department. The committee shall consist of three teachers from the department with the senior-most acting as the Chairman.

Marks distribution for CIE of the course:

Seminar Report:50 marks
Presentation skill:25 marks
Question and Answer: 25 marks. ■No SEE component for Technical Seminar

Non–credit mandatory courses (NCMC):

National Service Scheme/Physical Education (Sport and Athletics)/ Yoga:

(1) Securing 40 % or more in CIE,35 % or more marks in SEE, and 40 % or more in the sum total of CIE + SEE leads to successful completion of the registered course.

(2) In case, students fail to secure 35 % marks in SEE, they have to appear for SEE during the subsequent examinations conducted by the University.

(3) In case, any student fails to register for NSS, PE or Yoga/fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have not completed the requirements of the course. In such a case, the student has to fulfill the course requirements during subsequently to earn the qualifying CIE marks subject to the maximum program period.

(4) Successful completion of the course shall be indicated as satisfactory in the grade card. Non-completion of the course shall be indicated as Unsatisfactory.

(5) These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses shall be mandatory for the award of a degree.

B. E. (Common to all branches)

Choice Based Credit System (CBCS) and Outcome-Based Education (OBE)

SEMESTER - III

TRANSFORM CALCULUS, FOURIER SERIES AND NUMERICAL TECHNIQUES			
Course Code	**21MAT 31**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	2:2:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course objectives: The goal of the course Transform Calculus, Fourier series and Numerical techniques 21MAT 31 is

- To have an insight into solving ordinary differential equations by using Laplace transform techniques
- Learn to use the Fourier series to represent periodical physical phenomena in engineering analysis.
- To enable the students to study Fourier Transforms and concepts of infinite Fourier Sine and Cosine transforms and to learn the method of solving difference equations by the z-transform method.
- To develop proficiency in solving ordinary and partial differential equations arising in engineering applications, using numerical methods

Teaching-Learning Process (General Instructions):

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. In addition to the traditional lecture method, different types of innovative teaching methods may be adopted so that the delivered lessons shall develop students' theoretical and applied mathematical skills.
2. State the need for Mathematics with Engineering Studies and Provide real-life examples.
3. Support and guide the students for self–study.
4. You will also be responsible for assigning homework, grading assignments and quizzes, and documenting students' progress.
5. Encourage the students for group learning to improve their creative and analytical skills.
6. Show short related video lectures in the following ways:
   - As an introduction to new topics (pre-lecture activity).
   - As a revision of topics (post-lecture activity).
   - As additional examples (post-lecture activity).
   - As an additional material of challenging topics (pre-and post-lecture activity).
   - As a model solution for some exercises (post-lecture activity).

Module-1: Laplace Transform

Definition and Laplace transforms of elementary functions (statements only). Problems on Laplace's Transform of $e^{at}f(t)$, $t^n f(t)$, $\frac{f(t)}{t}$. Laplace transforms of Periodic functions (statement only) and unit-step function – problems.

Inverse Laplace transforms definition and problems, Convolution theorem to find the inverse Laplace transforms (without Proof) problems. Laplace transforms of derivatives, solution of differential equations. **(8 Hours)**

Self-study: Solution of simultaneous first-order differential equations. **(RBT Levels: L1, L2 and L3)**	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-2: Fourier Series

Introduction to infinite series, convergence and divergence. Periodic functions, Dirichlet's condition. Fourier series of periodic functions with period 2π and arbitrary period. Half range Fourier series. Practical harmonic analysis. **(8 Hours)**

Self-study: Convergence of series by D'Alembert's Ratio test and, Cauchy's root test.

(RBT Levels: L1, L2 and L3)

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-3: Infinite Fourier Transforms and Z-Transforms

Infinite Fourier transforms definition, Fourier sine and cosine transforms. Inverse Fourier transforms, Inverse Fourier cosine and sine transforms. Problems.

Difference equations, z-transform-definition, Standard z-transforms, Damping and shifting rules, Problems. Inverse z-transform and applications to solve difference equations. **(8 Hours)**

Self Study: Initial value and final value theorems, problems.

(RBT Levels: L1, L2 and L3)

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-4: Numerical Solution of Partial Differential Equations

Classifications of second-order partial differential equations, finite difference approximations to derivatives, Solution of Laplace's equation using standard five-point formula. Solution of heat equation by Schmidt explicit formula and Crank- Nicholson method, Solution of the Wave equation. Problems. **(8 Hours)**

Self Study: Solution of Poisson equations using standard five-point formula.

(RBT Levels: L1, L2 and L3)

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-5: Numerical Solution of Second-Order ODEs and Calculus of Variations

Second-order differential equations - Runge-Kutta method and Milne's predictor and corrector method. (No derivations of formulae).

Calculus of Variations: Functionals, Euler's equation, Problems on extremals of functional. Geodesics on a plane, Variational problems. **(8 Hours)**

Self Study: Hanging chain problem

(RBT Levels: L1, L2 and L3)

Course outcomes: After successfully completing the course, the students will be able :

- To solve ordinary differential equations using Laplace transform.
- Demonstrate the Fourier series to study the behaviour of periodic functions and their applications in system communications, digital signal processing and field theory.
- To use Fourier transforms to analyze problems involving continuous-time signals and to apply Z-Transform techniques to solve difference equations
- To solve mathematical models represented by initial or boundary value problems involving partial differential equations
- Determine the extremals of functionals using calculus of variations and solve problems arising in dynamics of rigid bodies and vibrational analysis.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

First test at the end of 5th week of the semester

Second test at the end of the 10th week of the semester

Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

First assignment at the end of 4th week of the semester

Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

The question paper will have ten questions. Each question is set for 20 marks. Marks scored shall be proportionally reduced to 50 marks

There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module

Suggested Learning Resources:

Text Books:

1. **B. S. Grewal**: "Higher Engineering Mathematics", Khanna publishers, 44th Ed.2018
2. **E. Kreyszig**: "Advanced Engineering Mathematics", John Wiley & Sons, 10th Ed. (Reprint), 2016.

Reference Books

1. **V. Ramana:** "Higher Engineering Mathematics" McGraw-Hill Education, 11th Ed.
2. **Srimanta Pal & Subodh C. Bhunia:** "Engineering Mathematics" Oxford University Press, 3rd Reprint, 2016.
3. **N.P Bali and Manish Goyal**: "A textbook of Engineering Mathematics" Laxmi Publications, Latest edition.
4. **C. Ray Wylie, Louis C. Barrett:** "Advanced Engineering Mathematics" McGraw – Hill Book Co.Newyork, Latest ed.
5. **Gupta C.B, Sing S.R and Mukesh Kumar:** "Engineering Mathematic for Semester I and II", Mc-Graw Hill Education(India) Pvt. Ltd 2015.
6. **H.K.Dass and Er. Rajnish Verma:** "Higher Engineering Mathematics" S.Chand Publication (2014).
7. **James Stewart: "**Calculus" Cengage publications, 7th edition, 4th Reprint 2019.

Web links and Video Lectures (e-Resources):
• http://.ac.in/courses.php?disciplineID=111 • http://www.class-central.com/subject/math(MOOCs) • http://academicearth.org/ • http://www.bookstreet.in. • VTU e-Shikshana Program • VTU EDUSAT Program
Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning • Quizzes • Assignments • Seminars

III Semester

Geodetic Engineering			
Course Code	**21CV32**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	2:2:2:0	SEE Marks	50
Total Hours of Pedagogy	50	Total Marks	100
Credits	4	Exam Hours	03

Course objectives:

- Provide basic knowledge about principles of surveying for location, design and construction of engineering projects
- Develop skills for using surveying instruments including, levelling instruments, plane tables, theodolite, compass
- Make students to familiar with cooperative efforts required in acquiring surveying data and applying fundamental concepts to eliminate errors and set out the works
- Provide information about new technologies that are used to abstracting the information of earth surface

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. The survey of India topomap has to be shared with students and few exercise must be given
2. The satellite imagery has to be procured and shared with students
3. The manual for conducting field survey has to be provided
4. The online courses available should be shared with students
5. YouTube videos
6. Power point presentations

Module-1

Introduction to Surveying: Importance of surveying in Civil Engineering, Concepts of plane and geodetic surveying Principles of surveying –Plans and maps – Surveying equipment's, Meridians, Bearings, Dip, Declination, Local attraction, Calculation of bearings and included angles. Compass surveying and Plane Table Surveying

Compass surveying: Prismatic and surveyor's compasses, temporary adjustments.

Plane Table Surveying: plane table and accessories, advantages and disadvantages of plane table survey, method of plotting - radiation, intersection, traversing, resection, two point and three point method

Teaching-Learning Process	Chalk and talk, PowerPoint Presentation, YouTube videos

Module-2

Levelling – Principles and basic definitions – Types of Levels – Types of adjustments and objectives – Types of levelling – Simple, Differential, Fly, Reciprocal, Profile, Cross sectioning – Booking of levels – Rise & fall and H. I methods (Numerical)

Areas and volumes: Measurement of area – by dividing the area into geometrical figures, area from offsets, mid ordinate rule, trapezoidal and Simpsons one third rule, area from co-ordinates, introduction to planimeter, digital planimeter. Measurement of volumes-trapezoidal and prismoidal formula.

Teaching-Learning	Chalk and talk, PowerPoint Presentation, YouTube videos

Process	

Module-3

Theodolite Surveying: Theodolite and types, fundamental axes and parts of theodolite, temporary adjustments of transit theodolite, Horizontal and Vertical angle measurements by repetition and reiteration Trigonometric levelling: Single and Double plane for finding elevation of objects Computation of distances and elevations using Tacheometric method.

Teaching-Learning Process	Chalk and talk, PowerPoint Presentation, YouTube videos

Module-4

Curve Surveying: Curves – Necessity – Types, Simple curves, Elements , Designation of curves, Setting out simple curves by linear methods (numerical problems on offsets from long chord & chord produced method), Setting out curves by Rankine's deflection angle method (numerical problems). Compound curves, Elements, Design of compound curves, Setting out of compound curves (numerical problems). Reverse curve between two parallel straights (numerical problems on Equal radius and unequal radius). Transition curves Characteristics, numerical problems on Length of Transition curve, Vertical curves –Types – (theory).

Teaching-Learning Process	Chalk and talk, PowerPoint Presentation, YouTube videos

Module-5

Photogrammetry and aerial survey: Introduction, definitions, basics principles, methods, importance of scale, height, applications.

Remote sensing: Introduction, Principle of Remote sensing, EMR, types, resolutions, types of satellites, type of sensors, LIDAR, visual and digital image processing and its applications. **Global Positioning System:** Definition, Principles of GPS and applications. Geographical Information System: Introduction and principle of Geographical Information System, components of GIS, applications

Advanced instrumentation in surveying: classification, measuring principles, Electronic theodolite, EDM, Total Station, Drones

Teaching-Learning Process	Chalk and talk, PowerPoint Presentation, YouTube videos

LABORATORY EXPERIMENTS

1.	Study of various instruments used for surveying, namely chain, tape, Compass,
2.	Dumpy level, Auto-level, Theodolite, Tacheometer, Total station and GPS. To find the distance between two points shown in the field using method of pacing, chaining and taping.
3.	To set regular geometric figures (Hexagon and Pentagon) using chain tape and accessories.
4.	To set regular geometric figures (Hexagon and Pentagon) using prismatic compass, given the bearing of one line.
5.	Study of use of Dumpy level and to determine the different in elevation between two points by differential levelling using Dumpy level
6.	To find the true difference in elevation between two points situated far apart by using Reciprocal levelling.

7.	Trigonometrical levelling: Single plane method and Double plane method
8.	Measurement of horizontal angle using theodolite by: i) Method of Repetition and ii) Reiteration method.
9.	Setting simple circular curve-Instrumental method,
10.	Setting compound curve using theodolite
11.	Plane table : Setting, orientation, radiation, intersection
12.	Demo: Total station, GPS

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

1. Execute survey using compass and plane table
2. Find the level of ground surface and Calculation of area and volumes
3. Operate theodolite for field execution
4. Estimate the capacity of reservoir
5. Interpret satellite imageries

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

CIE for the theory component of IPCC

Two Tests each of **20 Marks (duration 01 hour**)

- First test at the end of 5th week of the semester
- Second test at the end of the 10th week of the semester

Two assignments each of **10 Marks**

- First assignment at the end of 4th week of the semester
- Second assignment at the end of 9th week of the semester

Scaled-down marks of two tests and two assignments added will be CIE marks for the theory component of IPCC for **30 marks**.

CIE for the practical component of IPCC

- On completion of every experiment/program in the laboratory, the students shall be evaluated and marks shall be awarded on the same day. The**15 marks** are for conducting the experiment and preparation of the laboratory record, the other **05 marks shall be for the test** conducted at the end of the semester.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to 15 marks.
- The laboratory test **(duration 02/03 hours)** at the end of the 15th week of the semester /after completion of all the experiments (whichever is early) shall be conducted for 50 marks and scaled down to 05 marks**.**

Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **20 marks**.

SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (duration 03 hours)

1. The question paper will have ten questions. Each question is set for 20 marks. Marks scored shall be proportionally scaled down to 50 Marks
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.

Suggested Learning Resources:

Books

1. Surveying & levelling Vol. I ,II & III, B. C. Punmia, Laxmi Publications; seventeenth edition (2016)
2. Advanced Surveying: Total Station, GPS, GIS & Remote Sensing by Pearson 2017 by GopiSatheesh, R.Sathikumar, N. Madhu
3. Surveying Vol.I& II, S. K. Duggal, McGraw Hill Education; Fourth edition (2017)

4. Surveying and Levelling, R. Subramanian , second edition, 2012, Oxford University Press; 5. Engineering Surveying, Schofield and Breach, 6th edition, Butterworth-Heinemann (Elsevier publication, 2007) 6. Surveying , A Banister, S Raymond, R Baker, 7th edition, Pearson , New Delhi	
Web links and Video Lectures (e-Resources):	
• NPTEL courses	
Activity Based Learning (Suggested Activities in Class)/ Practical Based learning	

III Semester

STRENGTH OF MATERIALS			
Course Code	**21CV33**	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	2+2+2+0	SEE Marks	50
Total Hours of Pedagogy	50	Total Marks	100
Credits	4	Exam Hours	03 hrs

Course objectives: This course will enable students

1. To understand the basic concepts of the stresses and strains for different materials and strength of structural elements.
2. To know the development of internal forces and resistance mechanism for one dimensional and two-dimensional structural elements.
3. To analyse and understand different internal forces and stresses induced due to representative loads on structural elements.
4. To determine slope and deflections of beams.
5. To evaluate the behaviour of torsion members, columns and struts.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Blackboard teaching/PowerPoint presentations (if needed)
2. Regular review of students by asking questions based on topics covered in the class.

Module-1

Simple Stresses and Strains: Introduction, Properties of Materials, Stress, Strain, Hook's law, Poisson's Ratio, Stress – Strain Diagram for structural steel, Principles of superposition, Total elongation of tapering bars of circular and rectangular cross sections. Composite section, Volumetric strain, expression for volumetric strain, Elastic constants, relationship among elastic constants (No Numerical), Thermal stress and strains

Compound stresses: Introduction, Stress components on inclined planes, General two-dimensional stress system, Principal planes and stresses, maximum shear stresses and their planes (shear planes). Compound stress using Mohr's circle method.

Teaching-Learning Process	1.Blackboard teaching/PowerPoint presentations (if needed) 2.Regular review of students by asking questions based on topics covered in the class.

Module-2

Bending moment and shear force diagrams in beams: Definition of shear force and bending moment, Sign convention, Relationship between loading, shear force and bending moment, Shear force and bending moment equations, development of Shear Force Diagram(SFD) and Bending Moment Diagram (BMD) with salient values for cantilever, simply supported and overhanging beams for point loads, UDL(Uniformly Distributed Load), UVL(Uniformly Varying Load) and Couple.

Teaching-Learning Process	1.Blackboard teaching/PowerPoint presentations (if needed) 2.Regular review of students by asking questions based on topics covered in the class.

Module-3

	Bending stress in beams: Introduction – Bending stress in beam, Pure bending, Assumptions in simple bending theory, derivation of Simple bending equation (Bernoulli's equation), modulus of rupture, section modulus, Flexural rigidity, Problems **Shear stress in beams:** Derivation of Shear stress intensity equations, Derivation of Expressions of the shear stress intensity for rectangular, triangular and circular cross sections of the beams. Problems on calculation of the shear stress intensities at various critical levels of T, I and Hollow rectangular cross sections of the beam.	
	Teaching-Learning Process	1.Blackboard teaching/PowerPoint presentations (if needed) 2.Regular review of students by asking questions based on topics covered in the class.
	Module-4	
	Torsion: Twisting moment in shafts, simple torque theory, derivation of torsion equation, tensional rigidity, polar modulus, shear stress variation across solid circular and hollow circular sections, Problems **Thin cylinders:** Introduction: Longitudinal, circumferential (hoop) stress in thin cylinders. Expressions for longitudinal and circumferential stresses. Efficiency of longitudinal and circumferential joints. Problems on estimation of change in length, diameter and volume when the thin cylinder subjected to internal fluid pressure. **Thick cylinders:** Concept of Thick cylinders Lame's equationsapplicable to thick cylinders with usual notations, calculation of longitudinal, circumferential and radial stresses – simple numerical examples. Sketching the variation of radial stress (pressure) and circumferential stress across the wall of thick cylinder. U	
	Teaching-Learning Process	1.Blackboard teaching/PowerPoint presentations (if needed) 2.Regular review of students by asking questions based on topics covered in the class.
	Module-5	
	Elastic stability of columns: Introduction – Short and long columns, Euler's theory on columns, Effective length, slenderness ratio, radii of gyration, buckling load, Assumptions, derivations of Euler's Buckling load for different boundary conditions, Limitations of Euler's theory, Rankine's formula and related problems. **Deflection of determinate Beams:** Introduction, Elastic curve –Derivation of differential equation of flexure, Sign convention, Slope and deflection using Macaulay's method for statically determinate beams subjected to various vertical loads, moment, couple and their combinations. Numerical problems.	
	Teaching-Learning Process	1.Blackboard teaching/PowerPoint presentations (if needed) 2.Regular review of students by asking questions based on topics covered in the class.

LABORATORY

1. Dimensionality of bricks, Water absorption, Initial rate of absorption
2. Specific gravity of coarse and fine aggregate
3. Fineness modulus of Fine and Coarse aggregate
4. Compressive strength tests on building blocks (brick, solid blocks and hollow blocks)
5. Tension test on Mild steel and HYSD bars
6. Compression test on HYSD, Cast iron
7. Bending Test on Wood under two-point loading.

8. Shear Test on Mild steel – single and double shear
9. Impact test on Mild Steel (Charpy& Izod)

Course outcome (Course Skill Set)

After completion of the course, students will be able to

1. Evaluate the behaviour when a solid material is subjected to various types of forces (namely Compressive, Tensile, Thermal, Shear, flexure, Torque, internal fluid pressure) and estimate stresses and corresponding strain developed. (L3)
2. Estimate the forces developed and draw schematic diagram for stresses, forces, moments for simple beams with different types of support and are subjected to various types of loads (L3).
3. Evaluate the behaviour when a solid material is subjected to Torque and internal fluid pressure and estimate stresses and corresponding strain developed. (L3)
4. Distinguish the behaviour of short and long column and calculate load at failure & explain the behaviour of spring to estimate deflection and stiffness (L3)
5. Examine and Evaluate the mechanical properties of various materials under different loading conditions

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

CIE for the theory component of IPCC

Two Tests each of **20 Marks (duration 01 hour**)

- First test at the end of 5th week of the semester
- Second test at the end of the 10th week of the semester

Two assignments each of **10 Marks**

- First assignment at the end of 4th week of the semester
- Second assignment at the end of 9th week of the semester

Scaled-down marks of two tests and two assignments added will be CIE marks for the theory component of IPCC for **30 marks**.

CIE for the practical component of IPCC

- On completion of every experiment/program in the laboratory, the students shall be evaluated and marks shall be awarded on the same day. The**15 marks** are for conducting the experiment and preparation of the laboratory record, the other **05 marks shall be for the test** conducted at the end of the semester.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to 15 marks.
- The laboratory test **(duration 02/03 hours)** at the end of the 15th week of the semester /after completion of all the experiments (whichever is early) shall be conducted for 50 marks and scaled down to 05 marks**.**

Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory

component of IPCC for **20 marks**.

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SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (duration 03 hours)

1. The question paper will have ten questions. Each question is set for 20 marks. Marks scorded shall be proportionally scaled down to 50 Marks
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper shall include questions from the practical component).

- The minimum marks to be secured in CIE to appear for SEE shall be the 12 (40% of maximum marks-30) in the theory component and 08 (40% of maximum marks -20) in the practical component. The laboratory component of the IPCC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be included**.** The maximum of 04/05 questions to be set from the practical component of IPCC, the total marks of all questions should not be more than the 20 marks.

SEE will be conducted for 100 marks and students shall secure 35% of the maximum marks to qualify in the SEE. Marks secured will be scaled down to 50.

Suggested Learning Resources:

Books

1.Timoshenko and Young, “Elements of Strength of Materials” ,EastWest Press, 5t edition 2003

2.R. Subramanyam, “Strength of Materials”, Oxford University Press, 3rd Edition -2016

3.B.C Punmia Ashok Jain, Arun Jain, “Strength of Materials”, Laxmi - 2018-22 Publications, 10th Edition-2018

Web links and Video Lectures (e-Resources):

1.Strength of Materials web course by IIT Roorkee https://nptel.ac.in/courses/112107146/

2.Strength of Materials video course by IIT Kharagpur https://nptel.ac.in/courses/105105108/

3.Strength of Materials video course by IIT Roorkee https://nptel.ac.in/courses/112107147/18

4.All contents organized http://www.nptelvideos.in/2012/11/strengthof-materials-prof.html

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Seminars/Quizz(To assist in GATE Preparations
- Demonstrations in Lab
- Self Study on simple topics
- Simple problems solving using Excel
- Virtual Lab Experiments

Semester III

: **Earth Resources and Engineering**			
Course Code	21CV34	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course objectives:

- This course will enable students;

  1. To understand the importance of earth's dynamic interior in civil engineering and Geo Hazard mitigation and management
  2. To analyse the physical characteristics of the rocks and Minerals for its suitable application in Engineering
  3. To evaluate earth Process for providing sustainable management and Development through Geoengineering.
  4. Subsurface Exploration for providing safe and suitable site condition and Earth Resources for Reengineering activities
  5. To application of modern tools and techniques in Earth Resources Management and.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

- Chalk and Talk method.
- Show Video/animation films to explain earth dyanamics and influence of geology in prime civil constructions
- Encourage collaborative (Group Learning) Learning in the class
- Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking
- Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking process such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
- Topics will be introduced in a multiple representation.
- Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
- Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Module /unit – 01 – Introduction, scope of earth science in Engineering, 8 hrs
Geohazards and disasters, Mitigation and management

Earths internal dynamics ,Plate tectonics, Earth quakes types, causes iso-seismal line, seismic zonation map, seismic proof structures, Numerical problems on location of epicenter; volcanic eruption, types, causes, ; landslides, causes types, preventive measures; tsunamis causes consequences, mitigation;cyclones, causes management

Teaching-Learning Process	• chalk and talk method, • power point presentation. • Case studies • Field visits

Module-2	
Earth Resources **8hrs** Minerals -Industrial, rock forming and ore minerals. Physical properties, composition and uses Rocks as a construction materials- physical properties, texture, composition, applications for aggregate, decorative (facing/polishing), railway ballast, rocks for masonry work, monumental/architecture, rocks as aquifers, water bearing properties igneous, sedimentary	
Teaching-Learning Process	• Chalk and talk method, • Power point presentation and Animated vedeos • Case studies • Field visits experience the real world examples
Module-3	
Surface investigation for Civil Engineering projects **8hrs** Weathering, type, causes, soil insitu, drifted soil, soil profile, soil mineralogy , structure, types of soil, Black cotton soil v/s Lateritic soil; effects of weathering on monumental rocks, River morphology and basin investigation for engineering Projects like earthen dam, gravity dam, arch dam, features of river erosion, deposition and their influences on river valley projects, morphometric analysis of river basin, selection of site for artificial recharge,, interlinking of river basins, coastal process and landforms, sedimentation /siltation, erosion	
Teaching-Learning Process	• Chalk and talk method, • Power point presentation and Animated vedeos • Case studies • Field visits experience the real world examples
Module-4	
Subsurface investigation for deep foundation **8hrs** Borehole data(and problems), Dip and strike, and outcrop problems(numerical problem geometrical/ simple trigonometry based), Electrical Resistivity meter, depth of water table, (numerical problems) seismic studies, faults, folds, unconformity, joints types, recognitionand their significance in Civil engineering projects like tunnel project, dam project, , Ground improvements like rock bolting, rock jointing, grouting	
Teaching-Learning Process	• Chalk and talk method, • Power point presentation and Animated vedeos • Case studies • Field visits experience the real world examples
Module-5	
Geo-tools and techniques for civil Engineering Applications **7hrs** Toposheets , Remote sensing and GIS. Photogrammetry (scale, flight planning, overlap, elevation effects, interpretation keys, numericals on flight, planning scale , elevation, flyimg height, ….), GPS,, Ground Penetrating Radas (GPR), Drone, and their applications	
Teaching-Learning Process	• Chalk and talk method, • Power point presentation and Animated videos • Case studies • Field visits and research institutes experience the real world examples

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

1. Apply geological knowledge in different civil engineering practice.
2. Students will acquire knowledge on durability and competence of foundation rocks, and confidence enough to use the best building materials.
3. competent enough to provide services for the safety, stability, economy and life of the structures that they construct
4. Able to solve various issues related to ground water exploration, build up dams, bridges, tunnels which are often confronted with ground water problems
5. Intelligent enough to apply GIS, GPS and remote sensing as a latest tool in different civil engineering for safe and solid construction.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks. Marks scored out of 100, shall be proportionally reduced to 50 marks
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=aTVDiRtRook&list=PLDF5162B475DD915F
- https://www.youtube.com/watch?v=EBiLLJAxBuU&index=2&list=PLDF5162B475DD915F
- https://www.youtube.com/watch?v=sTY-ao4RZck&list=PLDF5162B475DD915F&index=3
- https://nptel.ac.in/courses
- https://youtu.be/fvoYHzAhvVM
- https://youtu.be/aTVDiRtRook

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- https://www.earthsciweek.org/classroom-activities
- Field Visits
- https://serc.carleton.edu/NAGTWorkshops/hazards/events/12262004.html?serc_source=recommendation
- https://serc.carleton.edu/NAGTWorkshops/visualization/examples/CBezanson.html?serc_source=recommendation
- https://serc.carleton.edu/NAGTWorkshops/coursedesign/goalsdb/14712.html

Textbooks -

1. Engineering Geology, by Parthasarathy et al, Wiley publications
2. A textbook of Engineering Geology by Chenna Kesavulu, Mac Millan India Ltd
3. Principle of Engineering Geology, by K.M. Bangar, Standard publishers
4. Physical and Engineering Geology, by S.K. Garg, Khanna publishers
5. Principles of Engineering Geology, by KVGK Gokhale, BS Publications

Reference books –

1. Introduction to Environmental Geology by Edward A Keller, Pearson publications.
2. Engineering Geology and Rock Mechanics B. P. Verma, Khanna publishers
3. Principles of Engineering Geology and Geotechnics, Krynine and Judd, CBS Publications

COMPUTER AIDED BUILDING PLANNING AND DRAWING			
Course Code	**21CVL35**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0+0+2+0	SEE Marks	50
Credits	01	Exam Hours	03 hrs

Course objectives:

Provide students with understanding

1. Gain skill set to prepare Computer Aided Engineering Drawings
2. Understanding the details of construction of different building elements
3. Visualize the completed form of the building and the intricacies of construction based on the engineering drawings
4. Get familiarization of practices used in Industry

Sl.NO	Experiments
	Module 1
1	**Drawing Basics:** Selection of scales for various drawings, thickness of lines, dimensioning, abbreviations and conventional representations as per IS:962.
2	**Simple Engineering Drawings with CAD** Drawing Tools**:** Lines Circle, Arc, Poly line, Multiline, Polygon, Rectangle, Spline, Ellipse, Modify tools: Erase, Copy, Mirror, Offset, Array, Move, Rotate, Scale, Stretch, Lengthen, Trim, Extend, Break, Chamfer and Fillet, Using Text: Single line text, Multiline text, Spelling, Edit text, Special Features: View tools, Layers concept, Dimension tools, Hatching, Customizing Toolbars, Working with multiple drawings.
	Module 2
3	**Drawings of Different Building Elements:** Following drawings are to be prepared for the data given using CAD Software a) Cross section of Foundation, masonry wall, RCC columns with isolated & combined footings. b) Different types of bonds in brick masonry. c) Different types of staircases – Dog legged, Open well, d) Lintel and chajja. e) RCC Slabs and beams. f) Cross section of a pavement. g) Septic Tank and sedimentation Tank. h) Layout plan of Rainwater recharging and harvesting system. i) Cross sectional details of a road for a Residential area with provision for all services. j) Steel truss (connections Bolted). **Note:**Students should sketch to dimension the above in a sketch book before doing the computer drawing.

Module 3	
4	**Building Drawings :** Principles of planning, Planning regulations and building bye-laws, factors affecting site selection, Functional planning of residential and public buildings, design aspects for different public buildings. Recommendations of NBC. Drawing of plan, elevation and sectional elevation including electrical, plumbing and sanitary services using CAD software for 1. Single and double story residential building. 2. Hostel building. 3. Hospital building. 4. School building. Submission drawing (sanction drawing)of two storied residential building with access to terrace including all details and statements as per the local bye-laws Industry Applications : 3D Modelling and Rendering, 2D Animation, Construction site Simulation **Note:** . Students should sketch to dimension the above in a sketch book before doing the computer drawing . One compulsory field visit/exercise to be carried out. . Single line diagrams to be given in the examination.

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

1. Prepare, read and interpret the drawings in a professional set up.
2. Know the procedures of submission of drawings and Develop working and submission drawings for building.
3. Plan and design of residential or public building as per the given requirements.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 35% (18 Marks out of 50) in the semester-end examination(SEE).

Continuous Internal Evaluation (CIE):

CIE marks for the practical course is **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment to be evaluated for conduction with observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled downed to 30 marks (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8th week of the semester and the second test shall be conducted after the 14th week of the semester.
- In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability. Rubrics suggested in Annexure-II of Regulation book
- The average of 02 tests is scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and average marks of two tests is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

SEE marks for the practical course is 50 Marks.

SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University

All laboratory experiments are to be included for practical examination.

(Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.

Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.

Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly

by examiners.
General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)
Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.
The duration of SEE is 03 hours

Rubrics suggested in Annexure-II of Regulation book

Question paper pattern:

- There will be four full questions with sub divisions if necessary from Module2 with each full question carrying twenty five marks. Students have to answer any two questions.
- There will be two full questions from Modulus 3 with each full question carrying fifty marks. Students have to answer any one question. The conduction of examination and question paper format of should be in line of 1st year CAED drawing. It's drawing paper but the exam will be conducted by batches in the computer labs. Question paper should be given in batches.

Suggested Learning Resources:

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Textbook:

1. MG Shah, CM Kale, SY Patki, "Building drawing with an integrated approach to Built Environment Drawing", Tata McGraw Hill Publishing co. Ltd, New Delhi.
2. Gurucharan Singh, "Building Construction", Standard Publishers, & distributors, New Delhi.
3. Malik RS and a Meo GS, "Civil Engineering Drawing", Asian Publishers/Computech Publication Pvt Ltd

Reference Books:

1. Time Saver Standard by Dodge F.W, F.W Dodge Corp.
2. IS: 962-1989 (Code of practice for architectural and building drawing).
3. National Building Code, BIS, New Delhi.

SAMPLE TEMPLATE

III/IV Semester

Constitution of India and Professional Ethics (CIP)

Course Code	**21CIP37/47**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0:2:0:0	SEE Marks	50
Total Hours of Pedagogy	15 Hours	Total Marks	100
Credits	01	Exam Hours	01 Hour

Course objectives: This course will enable the students

- To know the fundamental political structure & codes, procedures, powers, and duties of Indian government institutions, fundamental rights, directive principles, and the duties of citizens.
- To understand engineering ethics and their responsibilities, identify their individual roles and ethical responsibilities towards society.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

- ✓ Teachers shall adopt suitable pedagogy for effective teaching - learning process. The pedagogy shall involve the combination of different methodologies which suit modern technological tools and software's to meet the present requirements of the Global employment market.
  - (i) Direct instructional method (Low /Old Technology),
  - (ii) Flipped classrooms (High/advanced Technological tools),
  - (iii) Blended learning (combination of both),
  - (iv) Enquiry and evaluation based learning,
  - (v) Personalized learning,
  - (vi) Problems based learning through discussion,
  - (vii) Following the method of expeditionary learning Tools and techniques,
- **1.** Apart from conventional lecture methods, various types of innovative teaching techniques through videos, animation films may be adapted so that the delivered lesson can enhance the students in theoretical applied and practical skills in teaching of 21CIP39/49 in general.

Module - 1

Introduction to Indian Constitution: Definition of Constitution, Necessity of the Constitution, Societies before and after the Constitution adoption. Introduction to the Indian constitution, Making of the Constitution, Role of the Constituent Assembly. Preamble of Indian Constitution & Key concepts of the Preamble. Salient features of India Constitution.

Teaching-Learning Process	Chalk and talk method, Videos, Power Point presentation to teach. Creating real time stations in classroom discussions, Giving activities and assignments (Connecting Campus & community with administration real time situations).

Module - 2

Fundamental Rights (FR's), Directive Principles of State Policy (DPSP's) and Fundamental Duties (FD's) : Fundamental Rights and its Restriction and limitations in different Complex Situations. DPSP's and its present relevance in Indian society. Fundamental Duties and its Scope and significance in Nation building.

Teaching-Learning Process	Chalk and talk method, Videos, Power Point presentation to teach. Creating real time stations in classroom discussions, Giving activities and assignments (Connecting Campus & community with administration real time situations).

Module - 3

Union Executive : Parliamentary System, Union Executive – President, Prime Minister, Union Cabinet, Parliament - LS and RS, Parliamentary Committees, Important Parliamentary Terminologies. Supreme Court of India, Judicial Reviews and Judicial Activism.

Teaching-Learning Process	Chalk and talk method, Videos, Power Point presentation to teach. Creating real time stations in classroom discussions, Giving activities and assignments (Connecting Campus & community with administration real time situations).

Module - 4	
State Executive & Elections, Amendments and Emergency Provisions: State Executive, Election Commission, Elections & Electoral Process. Amendment to Constitution (Why and How) and Important Constitutional Amendments till today. Emergency Provisions.	
Teaching-Learning Process	Chalk and talk method, Videos, Power Point presentation to teach. Creating real time stations in classroom discussions, Giving activities and assignments (Connecting Campus & community with administration real time situations).
Module-5	
Professional Ethics: Definition of Ethics & Values. Professional & Engineering Ethics. Positive and Negative aspects of Engineering Ethics. Clash of Ethics, Conflicts of Interest. The impediments to Responsibility. Professional Risks, Professional Safety and liability in Engineering. Trust & Reliability in Engineering, Intellectual Property Rights (IPR's).	
Teaching-Learning Process	Chalk and talk method, Videos, Power Point presentation to teach. Creating real time stations in classroom discussions, Giving activities and assignments (Connecting Campus & community with administration real time situations).

Course outcome (Course Skill Set)

At the end of the course the student should :

CO 1: Have constitutional knowledge and legal literacy.

CO 2: Understand Engineering and Professional ethics and responsibilities of Engineers.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks that is 20 marks. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE and SEE taken together

Continuous Internal Evaluation:

Three Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject.

- The question paper will have 50 questions. Each question is set for 01 mark.
- SEE Pattern will be in MCQ Model (Multiple Choice Questions) for 50 marks. Duration of the examination is 01 Hour.

Textbook:

1. **"Constitution of India & Professional Ethics"** Published by Prasaranga or published on VTU website with the consent of the university authorities VTU Belagavi.

SAMPLE TEMPLATE

BE - **III/IV Semester – Common to all**

[illegible]			
[illegible] (Course Code)	21KSK39/49	[illegible]ದ [illegible]	50
[illegible] (Teaching Hours / Week (L:T:P: S)	0:2:0:1	[illegible]	50
[illegible] Total Hours of Pedagogy	25 [illegible]	[illegible]	100
[illegible] (Credits)	01	[illegible]	01 [illegible]

[illegible]:

1. [illegible],
2. [illegible].
3. [illegible].
4. [illegible].

[illegible] **(Teaching-Learning Process - General Instructions) :**

These are sample Strategies, which teacher can use to accelerate the attainment of the course outcomes.

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2. [illegible] - [illegible]-[illegible], [illegible], [illegible], [illegible].
3. [illegible].

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1. [illegible] - [illegible]
2. [illegible] : [illegible] - [illegible]. [illegible]
3. [illegible] - [illegible]. [illegible]. [illegible]. [illegible]. [illegible]

[illegible]	[illegible], [illegible], [illegible], [illegible].

SAMPLE TEMPLATE

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SAMPLE TEMPLATE

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(methods of CIE - MCQ, Quizzes, Open book test, Seminar or micro project)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The student has to obtain a minimum of 40% marks individually both in CIE and 35% marks in SEE to pass. Theory Semester End Exam (SEE) is conducted for 50 marks (01 hour duration). Based on this grading will be awarded.

Continuous Internal Evaluation:

Three Tests each of **20 Marks (duration 01 hour**)

a. First test at the end of 5th week of the semester
b. Second test at the end of the 10th week of the semester
c. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks : 1.** First assignment at the end of 4th week of the semester

2. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

3. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

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SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject.

1. The question paper will have 50 questions. Each question is set for 01 mark.

SEE Pattern will be in MCQ Model for 50 marks. Duration of the exam is 01 Hour.

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SAMPLE TEMPLATE

BE - III / IV Semester – Common to All

[illegible] – baLake Kannada (Kannada for Usage)

[illegible] - (Prescribed Textbook to Learn Kannada)

[illegible] (Course Code)	21KBK39/49	[illegible] (Continuous Internal Evaluation Marks)	50
[illegible] (Teaching Hours / Week (L:T:P: S)	0:2:0:1	[illegible] (Semester End Examination Marks)	50
[illegible] Total Hours of Pedagogy	25 [illegible]	[illegible] (Total Marks)	100
[illegible] (Credits)	01	[illegible] (Exam Hours)	01 [illegible]

[illegible] **(Course Learning Objectives):**

- To Create the awareness regarding the necessity of learning local language for comfortable and healthy life.
- To enable learners to Listen and understand the Kannada language properly.
- To speak, read and write Kannada language as per requirement.
- To train the learners for correct and polite conservation.

[illegible] **(Teaching-Learning Process - General Instructions) :**

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. [illegible].
2. [illegible].
3. [illegible].

1. [illegible].
2. [illegible].

Module-1

1. Introduction, Necessity of learning a local language. Methods to learn the Kannada language.
2. Easy learning of a Kannada Language: A few tips. Hints for correct and polite conservation, Listening and Speaking Activities
3. Key to Transcription.
4. [illegible], [illegible]/[illegible] [illegible] – **Personal Pronouns, Possessive Forms, Interrogative words**

[illegible]	[illegible], [illegible], [illegible], [illegible].

Module-2

1. □□□□□□□□ □□□□□□□□□□□ □□□□□□□, □□□□□□□□□□□ □□□□□□□□□□□ □□□□□□ □□□□□□□□□□ □□□□□□□□□ - **Possessive forms of nouns, dubitive question and Relative nouns**
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3. **PÁgÀPÀ gÀÆ¥ÀUÀ¼ÀÄ ªÀÄvÀÄÛ «¨sÀQÛ ¥ÀævÀåAiÀÄUÀ¼ÀÄ – ¸À¥ÀÛ«Ä «¨sÀQÛ ¥ÀævÀåAiÀÄ – (D, CzÀÄ, CªÀÅ, C°è) Predictive Forms, Locative Case**

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Module-3

1. **ZÀvÀÄyð «¨sÀQÛ ¥ÀævÀåAiÀÄzÀ §¼ÀPÉ ªÀÄvÀÄÛ ¸ÀASÁåªÁZÀPÀUÀ¼ÀÄ - Dative Cases, and Numerals**
4. **¸ÀASÁåUÀÄtªÁZÀPÀUÀ¼ÀÄ ªÀÄvÀÄÛ §ºÀÄªÀZÀ£À £ÁªÀÄgÀÆ¥ÀUÀ¼ÀÄ - Ordinal numerals and Plural markers**
5. **£ÀÆå£À / ¤µÉÃzsÁxÀðPÀ QæAiÀiÁ¥ÀzÀUÀ¼ÀÄ ªÀÄvÀÄÛ ªÀtð UÀÄtªÁZÀPÀUÀ¼ÀÄ**
   Defective / Negative Verbs and Colour Adjectives

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Module-4

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Permission, Commands, encouraging and Urging words (Imperative words and sentences)

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Accusative Cases and Potential Forms used in General Communication

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Module-5

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3. **Kannada Vocabulary List :** □□□□□□□□□□□□□□ □□□□□□□□□□ □□□□□□ □□□□□□ - **Kannada Words in Conversation**

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□□□□□ □□□□□□□□□□: **course Outcomes (Course Skill** Set): At the end of the Course, The Students will be able

1. To understand the necessity of learning of local language for comfortable life.
2. To Listen and understand the Kannada language properly.
3. To speak, read and write Kannada language as per requirement.
4. To communicate (converse) in Kannada language in their daily life with kannada speakers.
5. To speak in polite conservation.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Tests each of **20 Marks (duration 01 hour**)

a. First test at the end of 5th week of the semester
b. Second test at the end of the 10th week of the semester
c. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks : 1.** First assignment at the end of 4th week of the semester

7. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

8. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

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SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject.

2. The question paper will have 50 questions. Each question is set for 01 mark.
3. SEE Pattern will be in MCQ Model for 50 marks. Duration of the exam is 01 Hour.

Textbook :

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Semester III

Problem Solving with Python			
Course Code	21CV381	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0:2:0:0	SEE Marks	50
Total Hours of Pedagogy	15	Total Marks	100
Credits	1	Exam Hours	1 hr

Course objectives:

- To understand why Python is a useful scripting language for developers.
- To read and write simple Python programs
- To learn how to identify Python object types.
- To learn how to write functions and pass arguments in Python.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Introduction to Python: Installing Python and Python packages, Managing virtual environments with venv module

Introduction to NumPy arrays:Array creation, indexing, data types, broadcasting, copies and views, universal functions, I/O with NumPy

Teaching-Learning Process	Chalk and talk, PowerPoint Presentation, YouTube videos

Module-2

Introduction to NumPy and SciPy:NumPy subpackages– linalg, fft, random, polynomials, SciPy subpackages– linalg, fftpack, integrate, interpolate, optimize

Introduction to Matplotlib: Plotting 2D graphs with Matplotlib, annotations, legend, saving plots to file, bar and pie charts, line plots.

Teaching-Learning Process	Chalk and talk, PowerPoint Presentation, YouTube videos

Module-3

Linear algebra using NumPy and SciPy:Solving linear simultaneous equations using NumPy and SciPy using numpy.linalg and scipy.linalg – solve, inverse, determinant, least square solution,

Linear algebra using NumPy and SciPy (continued): Decomposition using lu and cholesky.

Solving eigenvalue problems using NumPy and SciPy:Using numpy.linalg and scipy.linalg – eig, eigvals.

Teaching-Learning Process	Chalk and talk, PowerPoint Presentation, YouTube videos

Module-4	
Solving initial value problems for ODE systems using scipy.integrate subpackage – solve_ivp, RK45, LSODA. Numerical integration of functions using SciPy:Using scipy.integratesubpackage– Definite integral using Gaussian quadrature – quad and quadrature Numerical integration of fixed samples using scipy.integratesubpackage– Trapezoidal rule trapezoid, Simpson's 1/3 rule using Simpson, Romberg integration romb.	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation, YouTube videos
Module-5	
Determining roots of equations using SciPyusing scipy.optimizesubpackage– Bisection method bisect, Brent's method brentq, Newton-Raphson method newton. Symbolic computing using SymPy and solving civil engineering problems using SymPy: Introduction, defining symbols, derivatives, integrals, limits, expression evaluation, expression simplification, solving equations, solving differential equations.	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation, YouTube videos

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

1. Understand Python syntax and semantics and be fluent in the use of Python flow control and functions.
2. Demonstrate proficiency in handling Strings and File Systems.
3. Represent compound data using Python lists, tuples, Strings, dictionaries.
4. Read and write data from/to files in Python Programs

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous internal Examination (CIE)

Three Tests (preferably in MCQ pattern with 20 questions) each of 20 Marks (duration 01 hour)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of 10 Marks

1. First assignment at the end of 4th week of the semester
2. Second assignment at the end of 9th week of the semester

Quiz/Group discussion/Seminar, any two of three suitably planned to attain the COs and POs for 20 Marks (duration 01 hours)

The sum of total marks of three tests, two assignments, and quiz /seminar/ group discussion will be out of 100 marks and shall be scaled down to 50 marks

Semester End Examinations (SEE)

SEE paper shall be set for 50 questions, each of 01 mark. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is 01 hour. The student has to secure minimum of 35% of the maximum marks meant for SEE.

Suggested Learning Resources:

Books

1. R. Nageswara Rao, "Core Python Programming", dreamtech

2. Python Programming: A Modern Approach, Vamsi Kurama, Pearson
3. Python Programming , Reema theraja, OXFORD publication

Web links and Video Lectures (e-Resources):

1. NumPy documentation at https://numpy.org/doc/
2. SciPy documentation at https://docs.scipy.org/doc/scipy/
3. Matplotlib documentation at https://matplotlib.org/stable/users/index
4. SymPy documentation at https://docs.sympy.org/latest/index.html

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Real world problem solving: Demonstration of projects developed using python language

Semester III

Microsoft Excel and Visual Basic for Applications			
Course Code	21CV382	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0:2:0:0	SEE Marks	50
Total Hours of Pedagogy	15	Total Marks	100
Credits	1	Exam Hours	01 hr

Course objectives:

- To learn basic operations using excel
- To solve problems using functions in excel
- To design structural elements using excel and VB as a tool

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. The online courses available should be shared with students
2. YouTube videos
3. Power point presentations
4. Assignments to solve all the problems using excel and VB.

Module-1

Introduction to Microsoft Excel, Workbooks, Worksheets, User Interface – navigating the interface, entering data, implicit data types, setting cell data types, Basic operations – copy/cut, paste, paste special, row and cell references, using cell names, Simple built-in formulae, Copying and pasting formulae

Built-in formulae – Trigonometric, Logarithmic, Exponential, Statistical, Matrix operations such as transpose, multiplication, inverse etc.

Plotting charts of different types, bar and pie charts, scatter plots, legend, Using Log and Semilog scales, Customizing chart axes, Using multiple axes, Preparing contour plots, Annotating charts.

Teaching-Learning Process	Chalk and talk, PowerPoint Presentation, YouTube videos

Module-2

Introduction to Visual Basic for Applications, User Interface – VBA Editor, VBA toolbar, Developing simple functions in VBA – area of a circle, minimum cover to reinforcement in a beam as per IS 456, Calling user defined functions, Organizing code into modules.

Debugging VBA code using built-in debugger – breakpoints, watch variables, trace lines of code with run to cursor, step into, step over and step out.

Developing subroutines, calling subroutines, Differences between functions and subroutines, Scope of subroutines – Public and Private, Calling a subroutine

Teaching-Learning Process	Chalk and talk, PowerPoint Presentation, YouTube videos

Module-3

VBA data types, Working with data types, Enforcing defining types with Option Explicit, Defining, initializing and using arrays within functions/subroutines.

Commenting code, Long statements spanning multiple lines, Program flow control – Branching and looping, using conditional statements, Calling Worksheet functions in VBA.

Develop functions for simple civil engineering applications – Stability of gravity dams, analysis of

rectangular footings subjected to axial compression and bending about both axes, etc.

Teaching-Learning Process	Chalk and talk, PowerPoint Presentation, YouTube videos

Module-4

Table lookup – Lookup, Vlookup, Hlookup, Match, Index, VBA Object model, creating and using user defined objects.

Building forms, triggering subroutines by pressing a button on a form

Interacting with other applications with support for VBA, such as, SAP2000/ETABS or any other software used by civil engineers.

Teaching-Learning Process	Chalk and talk, PowerPoint Presentation, YouTube videos

Module-5

Using Python to manipulate Microsoft Excel files, creating, editing and saving Microsoft Excel files from Python, Interacting with Microsoft Excel using Python xl wings package, Calling Python from VBA.

Developing functions and subroutine for a comprehensive civil engineering application – RC design, Steel design, or other similar problems from other fields of Civil Engineering.

Teaching-Learning Process	Chalk and talk, PowerPoint Presentation, YouTube videos

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

1. Solve Trigonometric, Logarithmic, Exponential, Statistical problems and perform Matrix operations
2. Solve civil engineering problems using VB as a tool
3. Design structural elements by integrating excel and VB

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous internal Examination (CIE)

Three Tests (preferably in MCQ pattern with 20 questions) each of 20 Marks (duration 01 hour)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of 10 Marks

1. First assignment at the end of 4th week of the semester
2. Second assignment at the end of 9th week of the semester

Quiz/Group discussion/Seminar, any two of three suitably planned to attain the COs and POs for 20 Marks (duration 01 hours)

1. The sum of total marks of three tests, two assignments, and quiz /seminar/ group discussion will be out of 100 marks and shall be scaled down to 50 marks

Semester End Examinations (SEE)

SEE paper shall be set for 50 questions, each of 01 mark. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is 01 hour. The student has to secure minimum of 35% of the maximum marks meant for SEE.

Suggested Learning Resources:
Books

1. Bourg, D.M., Excel Scientific and Engineering Cookbook, O'Reilly Media Inc., 2006.
2. Bilio, E.J., Excel for Scientists and Engineers – Numerical Methods, Wiley-Interscience, 2007.
3. Documentation for xlwingshttps://docs.xlwings.org/en/stable/

Web links and Video Lectures (e-Resources):

- https://freepdf-books.com/excel/
- https://jobscaptain.com/ms-excel-book-pdf/

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Assignments to understand the operations in Excel and VB may be given to students

IIISemester

Personality Development and Soft skills (AEC)			
Course Code	**21CV383**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	1:0:0:0	SEE Marks	50
Total Hours of Pedagogy	15	Total Marks	100
Credits	1	Exam Hours	2

Course objectives: Enable the students to

1. Experience self-fulfilment and overall development of one's own personality by developing personal skills.
2. Develop awareness about the significance of soft skills and impactful personality in professional life.
3. Improve the soft skills like effective communication, business correspondence, impressive presentation, leadership qualities, team-work, Time management leading to successful performance in interviews and group discussions.
4. Identify opportunities in career building and enhancement with proper time management and stress management.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Chalk and talk
2. Power point Presentation, video
3. Group discussion
4. Enacting, Demonstration
5. Industry interaction

Module-1	
Introduction to Soft-Skills-Personal Skills: Knowing Oneself/Self-Discovery-Confidence Building-Defining Strengths- Developing Positive Attitude- Thinking Creatively-Improving Perceptions - Forming Values.	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation
Module-2	
Interpersonal and Social Skills: Understanding others-Developing Inter-personal relationship Team Building-Group dynamics-Networking-Problem-solving.	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation.
Module-3	
Communication Skills: Art of Listening-Art of Speaking-Art of Reading-Art of Writing-Art of Writing E-mails: Email etiquette	
Teaching-Learning Process	Chalk and talk, Enacting, Demonstration.
Module-4	
Presentation skills: Group discussion- mock Group Discussion using video recording - public speaking.	
Teaching-Learning Process	Chalk and talk, Enacting, Demonstration, Activity

Module-5	
Corporate Skills: Working with others- Developing a proper body language-behavioural etiquettes and mannerism- Time Management –Stress Management	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

1. Develop effective communication skills (spoken and written) and effective presentation skills. Actively participate in group discussion / meetings / interviews and prepare & deliver presentations
2. Conduct effective business correspondence and prepare business reports which produce results.
3. Develop an understanding of and practice personal and professional responsibility.
4. Function effectively in multi-disciplinary and heterogeneous teams through the knowledge of team work, Inter-personal relationships, conflict management and leadership quality.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous internal Examination (CIE)

Three Tests (preferably in MCQ pattern with 20 questions) each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

1. First assignment at the end of 4th week of the semester
2. Second assignment at the end of 9th week of the semester

Quiz/Group discussion/Seminar, any two of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

The sum of total marks of three tests, two assignments, and quiz /seminar/ group discussion will be out of 100 marks and shall be **scaled down to 50 marks**

Semester End Examinations (SEE)

SEE paper shall be set for 50 questions, each of 01 mark. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is **01 hour.** The student has to secure minimum of 35% of the maximum marks meant for SEE.

Suggested Learning Resources:

Books

1. Meena K and V. Ayothi (2013) A Book on Development of Soft Skills (Soft Skills: A Road Map to Success), P. R. Publishers & Distributors, No. B-20 & 21, V. M. M Complex, Chatiram Bus Stand, Tiruchirappalli-620002. (Phone No: 0431-2702824Mobile No.: 9443370597, 9843074472)
2. Alex K. (2012) Soft Skills-Know Yourself & Know the World, S. Chand & Company LTD, Ram Nagar, New Delhi-110055. Mobile No.: 9442514814 (Dr.K.Alex

Web links and Video Lectures (e-Resources):

-

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Demonstrations of Videos
- Group Discussion
- Presentation on any social issues
- Quizzes

Semester III

Infrastructure Finance			
Course Code	21CV384	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0:2:0:0	SEE Marks	50
Total Hours of Pedagogy	15	Total Marks	100
Credits	01	Exam Hours	1 hr

Course objectives:

- To understand the infrastructure components
- Opportunities in infrastructure development
- Financial sources and investment for infrastructure

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. The online courses available should be shared with students
2. YouTube videos
3. Power point presentations
4. Visit to government, public and private organizations to understand infrastructure projects planning and execution procedures

Module-1

An Introduction to Infrastructure Finance

What is Infrastructure Business? Infrastructure then and now, Sector Structure and Size, Estimating the per capita cost.

Models of the Infrastructure Sectors

Classification system, Infrastructure and Service Organization, Business Models of Infrastructure Subsystems, Matrix of Owners and users of Infrastructure systems

Teaching-Learning Process	Chalk and talk, PowerPoint Presentation, YouTube videos

Module-2

Infrastructure and services:

How Infrastructure systems serve the built environment, , Services Structures and Equipment, Infrastructure support sector.

Investor and Business Opportunities in Infrastructure

Introduction, Bond Market, Stocks of Infrastructure Companies, infrastructure Funds, Infrastructure Indices, Commodity markets, Mortgage-Backed Securities, Private Equity and Infrastructure, The Infrastructure Support Sector, Infrastructure Investment Media, Corruption in Infrastructure Business, International Spending Plans.

Teaching-Learning Process	Chalk and talk, PowerPoint Presentation, YouTube videos

Module-3

Infrastructure Performance

Tracking Infrastructure Performance, Systems to measure, Performance Standards, Infrastructure scorecard.

Financial Models for Infrastructure Organisations

General Management Model, General Financing Model, Sector Financing Models, Public Private Partnerships, Regulations.

Teaching-Learning	Chalk and talk, PowerPoint Presentation, YouTube videos

Process	

Module-4

Capital Markets for Infrastructure

Capital Requirement of Sectors, Capital flows of Infrastructure, Capital structure of Infrstructure sectors, Sources of Capital, Investment Banking.

Teaching-Learning Process	Chalk and talk, PowerPoint Presentation, YouTube videos

Module-5

Revenues for the Infrastructure Sectors

Flow of Revenues, Rate Regulation, Revenue and cost of service analysis, Infrastructure revenue by Sector.

Opportunities and Risks for Infrastructure

Infrastructure as a policy sector, Infrastructure Policy elements, Sector Issues, Transformational Issues.

Teaching-Learning Process	Chalk and talk, PowerPoint Presentation, YouTube videos

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

1. Prepare a comprehensive development plan for infrastructure projects
2. Plan funding required and procedure to be adopted for infrastructure development
3. Estimate revenue generation and implement investment plans
4. Understand risk involved and policy issues related to infrastructure projects

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous internal Examination (CIE)

Three Tests (preferably in MCQ pattern with 20 questions) each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

1. First assignment at the end of 4th week of the semester
2. Second assignment at the end of 9th week of the semester

Quiz/Group discussion/Seminar, any two of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

The sum of total marks of three tests, two assignments, and quiz /seminar/ group discussion

will be out of 100 marks and shall be **scaled down to 50 marks**

Semester End Examinations (SEE)

SEE paper shall be set for 50 questions, each of 01 mark. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is **01 hour.** The student has to secure minimum of 35% of the maximum marks meant for SEE.

Suggested Learning Resources:

Books

1. Infrastructure Finance, Dr. K B Singh, Dr. Ajay Pratap Yadav, ISBN: 9788195248070, First edition, 2021, Raj Publications
2. Project and Infrastructure Finance: Corporate Banking Perspective, Vikas Srivastava , V. Rajaraman, Oxford University press, ISBN-13 978-0199465002, 2017

Web links and Video Lectures (e-Resources):

- https://www.pdfdrive.com/project-finance-e40552174.html
- https://www.yumpu.com/en/document/view/63829168/e-book-download-principles-of-project-finance-full-free-collection

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Assignments on new planning and design of an infrastructure facility may be given

Semester III

Fire Safety in Buildings			
Course Code	21CV385	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0:2:0:0	SEE Marks	50
Total Hours of Pedagogy	15	Total Marks	100
Credits	01	Exam Hours	1 hr

Course objectives:

- To understand the importance fire safety
- To learn various techniques involved in fire safety
- To design fire resistant buildings using proper materials and methods

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. The online courses available should be shared with students
2. YouTube videos
3. Power point presentations
4. Visit to fire stations and understand various fire accidents

Module-1

Fire: Introduction, Basic concepts of fire protection, Fire as a process of combustion, planning for fire protection, fire resistance

Ventilation and fuel controlled fire, process of combustion: flashover condition, effect of fire on construction material, design of fire resistance steel structure, concrete structure

Teaching-Learning Process	Chalk and talk, PowerPoint Presentation, YouTube videos

Module-2

Fire safety: urban planning, escape and refuge, internal planning, detection and suppression

Introduction to lift design, design of lift system, expected stop and floor of reversal, different cases, simulation, arrangements and escalators

Teaching-Learning Process	Chalk and talk, PowerPoint Presentation, YouTube videos

Module-3

Introduction to flow system: water supply, constant demand, variable demand and diversity factor, control systems

Flow in pipe networks and fixture units, design of water supply distribution system, flow in waste water pipes

Teaching-Learning Process	Chalk and talk, PowerPoint Presentation, YouTube videos

Module-4

Introduction to HVAC: governing equations to HVAC process, numerical problem on HVAC system, psychometric chart, equation based approach

Electrical systems: design of electrical systems, intelligent building, life cycle cost and basics of building maintenance, stages of maintenance management, planning for building maintenance, periodicity of maintenance management, estimation of repair cycle, cost profile of maintenance, lamp replacement, building inspection, planned and Ad-hoc maintenance

Teaching-Learning Process	Chalk and talk, PowerPoint Presentation, YouTube videos

Module-5	
Condition survey and health evaluation of buildings, diagnosis of building by visual survey, case studies of visual survey, effect of corrosion and alkali aggregate reaction, sampling and choice of test location Non-destructive testing, core strength test, carbonation and chloride measurement, electrical method of progress measurement Repair, rehabilitation, retrofit, periodicity and economics of condition survey, interpretation of test results	
Teaching-Learning Process	Chalk and talk, PowerPoint Presentation, YouTube videos

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

1. Understand types of fire, combustion process and fire resistance
2. Plan for fire safety and design of lifts
3. Design flow network in buildings
4. Design of electrical systems and maintenance
5. Perform health evaluation of buildings and suggest remedies

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous internal Examination (CIE)

Three Tests (preferably in MCQ pattern with 20 questions) each of 20 Marks (duration 01 hour)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of 10 Marks

1. First assignment at the end of 4th week of the semester
2. Second assignment at the end of 9th week of the semester

Quiz/Group discussion/Seminar, any two of three suitably planned to attain the COs and POs for 20 Marks (duration 01 hours)

The sum of total marks of three tests, two assignments, and quiz /seminar/ group discussion will be out of 100 marks and shall be scaled down to 50 marks

Semester End Examinations (SEE)

SEE paper shall be set for 50 questions, each of 01 mark. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is 01 hour. The student has to secure minimum of 35% of the maximum marks meant for SEE.

Suggested Learning Resources:

Books

1. J A Purkiss, Fire Safety Engineering: Design of Structures, ISBN 13 978-8131220085, Elsevier, 2009
2. V K Jain, Fire Safety in Buildings, ISBN-13 978-938980219, New Age International Private Limited; Third edition, 2020
3. Fire protection, services and maintenance management of building, NPTEL video lecture, IIT, Delhi
4. Bureau of Indian Standards, " HAND BOOK OF FUNCTIONAL REQUIREMENTS OF BUILDINGS, (SP-41 & SP- 32)", BIS 1987 and 1989.
5. Markus,T.A. & Morris, E.N., "BUILDING CLIMATE AND ENERGY" Pitman publishing limited. 1980.
6. Croome,J.D.&Roberts,B.M.,"AIRCONDITIONING AND VENTILATION OF BUILDINGS VOL-1".Pergamon press.
7. Building Services Design - T.W.MEVER
8. Building Engineering & System Design - F.S.MERRIT & J. AMBROSE
9. SP-35 (1987): Handbook of Water supply & drainage-BIS
10. N.B.C.-2007 BIS
11. Concept of building fire safety - D.EGAN.
12. Design of fire resisting structures - H.L. MALHOTRA.

List of reference materials/books/

1. An introduction to fire dynamics -D.DRYSDALE
2. Structural fire protection Edt by T.T.LIE
3. Elevator technology - G.C.BARNEY
4. HEATING VENTILATING AND AIR CONDITIONING Analysis and Design - Faye C. McQuiston and Jerald D. Parker.
5. Building Maintenance Management-R.LEE
6. Developments In Building Maintenance -I.EJ. GIBSON
7. ConcreteStructures:materials,Maintenance And Repair D.CAMPBELL,ALLEN & H.ROPER

Web links and Video Lectures (e-Resources):

- https://archive.nptel.ac.in/courses/105/102/105102176/

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Assignment students: A case study of fire hazard in building and restoration procedure adopted

VISVESVARAYA TECHNOLOGICAL UNIVERSITY
BELAGAVI

Scheme of Teaching and Examinations and Syllabus

M.Tech in Computer Science and Engineering (SCS)

(Effective from Academic year 2020 - 21)

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI
Scheme of Teaching and Examinations – 2020 - 21
M.Tech in Computer Science and Engineering (SCS)
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)

I SEMESTER

SL. No.	Course	Course Code	Course Title	Teaching Hours / Week			Examination				Credits
				Theory	Practical / Seminar	Skill Development Activities	Duration in Hours	CIE Marks	SEE Marks	Total Marks	
1	PCC	20SCS11	Mathematical Foundations of Computer Science	03	--	02	03	40	60	100	4
2	PCC	20SCS12	Artificial Intelligence and Machine Learning	03	--	02	03	40	60	100	4
3	PCC	20SCS13	Advanced Database Management Systems	03	--	02	03	40	60	100	4
4	PCC	20SCS14	Advanced Algorithms	03	--	02	03	40	60	100	4
5	PCC	20SCS15	Internet of Things and Applications	03	--	02	03	20+ 20	60	100	4
6	PCC	20SCSL16	Algorithms and Database Management Systems Laboratory	--	04	--	03	40	60	100	2
7	PCC	20RMI17	Research Methodology and IPR	01	--	02	03	40	60	100	2
			TOTAL	**16**	**04**	**12**	**21**	**280**	**420**	**700**	**24**

Note: PCC: Profession Core

Skill development activities:

Students and course instructor/s to involve either individually or in groups to interact together to enhance the learning and application skills. The students should interact with industry (small, medium and large), understand their problems or foresee what can be undertaken for study in the form of research/ testing / projects, and for creative and innovative methods to solve the identified problem. The students shall

1. Gain confidence in modeling of systems and algorithms.
2. Work on different software/s (tools) to Simulate, analyze and authenticate the output to interpret and conclude. Operate the simulated system under changed parameter conditions to study the system with respect to thermal study, transient and steady state operations, etc.
3. Handle advanced instruments to enhance technical talent.
4. Involve in case studies and field visits/ field work.
5. Accustom with the use of standards/codes etc., to narrow the gap between academia and industry.

All activities should enhance student's abilities to employment and/or self-employment opportunities, management skills, Statistical analysis, fiscal expertise, etc.

Internship: All the students have to undergo mandatory internship of 6 weeks during the vacation of I and II semesters and /or II and III semesters. A University examination shall be conducted during III semester and the prescribed credit shall be counted for the same semester. Internship shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not take-up/complete the internship shall be declared as fail in internship course and have to complete the same during the subsequent University examination after satisfying the internship requirements.

Note: (i) Four credit courses are designed for 50 hours Teaching – Learning process.
(ii) Three credit courses are designed for 40 hours Teaching – Learning process.

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI
Scheme of Teaching and Examinations – 2020 - 21
M.Tech in Computer Science and Engineering (SCS)
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)

II SEMESTER

SL. No.	Course	Course Code	Course Title	Teaching Hours / Week			Examination				Credits
				Theory	Practical / Seminar	Skill Development Activity	Duration in Hours	CIE Marks	SEE Marks	Total Marks	
1	PCC	20SCS21	Data Science	03	--	02	03	40	60	100	4
2	PCC	20SCS22	Semantic Web and Social Networks	03	--	02	03	40	60	100	4
3	PCC	20SCS23	Blockchain Technology	03	--	02	03	40	60	100	4
4	PEC	20SCS24X	Professional elective 1	04	--	--	03	40	60	100	4
5	PEC	20SCS25X	Professional elective 2	04	--	--	03	40	60	100	4
6	PCC	20SCSL26	Data Science Laboratory	--	04	--	03	40	60	100	2
7	PCC	20SCS27	Technical Seminar	--	02	--	--	100	--	100	2
			TOTAL	**17**	**06**	**06**	**18**	**340**	**360**	**700**	**24**

Note: PCC: Profession Core, PEC: Professional Elective Course

Professional Elective-1		**Professional Elective-2**	
Course Code 20LSCS24X	**Course Title**	**Course Code 20SCS25X**	**Course Title**
20SCS241	Advanced Cryptography	20SCS251	Image Processing and Machine Vision
20SCS242	Natural Language Processing	20SCS252	Object Oriented Design
20SCS243	Cloud Computing	20SCS253	Software Defined Networks
20SCS244	Pattern recognition	20SCS254	Modern Computer Architecture

Note:

1. Technical Seminar: CIE marks shall be awarded by a committee comprising of HoD as Chairman, Guide/co-guide, if any, and a senior faculty of the department. Participation in the seminar by all postgraduate students of the program shall be mandatory.
The CIE marks awarded for Technical Seminar, shall be based on the evaluation of Seminar Report, Presentation skill and performance in Question and Answer session in the ratio 50:25:25.

2. Internship: All the students shall have to undergo mandatory internship of 6 weeks during the vacation of I and II semesters and /or II and III semesters. A University examination shall be conducted during III semester and the prescribed internship credit shall be counted in the same semester. Internship shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not take-up/complete the internship shall be declared as fail in internship course and have to complete the same during the subsequent University examination after satisfying the internship
requirements.

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI
Scheme of Teaching and Examinations – 2020 - 21
M.Tech in Computer Science and Engineering (SCS)
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)

III SEMESTER

SL. No.	Course	Course Code	Course Title	Teaching Hours / Week			Examination				Credits
				Theory	Practical / Seminar	Skill Development Activity	Duration in Hours	CIE Marks	SEE Marks	Total Marks	
1	PCC	20SCS31	Deep Learning	03	--	02	03	40	60	100	4
2	PEC	20SCS32X	Professional elective 3	03	--	--	03	40	60	100	3
3	PEC	20SCS33X	Professional elective 4	03	--	--	03	40	60	100	3
4	Project	20SCS34	Project Work phase -1	--	02	--	--	100	--	100	2
5	PCC	20SCS35	Mini-Project	--	02	--	--	100	--	100	2
6	Internship	20SCSI36	Internship	(Completed during the intervening vacation of I and II semesters and /or II and III semesters.)			03	40	60	100	6
			TOTAL	**09**	**04**	**02**	**12**	**360**	**240**	**600**	**20**

Note: PCC: Profession Core, PEC: Professional Elective Course

Professional Elective-3		**Professional Elective-4**	
Course Code 20SCS32X	**Course Title**	**Course Code 20SCS33X**	**Course Title**
20SCS321	Engineering Economics	20SCS331	Business Intelligence and its Applications
20SCS322	Virtual Reality	20SCS332	Robotics and Automation
20SCS323	Soft and Evolutionary Computing	20SCS333	Speech Processing
20SCS324	Multi Core Architecture and Programming	20SCS334	Wireless Sensor Networks

Note:
1. Project Work Phase-1: Students in consultation with the guide/co-guide if any, shall pursue literature survey and complete the preliminary requirements of selected Project work. Each student shall prepare relevant introductory project document and present a seminar.
CIE marks shall be awarded by a committee comprising of HoD as Chairman, Guide/co-guide if any, and a senior faculty of the department. The CIE marks awarded for project work phase -1, shall be based on the evaluation of Project Report, Project Presentation skill and Question and Answer session in the ratio 50:25:25. SEE (University examination) shall be as per the University norms.
2. Internship: Those, who have not pursued /completed the internship, shall be declared as fail in internship course and have to complete the same during subsequent University examinations after satisfying the internship requirements. Internship SEE (University examination) shall be as per the University norms.

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI
Scheme of Teaching and Examinations – 2020 - 21
M.Tech in Computer Science and Engineering (SCS)
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)

IV SEMESTER

SL. No.	Course	Course Code	Course Title	Teaching Hours / Week			Examination				Credits
				Theory	Practical / Seminar	Skill Development Activity	Duration in Hours	CIE Marks	SEE Marks	Total Marks	
1	Project	20SCS41	Project work phase 2	--	04	03	03	40	60	100	20
			TOTAL	**--**	**04**	**03**	**03**	**40**	**60**	**100**	**20**

Note:
Project Work Phase-2:
CIE marks shall be awarded by a committee comprising of HoD as Chairman, Guide/co-guide, if any, and a Senior faculty of the department. The CIE marks awarded for project work phase -2, shall be based on the evaluation of Project Report subjected to plagiarism check, Project Presentation skill and Question and Answer session in the ratio 50:25:25.

SEE shall be at the end of IV semester. Project work evaluation and Viva-Voce examination (SEE), after satisfying the plagiarism check, shall be as per the University norms.

M.TECH IN NETWORK AND INTERNET ENGINEERING (LNI)
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER -I

MATHEMATICAL FOUNDATION OF COMPUTER SCIENCE

Course Code	20LNI11, 20SCS11, 20SCE11, 20SFC11, 20SCN11, 20SSE11, 20SIT11, 20SAM11, 20SIS11	CIE Marks	40
Teaching Hours/Week (L:P:S)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Vector Spaces: Vector spaces; subspaces Linearly independent and dependent vectors Basis and dimension; coordinate vectors-Illustrative examples. Linear transformations, Representation of transformations by matrices;
(RBT Levels: **L1 & L2)** (Textbook:1)

Module-2

Orthogonality and least squares: Inner product, orthogonal sets, orthogonal projections, orthogonal bases. Gram-Schmidt orthogonalization process. QR factorizations of a matrices, least square problems, applications to linear models (least square lines and least square fitting of other curves).
(RBT Levels: **L2 & L3)** (Textbook:1)

Module-3

Symmetric and Quadratic Forms: Diagonalization, Quadratic forms, Constrained Optimization, The Singular value decomposition. Applications to image processing and statistics, Principal Component Analysis
(RBT Levels: **L2 & L3)** (Textbook:1)

Module-4

Statistical Inference: Introduction to multivariate statistical models: Correlation and Regression analysis, Curve fitting (Linear and Non-linear)
(RBT Levels: **L2 & L3)** (Textbook:3)

Module-5

ProbabilityTheory: Random variable (discrete and continuous), Probability mass function (pmf), Probability density function (pdf), Mathematical expectation, Sampling theory: testing of hypothesis by ***t***-test, χ^2- test.
(RBT Levels: **L1 & L2)** (Textbook:3)

Course Outcomes:

On completion of this course, students are able to:

1. Understand the numerical methods to solve and find the roots of the equations.
2. Apply the technique of singular value decomposition for data compression, least square approximation in solving inconsistent linear systems
3. Understand vector spaces and related topics arising in magnification and rotation of images.
4. Utilize the statistical tools in multi variable distributions.
5. Use probability formulations for new predictions with discrete and continuous RV's.

Question Paper Pattern:

- The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.
- The question paper will have ten full questions carrying equal marks.
- Each full question consisting of 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbooks:

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Linear Algebra and its Applications	David C. Lay, Steven R. Lay and J. J. McDonald	Pearson Education Ltd	5th Edition 2015.
2	Numerical methods for Scientific	M K Jain, S.R.K	New Age	6th Ed., 2014

	and Engg. Computation	Iyengar, R K. Jain	International	
3	Probability, Statistics and Random Process	T. Veerarajan	Tata Mc-Graw Hill Co	3rd Edition 2016
Reference books:				
Sl No	**Title of the book**	**Name of the Author/s**	**Publisher Name**	**Edition and year**
1	Optimization: Theory & Applications Techniques	Rao. S.S	Wiley Eastern Ltd New Delhi.	
2	Signals, Systems, and Inference	Alan V. Oppenheim and George C. Verghese	Spring	2010.
3	Foundation Mathematics for Computer Science	John Vince	Springer International	
4	Higher Engineering Mathematics	B.S. Grewal	Khanna Publishers	44th Ed.,2017

M.TECH IN COMPUTER SCIENCE AND ENGINEERING (SCS)
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER –I

ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

Course Code	**20SCS12**, 20SSE254, 20SAM12, 20SIS31	CIE Marks	40
Teaching Hours/Week (L:P:S)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Introduction, problem Solving: state space search and control strategies

Module-2

Problem reduction and Game playing, Logic concepts and logic programming

Module-3

Advanced problem-solving paradigm: planning Knowledge representation

Module-4

Uncertainty Measure: Probability Theory, Bayesian Belief Networks,
Machine Learning Paradigms: Machine learning system, supervised and unsupervised learnings, Inductive, deductive learning, Clustering

Module-5

Support vector Machine, case-based reasoning and learning.
ANN: Single Layer, Multilayer. RBF, Design issues in ANN, Recurrent Network

Course outcomes: At the end of the course the student will be able to:

- Define Artificial intelligence and identify problems for AI. Characterize the search techniques to solve problems and recognize the scope of classical search techniques
- Define knowledge and its role in AI. Demonstrate the use of Logic in solving AI problems
- Demonstrate handling of uncertain knowledge and reasoning in probability theory.
- Understanding of Learning methods

Question paper pattern: The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbook/ Textbooks

Sl No	**Title of the book**	**Name of the Author/s**	**Publisher Name**	**Edition and year**

1	Artificial Intelligence:	SarojKaushik	Cengage Learning	2014 Edition
Reference Books				
1	Artificial Intelligence: Structures and Strategies for Complex Problem Solving	George F Luger	Pearson Addison Wesley	6th Ed, 2008
2	Artificial Intelligence	E Rich, K Knight, and S B Nair	Tata Mc-Graw Hill	3rd Ed, 2009
3	Artificial Intelligence: A Modern Approach	Stuart Russell and Peter Norvig	Prentice Hall	3rd, 2009

M.TECH IN COMPUTER SCIENCE AND ENGINEERING (SCS)
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER -I

ADVANCES IN DATA BASE MANAGEMENT SYSTEM

Course Code	**20SCS13,** 20SCE252, 20SIT14, 20SSE15,	CIE Marks	40
Teaching Hours/Week (L:P:S)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Review of Relational Data Model and Relational Database Constraints:
Relational model concepts; Relational model constraints and relational database schemas; Update operations, anomalies, dealing with constraint violations, Types and violations.

Object and Object-Relational Databases:
Overview of Object Database Concepts, Object Database Extensions to SQL, The ODMG Object Model and the Object Definition Language ODL, Object Database Conceptual Design, The Object Query Language OQL, Overview of the C++ Language Binding in the ODMG Standard.

Module-2

Disk Storage, Basic File Structures, Hashing, and Modern Storage Architectures:
Introduction, Secondary Storage Devices, Buffering of Blocks, Placing File Records on Disk Operations on Files, Files of Unordered Records (Heap Files), Files of Ordered Records (Sorted Files), Hashing Techniques, Other Primary File Organizations, Parallelizing Disk Access Using RAID Technology, Modern Storage Architectures.

Distributed Database Concepts:
Distributed Database Concepts, Data Fragmentation, Replication, and Allocation Techniques for Distributed Database Design, Overview of Concurrency Control and Recovery in Distributed Databases, Overview of Transaction Management in Distributed Databases,Query Processing and Optimization in Distributed Databases, Types of Distributed Database Systems , Distributed Database Architectures, Distributed Catalogue Management.

Module-3

NOSQL Databases and Big Data Storage Systems:
Introduction to NOSQL Systems, The CAP Theorem, Document-Based NOSQL Systems and MongoDB, NOSQL Key-Value Stores, Column-Based or Wide Column NOSQL Systems, NOSQL Graph Databases and Neo4j.

Big Data Technologies Based on MapReduce and Hadoop:
What Is Big Data? Introduction to MapReduce and Hadoop, Hadoop Distributed File System (HDFS), MapReduce: Additional Details Hadoop v2 alias YARN, General Discussion

Module-4

Enhanced Data Models: Introduction to Active, Temporal, Spatial, Multimedia, and Deductive Databases: Active Database Concepts and Triggers, Temporal Database Concepts, Spatial Database Concepts, Multimedia Database Concepts, Introduction to Deductive Databases.

Introduction to Information Retrieval and Web Search: Information Retrieval (IR) Concepts, Retrieval Models, Types of Queries in IR Systems, Text pre-processing, Inverted Indexing, Evaluation Measures of Search relevance, web Search and Analysis. Trends in Information Retrieval

Module-5

Data Mining Concepts: Overview of Data Mining Technology, Association Rules, Classification, Clustering, Approaches to Other Data Mining Problems, Applications of Data Mining, Commercial Data Mining Tools

Overview of Data Warehousing and OLAP: Introduction, Definitions, and Terminology, Characteristics of Data Warehouses, Data Modelling for Data Warehouses, building a Data Warehouse, Typical Functionality of a Data Warehouse, Data Warehouse versus Views, Difficulties of Implementing Data Warehouses.

Course outcomes:
At the end of the course the student will be able to:

- Select the appropriate high-performance database like parallel and distributed database
- Infer and represent the real-world data using object-oriented database
- Interpret rule set in the database to implement data warehousing of mining
- Discover and design database for recent applications database for better interoperability

Question paper pattern:
The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbook/ Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Fundamentals of Database Systems	Elmasri and Navathe	Pearson Education	2013
2	Database Management Systems	Raghu Ramakrishnan and Johannes Gehrke	McGraw-Hill	3rd Edition, 2013.
Reference Books				
1	Database System Concepts	Abraham Silberschatz, Henry F. Korth, S. Sudarshan	McGraw Hill	6th Edition, 2010

M.TECH IN COMPUTER SCIENCE AND ENGINEERING (SCS)
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER – I

ADVANCED ALGORITHMS

Course Code	**20SCS14,** 20SSE244, 20SIS321	CIE Marks	40
Teaching Hours/Week (L:P:S)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Review of Analysis Techniques: Growth of Functions: Asymptotic notations; Standard notations and common functions; Recurrences and Solution of Recurrence equations- The substitution method, The recurrence – tree method, The master method; Amortized Analysis: Aggregate, Accounting and Potential Methods.

Module-2

Graph Algorithms: Bellman - Ford Algorithm; Single source shortest paths in a DAG; Johnson's Algorithm for sparse graphs; Flow networks and Ford-Fulkerson method; Maximum bipartite matching. **Polynomials and the FFT:** Representation of polynomials; The DFT and FFT; Efficient implementation of FFT.

Module-3

Number -Theoretic Algorithms: Elementary notions; GCD; Modular Arithmetic; Solving modular linear equations; The Chinese remainder theorem; Powers of an element; RSA cryptosystem; Primality testing; Integer factorization

Module-4

String-Matching Algorithms: Naïve string Matching; Rabin - Karp algorithm; String matching with finite automata; Knuth-Morris-Pratt algorithm; Boyer – Moore algorithms.

Module-5

Probabilistic and Randomized Algorithms: Probabilistic algorithms; Randomizing deterministic algorithms, Monte Carlo and Las Vegas algorithms; Probabilistic numeric algorithms

Course outcomes:

At the end of the course the student will be able to:

- Design and apply iterative and recursive algorithms.
- Design and implement optimization algorithms in specific applications.
- Design appropriate shared objects and concurrent objects for applications.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbook/ Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Introduction to Algorithms	T. H Cormen, C E Leiserson, R L Rivest and C Stein	PHI	3rd Edition, 2010
2	Algorithms	Kenneth A. Berman	Cengage Learning	2002.

Reference Books

1	Fundamentals of Computer Algorithms	Ellis Horowitz, SartajSahni, S.Rajasekharan	Universities press	2nd Edition, 2007

M.TECH IN COMPUTER SCIENCE AND ENGINEERING (SCS)
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER – I

INTERNET OF THINGS AND APPLICATIONS

Course Code	**20SCS15**, 20LNI22, 20SCE23, 20SCN14, 20SAM323, 20SIS14	CIE Marks	20+20 (IA test+ Mini project)
Teaching Hours/Week (L:P:S)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Note: CIE marks can be distributed as: IA test (20 marks) + Mini project (individual/Group) 20 Marks

Module-1

What is The Internet of Things? Overview and Motivations, Examples of Applications, IPV6 Role, Areas of Development and Standardization, Scope of the Present Investigation.Internet of Things Definitions and frameworks-IoT Definitions, IoT Frameworks, Basic Nodal Capabilities. Internet of Things Application Examples-Overview, Smart Metering/Advanced Metering Infrastructure-Health/Body Area Networks, City Automation, Automotive Applications, Home Automation, Smart Cards, Tracking, Over-The-Air-Passive Surveillance/Ring of Steel, Control Application Examples, Myriad Other Applications.

Module -2

Fundamental IoT Mechanism and Key Technologies-Identification of IoT Object and Services, Structural Aspects of the IoT, Key IoT Technologies. Evolving IoT Standards-Overview and Approaches, IETF IPV6 Routing Protocol for RPL Roll, Constrained Application Protocol, Representational State Transfer, ETSI M2M,Third Generation Partnership Project Service Requirements for Machine-Type Communications, CENELEC, IETF Ipv6 Over Low power WPAN, Zigbee IP(ZIP),IPSO

Module – 3

Layer ½ Connectivity: Wireless Technologies for the IoT-WPAN Technologies for IoT/M2M, Cellular and Mobile Network Technologies for IoT/M2M,Layer 3 Connectivity:Ipv6 Technologies for the IoT: Overview and Motivations. Address Capabilities,Ipv6 Protocol Overview, Ipv6 Tunnelling, Ipsec in Ipv6,Header Compression Schemes, Quality of Service in Ipv6, Migration Strategies to Ipv6.

Module-4

Case Studies illustrating IoT Design-Introduction, Home Automation, Cities, Environment, Agriculture, Productivity Applications.

Module-5

Data Analytics for IoT – Introduction, Apache Hadoop, Using HadoopMapReduce for Batch Data Analysis, Apache Oozie, Apache Spark, Apache Storm, Using Apache Storm for Real-time Data Analysis, Structural Health Monitoring Case Study.

Note: CIE marks can be distributed as: IA test (20 marks) + Mini project (individual/Group) 20 Marks

Course outcomes:

At the end of the course the student will be able to:

- Develop schemes for the applications of IOT in real time scenarios
- Manage the Internet resources
- Model the Internet of things to business
- Understand the practical knowledge through different case studies

Understand data sets received through IoT devices and tools used for analysis

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbook/ Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Building the Internet of Things with Ipv6 and MIPv6:The Evolving World of M2M Communications	Daniel Minoli	Wiley	2013
2	Internet of Things: A Hands-on Approach	ArshdeepBahga, Vijay Madisetti	Universities Press	2015
Reference Books				
1	The Internet of Things	Michael Miller	Pearson	2015 First Edition
2	Designing Connected Products	Claire Rowland,Elizabeth Goodman et.al	O'Reilly	First Edition, 2015

M.TECH IN COMPUTER SCIENCE AND ENGINEERING (SCS)
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER – I

ALGORITHMS AND DATABASE MANAGEMENT SYSTEMS LABORATORY

Course Code	**20SCSL16**	CIE Marks	40
Teaching Hours/Week (L:P:S)	0:4:0	SEE Marks	60
Credits	02	Exam Hours	03

PART A: Algorithms Laboratory

List of Experiments:

1. Program to implement Ford-Fulkerson method.

2. Program to implement Naive algorithm.
3. Program to implement Rabin - Karp algorithm.
4. Program to implement Boyer – Moore algorithm.
5. Program to implement Monte Carlo algorithm.

PART B: ADBMS Laboratory

List of Experiments

Note: The following experiments may be implemented on MySQL/ORACLE or any other suitable RDBMS with support for Object features

1. **Develop a database application to demonstrate storing and retrieving of BLOB and CLOB objects.**
   a. Write a binary large object (BLOB) to a database as either binary or character (CLOB) data, depending on the type of the field in your data source. To write a BLOB value to the database, issue the appropriate INSERT or UPDATE statement and pass the BLOB value as an input parameter. If your BLOB is stored as text, such as a SQL Server text field, pass the BLOB as a string parameter. If the BLOB is stored in binary format, such as a SQL Server image field, pass an array of type byte as a binary parameter.
   b. Once storing of BLOB and CLOB objects is done, retrieve them and display the results accordingly.

2. **Develop a database application to demonstrate the representation of multi valued attributes, and the use of nested tables to represent complex objects. Write suitable queries to demonstrate their use.**

   Consider Purchase Order Example: This example is based on a typical business activity: managing customer orders. Need to demonstrate how the application might evolve from relational to object-relational, and how you could write it from scratch using a pure object-oriented approach.
   a. Show how to implement the schema -- Implementing the Application under the Relational Model -- using only Oracle's built-in data types. Build an object-oriented application on top of this relational schema using object views

3. **Design and develop a suitable Student Database application by considering appropriate attributes. Couple of attributes to be maintained is the Attendance of a student in each subject for which he/she has enrolled and Internal Assessment Using TRIGGERS, write active rules to do the following:**
   a. Whenever the attendance is updated, check if the attendance is less than 85%; if so, notify the Head of the Department concerned.
   b. Whenever, the marks in an Internal Assessment Test are entered, check if the marks are less than 40%; if so, notify the Head of the Department concerned.

Use the following guidelines when designing triggers:

- Use triggers to guarantee that when a specific operation is performed, related actions are performed.
- Use database triggers only for centralized, global operations that should be fired for the triggering statement, regardless of which user or database application issues the statement.
- Do not define triggers that duplicate the functionality already built into Oracle. For example, do not define triggers to enforce data integrity rules that can be easily enforced using declarative integrity constraints.
- Limit the size of triggers (60 lines or fewer is a good guideline). If the logic for your trigger requires much more than 60 lines of PL/SQL code, it is better to include most of the code in a stored procedure, and call the procedure from the trigger.
- Be careful not to create recursive triggers. For example, creating an AFTER UPDATE statement trigger on the EMP table that itself issues an UPDATE statement on EMP causes the trigger to fire recursively until it has run out of memory.

1. **Design, develop, and execute a program to implement specific Apriori algorithm for**

mining association rules. Run the program against any large database available in the public domain and discuss the results.

Association rules are if/then statements that help uncover relationships between seemingly unrelated data in a relational database or other information repository. An example of an association rule would be "If a customer buys a dozen eggs, he is 80% likely to also purchase milk."

Course outcomes:
At the end of the course the student will be able to:

- Work on the concepts of Software Testing and ADBMS at the practical level
- Compare and pick out the right type of software testing process for any given real-world problem
- Carry out the software testing process in efficient way
- Establish a quality environment as specified in standards for developing quality software
- Model and represent the real-world data using object-oriented database
- Embed the rules set in the database to implement various features of ADBMS
- Choose, design and implement recent applications database for better interoperability

Conduction of Practical Examination:
All laboratory experiments (nos) are to be included for practical examination.
Students to pick one experiment from **each part and execute both**
Strictly follow the instructions as printed on the cover page of answer script for breakup of marks
Change of experiment is allowed only once and marks allotted to the procedure part to be made zero.

RESEARCH METHODOLOGY AND IPR			
Course Code	20RMI17	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	1:0:2	SEE Marks	60
Credits	02	Exam Hours	03

Module-1

Research Methodology: Introduction, Meaning of Research, Objectives of Research, Motivation in Research, Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Importance of Knowing How Research is Done, Research Process, Criteria of Good Research, and Problems Encountered by Researchers in India.
Defining the Research Problem: Research Problem, Selecting the Problem, Necessity of Defining the Problem, Technique Involved in Defining a Problem, An Illustration.

Module-2

Reviewing the literature: Place of the literature review in research, Bringing clarity and focus to your research problem, Improving research methodology, Broadening knowledge base in research area, Enabling contextual findings, How to review the literature, searching the existing literature, reviewing the selected literature, Developing a theoretical framework, Developing a conceptual framework, Writing about the literature reviewed.
Research Design: Meaning of Research Design, Need for Research Design, Features of a Good Design, Important Concepts Relating to Research Design, Different Research Designs, Basic Principles of Experimental Designs, Important Experimental Designs.

Module-3

Design of Sampling: Introduction, Sample Design, Sampling and Non-sampling Errors, Sample Survey versus Census Survey, Types of Sampling Designs.
Measurement and Scaling: Qualitative and Quantitative Data, Classifications of Measurement Scales, Goodness of Measurement Scales, Sources of Error in Measurement Tools, Scaling, Scale Classification Bases, Scaling Technics, Multidimensional Scaling, Deciding the Scale.
Data Collection: Experimental and Surveys, Collection of Primary Data, Collection of Secondary Data, Selection of Appropriate Method for Data Collection, Case Study Method.

Module-4

Testing of Hypotheses: Hypothesis, Basic Concepts Concerning Testing of Hypotheses, Testing of Hypothesis, Test Statistics and Critical Region, Critical Value and Decision Rule, Procedure for Hypothesis Testing, Hypothesis Testing for Mean, Proportion, Variance, for Difference of Two Mean, for Difference of Two Proportions, for Difference of Two Variances, P-Value approach, Power of Test, Limitations of the Tests of Hypothesis.
Chi-square Test: Test of Difference of more than Two Proportions, Test of Independence of Attributes, Test of Goodness of Fit, Cautions in Using Chi Square Tests.

Module-5

Interpretation and Report Writing: Meaning of Interpretation, Technique of Interpretation, Precaution in Interpretation, Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Precautions for Writing Research Reports.
Intellectual Property: The Concept, Intellectual Property System in India, Development of TRIPS Complied Regime in India, Patents Act, 1970, Trade Mark Act, 1999,The Designs Act, 2000, The Geographical Indications of Goods (Registration and Protection) Act1999, Copyright Act,1957,The Protection of Plant Varieties and Farmers' Rights Act, 2001,The Semi-Conductor Integrated Circuits Layout Design Act, 2000, Trade Secrets, Utility Models, IPR and Biodiversity, The Convention on Biological Diversity (CBD) 1992, Competing Rationales for Protection of IPRs, Leading International Instruments Concerning IPR, World Intellectual Property Organisation (WIPO),WIPO and WTO, Paris Convention for the Protection of Industrial Property, National Treatment, Right of Priority, Common Rules, Patents, Marks, Industrial Designs, Trade Names, Indications of Source, Unfair Competition, Patent Cooperation Treaty (PCT), Advantages of PCT Filing, Berne Convention for the Protection of Literary and Artistic Works, Basic Principles, Duration of Protection, Trade Related Aspects of Intellectual Property Rights(TRIPS) Agreement, Covered under TRIPS Agreement, Features of the Agreement, Protection of Intellectual Property under TRIPS, Copyright and Related Rights, Trademarks, Geographical indications, Industrial Designs, Patents, Patentable Subject Matter, Rights Conferred, Exceptions, Term of protection, Conditions on Patent Applicants, Process Patents, Other Use without Authorization of the Right Holder, Layout-Designs of Integrated Circuits, Protection of Undisclosed Information, Enforcement of Intellectual Property Rights, UNSECO.

Course outcomes:
At the end of the course the student will be able to:

- Discuss research methodology and the technique of defining a research problem
- Explain the functions of the literature review in research, carrying out a literature search, developing theoretical and conceptual frameworks and writing a review.
- Explain various research designs, sampling designs, measurement and scaling techniques and also different methods of data collections.
- Explain several parametric tests of hypotheses, Chi-square test, art of interpretation and writing research reports
- Discuss various forms of the intellectual property, its relevance and business impact in the changing global business environment and leading International Instruments concerning IPR.

Question paper pattern:

- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module.

Textbooks

(1) Research Methodology: Methods and Techniques, C.R. Kothari, Gaurav Garg,New Age International,4th Edition, 2018.

(2) Research Methodology a step-by-step guide for beginners. (For the topic Reviewing the literature under module 2), RanjitKumar,SAGE Publications,3rd Edition, 2011.

(3) Study Material (For the topic Intellectual Property under module 5),
Professional Programme Intellectual Property Rights, Law and Practice, The Institute of Company Secretaries of India, Statutory Body Under an Act of Parliament, September 2013.

Reference Books

(1) Research Methods: the concise knowledge base, Trochim, Atomic Dog Publishing, 2005.

(2) Conducting Research Literature Reviews: From the Internet to Paper, Fink A, Sage Publications, 2009.

M.TECH IN COMPUTER SCIENCE AND ENGINEERING (SCS)
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SEMESTER – II

DATA SCIENCE

Course Code	**20SCS21,** 20SAM14, 20SIS22	CIE Marks	40
Teaching Hours/Week (L:P:S)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Introduction: What is Data Science? Big Data and Data Science hype – and getting past the hype, Why now? – Datafication, Current landscape of perspectives, Skill sets. NeededStatistical Inference: Populations and samples, Statistical modelling, probability distributions, fitting a model, - Introduction to R

Module-2

Exploratory Data Analysis and the Data Science Process: Basic tools (plots, graphs and summary statistics) of EDA, Philosophy of EDA,The Data Science Process, Case Study: RealDirect (online real estate firm). Three Basic Machine Learning Algorithms: Linear Regression, k-Nearest Neighbours (k-NN), k-means

Module-3

One More Machine Learning Algorithm and Usage in Applications: Motivating application: Filtering Spam, Why Linear Regression and k-NN are poor choices for Filtering Spam, Naive Bayes and why it works for Filtering Spam, Data Wrangling: APIs and other tools for scrapping the Web

Module-4

Feature Generation and Feature Selection (Extracting Meaning from Data): Motivating application: user (customer) retention. Feature Generation (brainstorming, role of domain expertise, and place for imagination), Feature Selection algorithms. Filters; Wrappers; Decision Trees; Random Forests. Recommendation Systems: Building a User-Facing Data Product, Algorithmic ingredients of a Recommendation Engine, Dimensionality Reduction, Singular Value Decomposition, Principal Component Analysis, Exercise: build your own recommendation system

Module-5

Mining Social-Network Graphs: Social networks as graphs, Clustering of graphs, Direct discovery of communities in graphs, Partitioning of graphs, Neighbourhood properties in graphs, Data Visualization: Basic principles, ideas and tools for data visualization. Data Science and Ethical Issues, Discussions on privacy, security, ethics, Next-generation data scientists

Course outcomes:
At the end of the course the student will be able to:

- Define data science and its fundamentals
- Demonstrate the process in data science
- Explain machine learning algorithms necessary for data sciences
- Illustrate the process of feature selection and analysis of data analysis algorithms
- Visualize the data and follow of ethics

Question paper pattern:
The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbook/ Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Doing Data Science	Cathy O'Neil and Rachel Schutt	Straight Talk from The Frontline.O'Reilly	2014
2	Mining of Massive Datasets. V2.1	Jure Leskovek, AnandRajaraman and Jeffrey Ullman	Cambridge University Press	2014
Reference Books				
1	Machine Learning: A Probabilistic Perspective	Kevin P. Murphy		2013
2	Data Mining: Concepts and Techniques	Jiawei Han, MichelineKamber and Jian Pei	ThirdEdition	2012.
3	Practical Statistics for Data Scientists	Peter Bruce and Andrew Bruce	O'reilly series	

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SEMESTER – II

SEMANTIC WEB AND SOCIAL NETWORKS

Course Code	**20SCS22,** 20LNI12, 20SAM332	CIE Marks	40
Teaching Hours/Week (L:P:S)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Web Intelligence Thinking and Intelligent Web Applications, The Information age,The World Wide Web, Limitations of Today's Web, The Next Generation Web, Machine Intelligence, Artificial Intelligence, Ontology, Inference engines, Software Agents, Berners-Lee www, Semantic Road Map, Logic on the semantic Web.

Module 2

Knowledge Representation for the Semantic Web Ontologies and their role in the semantic web, Ontologies Languages for the Semantic Web – Resource Description Framework(RDF) / RDF Schema, Ontology Web Language(OWL), UML, XML/XML Schema.

Module 3

Ontology Engineering, Ontology Engineering, Constructing Ontology, Ontology Development Tools, Ontology Methods, Ontology Sharing and Merging, Ontology Libraries and Ontology Mapping, Logic, Rule and Inference Engines.

Module 4

Semantic Web Applications, Services and Technology Semantic Web applications and services, Semantic Search, e-learning, Semantic Bioinformatics, Knowledge Base, XML Based Web Services, Creating an OWL-S Ontology for Web Services, Semantic Search Technology, Web Search Agents and Semantic Methods.

Module 5

Social Network Analysis and semantic web What is social Networks analysis, development of the social networks analysis, Electronic Sources for Network Analysis – Electronic Discussion networks, Blogs and Online Communities, Web Based Networks. Building Semantic Web Applications with social network features.

Course outcomes:

At the end of the course the student will be able to:

- Demonstrate the semantic web technologies like RDF Ontology and others
- Learn the various semantic web applications
- Identify the architectures and challenges in building social networks
- Analyse the performance of social networks using electronic sources

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbook/ Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Thinking on the Web	Berners Lee, Godel and Turing	Wiley inter science	2008
2	Social Networks and the Semantic Web	Peter Mika	Springer	2007
Reference Books				
1	Semantic Web and Semantic Web Services	Liyang Lu Chapman and Hall	CRC Publishers	
2	Semantic Web Technologies, Trends and Research in Ontology Based Systems.			
3	Programming the Semantic Web	T.Segaran, C.Evans, J.Taylor	O'Reilly.	

M.TECH IN **COMPUTER NETWORK ENGINEERING (SCN), COMPUTER SCIENCE & ENGINEERING(SCS) ARTIFICIAL INTELLIGENCE & MACHINE LEARNING(SAM)**

Choice Based Credit System (CBCS) and Outcome Based Education (OBE) SEMESTER - I

BLOCKCHAIN TECHNOLOGY

Course Code	20SCN15, 20SCS23, 20SAM254,	CIE Marks	40
Teaching Hours/Wee(L:P:S)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Course Objectives:

The blockchain technology course allows the students to explore the driving force behind the cryptocurrency Bitcoin. Along with the Decentralization, Cryptography, Bitcoins with its alternative coins, Smart contracts and outside of currencies.

Module-1

Blockchain 101: Distributed systems, History of blockchain, Introduction to blockchain, Types of blockchain, CAP theorem and blockchain, Benefits and limitations of blockchain.

Module-2

Decentralization and Cryptography:
Decentralization using blockchain, Methods of decentralization, Routes to decentralization, Decentralized organizations. Cryptography and Technical Foundations: Cryptographic primitives, Asymmetric cryptography, Public and private keys

Module-3

Bitcoin and Alternative Coins A: Bitcoin, Transactions, Blockchain, Bitcoin payments B: Alternative Coins, Theoretical foundations, Bitcoin limitations, Namecoin, Litecoin, Primecoin, Zcash

Module-4

Smart Contracts and Ethereum 101: Smart Contracts: Definition, Ricardian contracts. Ethereum 101:Introduction, Ethereum blockchain, Elements of the Ethereum blockchain, Precompiled contracts.

Module-5

Alternative Blockchains: Blockchains Blockchain-Outside of Currencies: Internet of Things, Government, Health, Finance, Media

Course outcomes:

At the end of the course the student will be able to:

1. Understand the types, benefits and limitation of blockchain.
2. Explore the blockchain decentralization and cryptography concepts.
3. Enumerate the Bitcoin features and its alternative options.
4. Describe and deploy the smart contracts
5. Summarize the blockchain features outside of currencies.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.
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Textbook/ Textbooks

1 Mastering Blockchain - Distributed ledgers, decentralization and smart contracts explained, Author- Imran Bashir, Packt Publishing Ltd, Second Edition, ISBN 978-1- 78712-544-5, 2017

Reference Books

1 Bitcoin and Cryptocurrency Technologies, Author- Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, Steven Goldfeder, Princeton University, 2016

2 Blockchain Basics: A Non-Technical Introduction in 25 Steps, Author- Daniel Drescher, Apress, First Edition, 2017

3 Mastering Bitcoin: Unlocking Digital Cryptocurrencies, Andreas M. Antonopoulos, O'Reilly Media, First Edition, 2014

M.TECH IN COMPUTER SCIENCE AND ENGINEERING (SCS) **Choice Based Credit System (CBCS) and Outcome Based Education (OBE)**			
ADVANCED CRYPTOGRAPHY			
Course Code	**20SCS241**, 20LNI254	CIE Marks	40
Teaching Hours/Week (L:P:S)	4:0:0	SEE Marks	60
Credits	04	Exam Hours	03
Module-1			
Number Theory: Introduction to number theory, Overview of modular arithmetic, discrete logarithms, and primality/factoring, Euclid's algorithm, Finite fields, Prime numbers, Fermat's and Euler's theorem-Testing for primality.			
Module-2			
Symmetric & Asymmetric Cryptography: Classical encryption techniques, Block cipher design principles and modes of operation, Data encryption standard, Evaluation criteria for AES, AES cipher, Principles of public key cryptosystems, The RSA algorithm, Key management – Diffie Hellman Key exchange, Elliptic curve arithmetic-Elliptic curve cryptography.			
Module-3			
Authentication functions:MAC,Hash function, Security of hash function and MAC,MD5,SHA,HMAC, CMAC, Digital signature and authentication protocols, DSS,EI Gamal – Schnorr.			
Module-4			
Authentication applications: Kerberos & X.509 Authentication services Internet Firewalls for Trusted System: Roles of Firewalls , Firewall related terminology-,Types of Firewalls ,Firewall designs, Intrusion detection system , Virus and related threats, Countermeasures , Firewalls design principles ,Trusted systems, Practical implementation of cryptography and security.			
Module-5			
Quantum Cryptography and Quantum Teleportation: Heisenberg uncertainty principle, polarization states of photons, quantum cryptography using polarized photons, local vs. nonlocal interactions,			

entanglements, EPR paradox, Bell's theorem, Bell basis, teleportation of a single qubit theory and experiments.

Course outcomes:

At the end of the course the student will be able to:

- Understand OSI security architecture and classical encryption techniques.
- Acquire fundamental knowledge on the concepts of finite fields and number theory.
- Understand various block cipher and stream cipher models.
- Describe the principles of public key cryptosystems, hash functions and digital signature.
- Compare various Cryptographic Techniques
- Design Secure applications
- Inject secure coding in the developed applications

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbook/ Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Cryptography and Network Security Principles And Practice	William Stallings	Pearson Education	Fourth Edition
2	A Course in Number Theory and Cryptology	Neal Koblitz	Springer	1987
Reference Books				
1	Cryptography and Network Security	Behrouz A Forouzan, DebdeepMukhopadhyay	Mc-GrawHill	3rd Edition, 2015
2	Applied Cryptography and Network Security	Damien Vergnaud and Michel Abdalla	7th International Conference, ACNS 2009, Paris-Rocquencourt, France	June 2-5, 2009, Proceedings
3	**Quantum Computation and Quantum Information**	**Michael A. Nielsen and Issac L Chuang**	**Cambridge University Press**	**10th Anniversary Edition Hardcover – Illustrated 2010**

M.TECH IN COMPUTER SCIENCE AND ENGINEERING (SCS)
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SEMESTER - II

NATURAL LANGUAGE PROCESSING

Course Code	**20SCS242**, 20SCE243, 20SAM23	CIE Marks	40
Teaching Hours/Week (L:P:S)	4:0:0	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

OVERVIEW AND LANGUAGE MODELING: Overview: Origins and challenges of NLP-Language and Grammar-Processing Indian Languages- NLP Applications-Information Retrieval. Language Modeling: Various Grammar- based Language Models-Statistical Language Model.

Module -2

WORD LEVEL AND SYNTACTIC ANALYSIS: Word Level Analysis: Regular Expressions-Finite-

State Automata-Morphological Parsing-Spelling Error Detection and correction-Words and Word classes-Part-of Speech Tagging. Syntactic Analysis: Context-free Grammar-Constituency- Parsing-Probabilistic Parsing.

Module - 3

Extracting Relations from Text: From Word Sequences to Dependency Paths: Introduction, Subsequence Kernels for Relation Extraction, A Dependency-Path Kernel for Relation Extraction and Experimental Evaluation. Mining Diagnostic Text Reports by Learning to Annotate Knowledge Roles: Introduction, Domain Knowledge and Knowledge Roles, Frame Semantics and Semantic Role Labelling, Learning to Annotate Cases with Knowledge Roles and Evaluations. A Case Study in Natural Language Based Web Search: InFact System Overview, The GlobalSecurity.org Experience.

Module-4

Evaluating Self-Explanations in iSTART: Word Matching, Latent Semantic Analysis, and Topic Models: Introduction, iSTART: Feedback Systems, iSTART: Evaluation of Feedback Systems, Textual Signatures: Identifying Text-Types Using Latent Semantic Analysis to Measure the Cohesion of Text Structures: Introduction, Cohesion, Coh-Metrix, Approaches to Analysing Texts, Latent Semantic Analysis, Predictions, Results of Experiments. Automatic Document Separation: A Combination of Probabilistic Classification and Finite-State Sequence Modelling: Introduction, Related Work, Data Preparation, Document Separation as a Sequence Mapping Problem, Results. Evolving Explanatory Novel Patterns for Semantically based Text Mining: Related Work, A Semantically Guided Model for Effective Text mining.

Module-5

INFORMATION RETRIEVAL AND LEXICAL RESOURCES: Information Retrieval: Design features of Information Retrieval Systems-Classical, Non classical, Alternative Models of Information Retrieval – valuation Lexical Resources: World Net-Frame Net- Stemmers-POS Tagger- Research Corpora.

Course outcomes:

At the end of the course the student will be able to:

- Analyse the natural language text.
- Generate the natural language.
- Demonstrate Text mining.
- Apply information retrieval techniques.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbook/ Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Natural Language Processing and Information Retrieval	TanveerSiddiqui, U.S. Tiwary	Oxford University Press	2008
2	Anne Kao and Stephen R. Potee	Natural LanguageProcessing andText Mining	Springer-Verlag London Limited	2007

Reference Books

1	Speech and Language Processing: Anintroduction to Natural Language Processing, Computational Linguistics and SpeechRecognition	Daniel Jurafsky and James H Martin	Prentice Hall	2008 2nd Edition
2	Natural Language Understanding	James Allen	Benjamin/Cummingsp ublishing company	2nd edition, 1995
3	Information Storage and Retrieval systems	Gerald J. Kowalski and Mark.T.	Kluwer academic Publishers	2000.

		Maybury		
4	Natural Language Processing with Python	Steven Bird, Ewan Klein, Edward Loper	O'Reilly Media	2009
5	Foundations of Statistical Natural Language Processing	Christopher D.Manning and HinrichSchutze	MIT Press	1999

M.TECH IN COMPUTER SCIENCE AND ENGINEERING (SCS)
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SEMESTER – II

CLOUD COMPUTING

Course Code	**20SCS243**, 20LNI15, 20SCE14, 20SIT22, 20SSE251, 20SCN31, 20SIS12	CIE Marks	40
Teaching Hours/Week (L:P:S)	4:0:0	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Introduction, Cloud Infrastructure: Cloud computing, Cloud computing delivery models and services, Ethical issues, Cloud vulnerabilities, Cloud computing at Amazon, Cloud computing the Google perspective, Microsoft Windows Azure and online services, Open-source software platforms for private clouds, Cloud storage diversity and vendor lock-in, Energy use and ecological impact, Service level agreements, User experience and software licensing. Exercises and problems.

Module 2

Cloud Computing: Application Paradigms.: Challenges of cloud computing, Architectural styles of cloud computing, Workflows: Coordination of multiple activities, Coordination based on a state machine model: The Zookeeper, The Map Reduce programming model, A case study: The Gre The Web application, Cloud for science and engineering, High-performance computing on a cloud, Cloud computing for Biology research, Social computing, digital content and cloud computing.

Module 3

Cloud Resource Virtualization: Virtualization, Layering and virtualization, Virtual machine monitors, Virtual Machines, Performance and Security Isolation, Full virtualization and paravirtualization, Hardware support for virtualization, Case Study: Xen a VMM based paravirtualization, Optimization of network virtualization, vBlades, Performance comparison of virtual machines, The dark side of virtualization, Exercises and problems

Module 4

Cloud Resource Management and Scheduling: Policies and mechanisms for resource management, Application of control theory to task scheduling on a cloud, Stability of a two-level resource allocation architecture, Feedback control based on dynamic thresholds, Coordination of specialized autonomic performance managers, A utility-based model for cloud-based Web services, Resourcing bundling: Combinatorial auctions for cloud resources, Scheduling algorithms for computing clouds, Fair queuing, Start-time fair queuing, Borrowed virtual time, Cloud scheduling subject to deadlines, Scheduling MapReduce applications subject to deadlines, Resource management and dynamic scaling, Exercises and problems.

Module 5

Cloud Security, Cloud Application Development: Cloud security risks, Security: The top concern for cloud users, Privacy and privacy impact assessment, Trust, Operating system security, Virtual machine Security, Security of virtualization, Security risks posed by shared images, Security risks posed by a management OS, A trusted virtual machine monitor, Amazon web services: EC2 instances, Connecting clients to cloud instances through firewalls, Security rules for application and transport layer protocols in EC2, How to launch an EC2 Linux instance and connect to it, How to use S3 in java, Cloud-based simulation of a distributed trust algorithm, A trust management service, A cloud service for adaptive data streaming, Cloud based optimal FPGA synthesis .Exercises and problems.

Course outcomes:
At the end of the course the student will be able to:

- Compare the strengths and limitations of cloud computing

- Identify the architecture, infrastructure and delivery models of cloud computing
- Apply suitable virtualization concept.
- Choose the appropriate cloud player
- Address the core issues of cloud computing such as security, privacy and interoperability
- Design Cloud Services
- Set a private cloud

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbook/ Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Cloud Computing Theory and Practice	Dan C Marinescu	Elsevier(MK)	2013.
Reference Books				
1	RajkumarBuyya , James Broberg, AndrzejGoscinski	Computing Principles and Paradigms	Willey	2014
2	Cloud Computing Implementation, Management and Security	John W Rittinghouse, James F Ransome	CRC Press	2013

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SEMESTER - II

PATTERN RECOGNITION

Course Code	**20SCS244**, 20SCE242, 20SAM253	CIE Marks	40
Teaching Hours/Week (L:P:S)	4:0:0	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Introduction: Definition of PR, Applications, Datasets for PR, Different paradigms for PR, Introduction to probability, events, random variables, Joint distributions and densities, moments. Estimation minimum risk estimators, problems

Module -2

Representation: Data structures for PR, Representation of clusters, proximity measures, size of patterns, Abstraction of Data set, Feature extraction, Feature selection, Evaluation

Module – 3

Nearest Neighbour based classifiers & Bayes classifier: Nearest neighbour algorithm, variants of NN algorithms, use of NN for transaction databases, efficient algorithms, Data reduction, prototype selection, Bayes theorem, minimum error rate classifier, estimation of probabilities, estimation of probabilities, comparison with NNC, Naive Bayes classifier, Bayesian belief network

Module-4

Naive Bayes classifier, Bayesian belief network, Decision Trees: Introduction, DT for PR, Construction of DT, splitting at the nodes, Over fitting & Pruning, Examples , Hidden Markov models: Markov models for classification, Hidden Markov models and classification using HMM

Module-5

Clustering: Hierarchical (Agglomerative, single/complete/average linkage, wards, Partitional (Forgy's, k-means, Isodata), clustering large data sets, examples, An application: Handwritten Digit recognition

Course outcomes:
At the end of the course the student will be able to:

- Explain pattern recognition principals
- Develop algorithms for Pattern Recognition.
- Develop and analyse decision tress.
- Design the nearest neighbour classifier.
- Apply Decision tree and clustering techniques to various applications

Question paper pattern:
The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbook/ Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Pattern Recognition (An Introduction)	V Susheela Devi, M Narsimha Murthy	Universities Press	2011
2	Pattern Recognition & Image Analysis	Earl Gose, Richard Johnsonbaugh, Steve Jost	PH	1996.
Reference Books				
1	Pattern Classification	Duda R. O., P.E. Hart, D.G. Stork	John Wiley and sons	2000.

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SEMESTER - II

IMAGE PROCESSING AND MACHINE VISION

Course Code	**20SCS251**	CIE Marks	40
Teaching Hours/Week (L:P:S)	4:0:0	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Introduction and Digital Image Fundamentals
Motivation & Perspective, Applications, Components of Image Processing System, Fundamentals Steps in Image 20% Processing, Image Sampling and Quantization, Some basic relationships like Neighbours, Connectivity, Distance Measures between pixels

Module-2

Image Enhancement in the Spatial and Frequency Domain
Image enhancement by point processing, Image enhancement by neighbourhood processing, Basic Grey Level 20% Transformations, Histogram Processing, Enhancement Using Arithmetic and Logic operations, Zooming, Basics of Spatial Filters, Smoothening and Sharpening Spatial Filters, Combining Spatial Enhancement Methods. Introduction to Fourier Transform and the frequency Domain, Smoothing and Sharpening Frequency Domain Filters, Homomorphic Filtering

Module-3

Image Restoration and Image Compression
Model of The Image Degradation / Restoration Process, Noise Models, Restoration in the presence of Noise Only Spatial Filtering, Periodic Noise Reduction by Frequency Domain Filtering, Linear Position-Invariant Degradations, Estimation of Degradation Function, Inverse filtering, Wiener filtering, Constrained Least Square Filtering, Geometric Mean Filter, Geometric Transformations. Data Redundancies, Image Compression models, Elements of Information Theory, Lossless and Lossy compression, Huffman Coding, Shanon-Fano Coding, Arithmetic Coding, Golomb Coding, LZW Coding, Run Length Coding, Loss less predictive Coding, Bit Plane Coding, Image compression standards.

Module-4

Image Segmentation and Morphological Image Processing

Discontinuity based segmentation, similaritybased segmentation, Edge linking and boundary detection, 20% Threshold, Region based Segmentation Introduction to Morphology, Dilation, Erosion, Some basic Morphological Algorithms

Module-5

Object Representation and description and Computer Vision Techniques

Introduction to Morphology, Some basic Morphological Algorithms, Representation, Boundary Descriptors, Regional Descriptors, Chain Code, Structural Methods. Review of Computer Vision applications; Fuzzy-Neural algorithms for computer vision applications

Course outcomes:

At the end of the course the student will be able to:

- Explain the fundamentals of image processing and computer vision
- Illustrate the image enhancement techniques
- Illustrate Image restoration and image compression technique
- Tell about image segmentation and morphological image processing
- Summarize computer vision techniques and its uses

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbook/ Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Digital Image Processing	Rafael C. Gonzalez & Richard E. Woods	Pearson Education	3rd edition
2	Computer Vision: A Modern Approach	David A. Forsyth, Jean Ponce	Prentice Hall	
3	Fundamental of Digital Image Processing	A.K. Jain	PHI	
Reference Books				
1	Digital Image Processing	W.K. Pratt		

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SEMESTER - II

OBJECT ORIENTED DESIGN

Course Code	**20SCS252,** 20SCN254M 20SIS242	CIE Marks	40
Teaching Hours/Week (L:P:S)	4:0:0	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

The Motivation for Object-Oriented Programming, Classes and Objects: The Building Blocks of the Object-Oriented ParadigmTopologies of Action-Oriented Versus Object-Oriented Applications,

Module-2

The Relationships Between Classes and ObjectsThe Inheritance Relationship

Module-3

Multiple Inheritance, The Association Relationship,

Module-4

Class-Specific Data and Behaviour, Physical Object-Oriented Design,

Module-5

The Relationship Between Heuristics and Patterns, The Use of Heuristics in Object-Oriented Design

Course outcomes:

At the end of the course the student will be able to:

- Identify the heuristics of the object-oriented programming
- Explain the fundamentals of OOP
- Examine fine object-oriented relations
- Explain the role of Physical Object-Oriented Design,
- Make use of Heuristics in The Use of Heuristics in Object-Oriented Design

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbook/ Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Object Oriented Design Heuristics	Arthur J Riel	Addison-Wesley	1996
Reference Books				
1	Elements of Reusable Object-Oriented Software	Ralph Johnson, Erich Gamma, Richard Helm, John Vlissides	Pearson	
2	Object - Oriented Modeling and Design With UM	Paperback, Michael R. Blaha)	Pearson	2007

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SEMESTER - II

SOFTWARE DEFINED NETWORKS

Course Code	**20SCS253**, 20LNI31, 20SCE333, 20SCN243, 20SAM324, 20SIS243	CIE Marks	40
Teaching Hours/Week (L:P:S)	4:0:0	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Introduction, Centralized and Distributed Control and Data Planes, OpenFlow

Module-2

SDN Controllers, Network Programmability,

Module-3

Data Centre Concepts and Constructs, Network Function Virtualization

Module-4

Network Topology and Topological Information Abstraction, Building an SDN Framework

Module-5

Use Cases for Bandwidth Scheduling, Manipulation, and Calendaring, Use Cases for Input Traffic Monitoring, Classification, and Triggered Actions

Course outcomes:

At the end of the course the student will be able to:

- Explain the fundamentals of SDN and make use of open flow tool
- Illustrate the concepts of controllers and network programmability
- Explain data centre and NFV
- Build an SDN framework
- Report use case

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbook/ Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	SDN: Software Defined Networks	Ken Gray, Thomas D. Nadeau	O'Reilly	2013
Reference Books				
2	Software Defined Networks	Paul Goransson Chuck Black Timothy Culver	Elsevier	2nd Edition 2016

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SEMESTER - II

MODERN COMPUTER ARCHITECTURE

Course Code	**20SCS254**	CIE Marks	40
Teaching Hours/Week (L:P:S)	4:0:0	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Fundamentals of Computer Design, Pipelining, ILP Introduction; Classes of computers; Defining computer architecture; Trends in Technology, power in Integrated Circuits and cost; Dependability; Measuring, reporting and summarizing Performance; Quantitative Principles of computer design. Introduction; Pipeline hazards; Implementation of pipeline; What makes pipelining hard to implement? Instruction –Level Parallelism – 1 ILP: Concepts and challenges; Basic Compiler Techniques for exposing ILP; Reducing Branch costs with prediction; Overcoming Data hazards with Dynamic scheduling; Hardware-based speculation. Instruction –Level Parallelism – 2 Exploiting ILP using multiple issue and static scheduling; Exploiting ILP using dynamic scheduling, multiple issue and speculation; Advanced Techniques for instruction delivery and Speculation; The Intel Pentium 4 as example.

Module-2

Review of Memjory Hierarchy, Memory Hierarchy design Introduction; Cache performance; Cache Optimizations, Virtual memory, Introduction; Advanced optimizations of Cache performance; Memory technology and optimizations; Protection: Virtual memory and virtual machines.

Module-3

Theory of Parallelism Parallel Computer Models, The State of Computing, Multiprocessors and Multicomputer, Multivector and SIMD Computers, PRAM and VLSI Models, Program and Network Properties, Conditions of Parallelism, Program Partitioning and Scheduling, Program Flow Mechanisms, System Interconnect Architectures, Principles of Scalable Performance, Performance Metrics and Measures, Parallel Processing Applications, Speedup Performance Laws. For all Algorithm or mechanism any one example is sufficient.

Module-4

Hardware Technologies Processors and Memory Hierarchy, Advanced Processor Technology,

Superscalar and Vector Processors, Memory Hierarchy Technology, Virtual Memory Technology. For all Algorithms or mechanisms any one example is sufficient. Bus Systems, Cache Memory Organizations, Shared Memory Organizations, Sequential and Weak Consistency Models, Pipelining and Superscalar Techniques, Linear Pipeline Processors, Nonlinear Pipeline Processors. For all Algorithms or mechanisms any one example is sufficient

Module-5

Parallel and Scalable Architectures Multiprocessors and Multicomputers, Multiprocessor System Interconnects, Cache Coherence and Synchronization Mechanisms, MessagePassing Mechanisms, Multivector and SIMD Computers, Vector Processing Principles, Multivector Multiprocessors, Compound Vector Processing, Scalable, Multithreaded, and Dataflow Architectures, Latency-Hiding Techniques, Principles of Multithreading, FineGrainMulticomputers. For all Algorithms or mechanisms any one example is sufficient.

Course outcomes:

At the end of the course the student will be able to:

- Explain the fundamentals of Fundamentals of Computer Design, Pipelining, ILP
- Summarize the concept of memory
- Abstracting the concept of parallelism
- Summarize the hardware technologies
- Outlineparallel and scalable architectures

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbook/ Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Advanced Computer Architecture (SIE): Parallelism, Scalability, Programmability	Kai Hwang and NareshJotwani	McGraw Hill Education	3/e. 2015
2	Computer Architecture: A quantitative approach	John L. Hennessy and David A. Patterson	Morgan Kaufmann Elseveir	5th edition 2013
Reference Books				
1	Computer Systems and Design and Architecture	Vincent Heuring, et al	Pearson Education	2nd edition, 2009

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SEMESTER – II

DATA SCIENCE LABORATORY

Course Code	**20SCSL26**	CIE Marks	40
Teaching Hours/Week (L:P:S)	0:4:0	SEE Marks	60
Credits	02	Exam Hours	03

The purpose of this laboratory is to get you acquainted with Python/R and use them in implementing Data Science and Algorithms.

Data Sets

Iris

Iris is a particularly famous *toy dataset* (i.e. a dataset with a small number of rows and columns, mostly used for initial small-scale tests and proofs of concept). This specific dataset contains information about the Iris, a genus that includes 260-300 species of plants. The Iris dataset contains measurements for 150 Iris flowers, each belonging to one of three species: Virginica, Versicolor and Setose. (50 flowers for each of the three species). Each of the 150 flowers contained in the Iris dataset is represented by 5 values:

- Sepal length, in cm
- Sepal width, in cm
- petal length, in cm
- petal width, in cm

Iris species, one of: iris-setose, iris-versicolor, iris-virginica. Each row of the dataset represents a distinct flower (as such, the dataset will have 150 rows). Each row then contains 5 values (4 measurements and a species label). The dataset is described in more detail on the UCI Machine Learning Repository website. The dataset can either be downloaded directly from there (iris.data file), or from a terminal, using the *wget* tool. The following command downloads the dataset from the original URL and stores it in a file named iris.csv.

```
$ wget "https://archive.ics.uci.edu/ml/machine-learning-databases/iris/iris.data" -O iris.csv
```

Citybik.es

Citybik.es is a website that offers an Application Programming Interface (or API, for short) for the usage of bike-sharing services throughout the world. Among the others, data for one of Turin's bike sharing system is available. The information available is at a "station" granularity. This means that all the data available regards the bike stations: some of the useful information available is the station name, its position (in terms of latitude and longitude), the number of available bikes and the number of free docks. The data is offered in near real-time (i.e. it is updated every 15-30 minutes).

The API endpoint to request the data about for the Bike service is the following: http://api.citybik.es/v2/networks/to-bike. This dataset is in the JSON (JavaScript Object Notation) format.

MNIST

The MNIST dataset is another particularly famous dataset as CSV file. It contains several thousands of hand-written digits (0 to 9). Each hand-written digit is contained in a 28 × 28 8-bit grayscale image. This means that each digit has 784 (28^2) pixels, and each pixel has a value that ranges from 0 (black) to 255 (white). The dataset can be downloaded from the following URL: https://raw.githubusercontent.com/dbdmg/data-science-lab/master/datasets/mnist_test.csv. Each row of the MNIST datasets represents a digit. For the sake of simplicity, this dataset contains only a small fraction (10,000 digits out of 70,000) of the real MNIST dataset, which is known as the MNIST test set. For each digit, 785 values are available.

Exercises

1. **Iris dataset**

Load the Iris dataset as a list of lists (each of the 150 lists should have 5 elements). Compute and print the mean and the standard deviation for each of the 4 measurement columns (i.e. sepal length and width, petal length and width). Compute and print the mean and the standard deviation for each of the 4 measurement columns, separately for each of the three Iris species (Versicolor, Virginica and Setose). Which measurement would you consider "best", if you were to guess the Iris species based only on those four values?

2. **Citybik.es dataset**

Load the Citybik.es dataset as a Python dictionary. Use of the json module. Count and print the number of active stations (a station is active if its extra.status field is "online"). Count and print the total number of

bikes available (field free_bikes) and the number of free docks (field empty_slots) throughout all stations. Given the coordinates (latitude, longitude) of a point (e.g. 45.074512, 7.694419), identify the closest bike station to it that has available bikes. For computing the distance among two points (given their coordinates), you can use the function distance_coords() defined in the code snippet below (which is an implementation of the great-circle distance):

```
from math import cos, acos, sin
defdistance_coords(lat1, lng1, lat2, lng2):
    """Compute the distance among two points."""
    deg2rad = lambda x: x * 3.141592 / 180
    lat1, lng1, lat2, lng2 = map(deg2rad, [ lat1, lng1, lat2, lng2 ])
    R = 6378100 # Radius of the Earth, in meters
    return R * acos(sin(lat1) * sin(lat2) + cos(lat1) * cos(lat2) * cos(lng1 - lng2))
```

3. **MNIST dataset**

Load the MNIST dataset. Create a function that, given a position $1 \leq k \leq 10,000$, prints the k^{th} digit of the dataset (i.e. the k^{th} row of the csv file) as a grid of 28×28 characters. More specifically, you should map each range of pixel values to the following characters:

[0, 64) → " "
[64, 128) → "."
[128, 192) → "*"
[192, 256) → "#"

Compute the Euclidean distance between each pair of the 784-dimensional vectors of the digits at the following positions: 26^{th}, 30^{th}, 32^{nd}, 35^{th}. Based on the distances computed in the previous step and knowing that the digits listed are 7, 0, 1, 1, can you assign the correct label to each of the digits ?

4. **Tips dataset**

Read the dataset "Tips.csv" as a dataframe "Data". Extract the columns in the following sequence - Time, TotalBill, Tips. Plot a histogram for the variable 'TotalBill' to check which range has the highest frequency. Draw a bar chart for the variable "Day". Identify the category with the maximum count. Demonstrate the data distributions using box, scatter plot, histogram, and bar chart on iris dataset. Demonstrate the correlation plot on iris dataset and perform exploratory visualization giving an overview of relationships among data with covariance analysis.

5. Split the **Iris** dataset into two the datasets - **IrisTest_TrainData.csv, IrisTest_TestData.csv.** Read them as two separate data frames named Train_Data and Test_Data respectively.

   Answer the following questions:
   - How many missing values are there in **Train_Data**?
   - What is the proportion of Setosa types in the **Test_Data**?
   - What is the accuracy score of the K-Nearest Neighbor model (model_1) with 2/3 neighbors using **Train_Data** and **Test_Data**?
   - Identify the list of indices of misclassified samples from the '**model_1**'.
   - Build a logistic regression model (model_2) keeping the modelling steps constant. Find the accuracy of the model_2

6. Import a dataset from **http://www.ats.ucla.edu/stat/data/binary.csv**. Do the Logistic Regression to find out relation between variables that are affecting the admission of a student in a institute based on his or her GRE score, GPA obtained and rank of the student. Also check the model is fit or not. Apply regression Model techniques to predict the data on above dataset

7. Demonstrate Decision tree classification model and Evaluate the performance of classifier on **Iris**

dataset. **8.** Demonstrate any of the Clustering model and Evaluate the performance on **Iris dataset**.
Course outcomes: At the end of the course the student will be able to:
• Demonstration of data visualization methods • Understanding and implementation of data science algorithms
Conduction of Practical Examination: All laboratory experiments (nos) are to be included for practical examination. Students are allowed to pick one experiment from **the list** Strictly follow the instructions as printed on the cover page of answer script for breakup of marks **Change of experiment is allowed only once and marks allotted to the procedure part to be made zero.**

TECHNICAL SEMINAR			
Course Code	20SCS27	CIE Marks	100
Number of contact Hours/week (L:P:SDA)	0:0:2	SEE Marks	--
Credits	02	Exam Hours	--

Course objectives:

The objective of the seminar is to inculcate self-learning, face audience confidently, enhance communication skill, involve in group discussion and present and exchange ideas.

Each student, under the guidance of a Faculty, is required to

- Choose, preferably through peer reviewed journals, a recent topic of his/her interest relevant to the Course of Specialization.
- Carryout literature survey, organize the Course topics in a systematic order.
- Prepare the report with own sentences.
- Type the matter to acquaint with the use of Micro-soft equation and drawing tools or any such facilities.
- Present the seminar topic orally and/or through power point slides.
- Answer the queries and involve in debate/discussion.
- Submit two copies of the typed report with a list of references.

The participants shall take part in discussion to foster friendly and stimulating environment in which the students are motivated to reach high standards and become self-confident.

The CIE marks for the seminar shall be awarded (based on the relevance of the topic, presentation skill, participation in the question and answer session and quality of report) by the committee constituted for the purpose by the Head of the Department. The committee shall consist of three faculties from the department with the senior most acting as the Chairperson.

Marks distribution for CIE of the course 20XXX27 seminar:

Seminar Report: 30 marks

Presentation skill:50 marks

Question and Answer:20 marks

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SEMESTER - III

DEEP LEARNING

Course Code	**20SCS31,** 20SAM31, 20SIS334	CIE Marks	40
Teaching Hours/Week (L:P:S)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Machine Learning Basics: Learning Algorithms, Capacity, Overfitting and Underfitting, Hyperparameters and Validation Sets, Estimator, Bias and Variance, Maximum Likelihood Estimation, Bayesian Statistics, Supervised Learning Algorithms, Unsupervised Learning Algorithms, Stochastic Gradient Decent, building a Machine Learning Algorithm, Challenges Motivating Deep Learning.

Module-2

Deep Feedforward Networks: Gradient-Based Learning, Hidden Units, Architecture Design, Back-Propagation. **Regularization:** Parameter Norm Penalties, Norm Penalties as Constrained Optimization, Regularization and Under-Constrained Problems, Dataset Augmentation, Noise Robustness, Semi-Supervised Learning, Multi-Task Learning, Early Stopping, Parameter Tying and Parameter Sharing, Sparse Representations, Bagging, Dropout.

Module-3

Optimization for Training Deep Models: How Learning Differs from Pure Optimization, Challenges in Neural Network Optimization, Basic Algorithms. Parameter Initialization Strategies, Algorithms with Adaptive Learning Rates. **Convolutional Networks:** The Convolution Operation, Motivation, Pooling, Convolution and Pooling as an Infinitely Strong Prior, Variants of the Basic Convolution Function, Structured Outputs, Data Types, Efficient Convolution Algorithms, Random or Unsupervised Features.

Module-4

Sequence Modelling: Recurrent and Recursive Nets: Unfolding Computational Graphs, Recurrent Neural Networks, Bidirectional RNNs, Encoder-Decoder Sequence-to-Sequence Architectures, Deep Recurrent Networks, Recursive Neural Networks. Long short-term memory

Module-5

Practical Methodology: Performance Metrics, Default Baseline Models, Determining Whether to Gather More Data, Selecting Hyperparameters, Debugging Strategies, Example: Multi-Digit Number Recognition. **Applications:** Vision, NLP, Speech.

Course outcomes:
At the end of the course the student will be able to:

- Identify the deep learning algorithms which are more appropriate for various types of learning tasks in various domains.
- Implement deep learning algorithms and solve real-world problems.
- Execute performance metrics of Deep Learning Techniques.

Question paper pattern:
The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbook/ Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Deep Learning	Lan Good fellow and YoshuaBengio	MIT Press https://www.deeplearningbook.org/	2016.

		and Aaron Courville		
Reference Books				
1	Neural Networks:Asystematic Introduction	Raúl Rojas		1996.
2	Pattern Recognition and machine Learning	Chirstopher Bishop		2007.

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SEMESTER - III

ENGINEERING ECONOMICS

Course Code	**20SCS321**	CIE Marks	40
Teaching Hours/Week (L:P:S)	4:0:0	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Economic Decisions Making, Economic Decisions Making – Overview, Problems, Role, Decision making process. Engineering Costs & Estimation – Fixed, Variable, Marginal & Average Costs, Sunk Costs, Opportunity Costs, Recurring And Nonrecurring Costs, Incremental Costs, Cash Costs vs Book Costs, Life-Cycle Costs; Types Of Estimate, Estimating Models - Per-Unit Model, Segmenting Model, Cost Indexes, Power-Sizing Model, Improvement & Learning Curve, Benefits. Case Study - Price and Income Elasticity of Demand in the real world

Module-2

Cash Flow, Interest and Equivalence: Cash Flow – Diagrams, Categories & Computation, Time Value of Money, Debt repayment, Nominal & Effective Interest.

Module-3

Cash Flow & Rate Of Return Analysis Calculations, Treatment of Salvage Value, Annual Cash Flow Analysis, Analysis Periods; Internal Rate Of Return, Calculating Rate of Return, Incremental Analysis; Best Alternative Choosing An Analysis Method, Future Worth Analysis, Benefit-Cost Ratio Analysis, Sensitivity And Breakeven Analysis. Economic Analysis In The Public Sector - Quantifying And Valuing Benefits & drawbacks. Case Study – Tata Motors

Module-4

Inflation and Price Change Definition, Effects, Causes, Price Change with Indexes, Types of Index, Composite vs Commodity Indexes, Use of Price Indexes in Engineering Economic Analysis, Cash Flows that inflate at different Rates.
Case Study – Competition in the Advertise Segment in India

Module-5

Present Worth Analysis: End-Of-Year Convention, Viewpoint of Economic Analysis Studies, Borrowed Money Viewpoint, Effect Of Inflation & Deflation, Taxes, Economic Criteria, Applying Present Worth Techniques, Multiple Alternatives.

Course outcomes:
At the end of the course the student will be able to:

- Describe the principles of economics that govern the operation of any organization under diverse market conditions
- Comprehend macroeconomic principles and decision making in diverse business set up
- Explain the Inflation & Price Change as well as Present Worth Analysis
- Apply the principles of economics through various case studies

Question paper pattern:
The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each

	module.			
Textbook/ Textbooks				
Sl No	**Title of the book**	**Name of the Author/s**	**Publisher Name**	**Edition and year**
1	Economics for Engineers	James L.Riggs,David D. Bedworth, Sabah U. Randhawa	Tata McGraw-Hill	
2	Engineering Economics Analysis	Donald Newnan, Ted Eschembach, Jerome Lavelle	OUP	
3	Principle of Engineering Economic Analysis	John A. White, Kenneth E.Case,DavidB.Pratt	John Wiley	
4	Engineering Economy	Sullivan and Wicks	Pearson	
Reference Books				
1	Engineering Economics	Riggs James	TMG	

M.TECH IN COMPUTER SCIENCE AND ENGINEERING (SCS) **Choice Based Credit System (CBCS) and Outcome Based Education (OBE)** **SEMESTER - III**			
VIRTUAL REALITY			
Course Code	**20SCS322,** 20SAM321	,CIE Marks	40
Teaching Hours/Week (L:P:S)	4:0:0	SEE Marks	60
Credits	04	Exam Hours	03
Module-1			
Definition of VR, modern experiences, historical perspective. Hardware, sensors, displays, software, virtual world generator, game engines, human senses, perceptual psychology, psychophysics. Geometric modelling, transforming rigid bodies, yaw, pitch, roll, axis-angle representation, quaternions, 3D rotation inverses and conversions, homogeneous transforms, transforms to displays, look-at and eye transforms, canonical view and perspective transforms, viewport transforms.			
Module-2			
Light propagation, lenses and images, diopters, spherical aberrations, optical distortion; more lens aberrations; spectral properties; the eye as an optical system; cameras; visual displays. Parts of the human eye, photoreceptors and densities, scotopic and photopic vision, display resolution requirements, eye movements, neural vision structures, sufficient display resolution, other implications of physiology on VR. Depth perception, motion perception, vection, stroboscopic apparent motion, color perception, combining information from multiple cues and senses, implications of perception on VR.			
Module-3			
Graphical rendering, ray tracing, shading, BRDFs, rasterization, barycentric coordinates, VR rendering problems, anti-aliasing, distortion shading, image warping (time warp), panoramic rendering. Velocities, acceleration, vestibular system, virtual world physics, simulation, collision detection, avatar motion, vection			
Module-4			
Tracking systems, estimating rotation, IMU integration, drift errors, tilt and yaw correction, estimating position, camera-feature detection model, perspective n-point problem, sensor fusion, lighthouse			

approach, attached bodies, eye tracking, inverse kinematics, map building, SLAM.

Remapping, locomotion, manipulation, social interaction, specialized interaction mechanisms.

Module-5

Sound propagation, ear physiology, auditory perception, auditory localization; Fourier analysis; acoustic modelling, HRTFs, rendering, auralization.

Perceptual training, recommendations for developers, best practices, VR sickness, experimental methods that involve human subjects

Touch, haptics, taste, smell, robotic interfaces, telepresence, brain-machine interfaces.

Course outcomes:
At the end of the course the student will be able to:

- Explain fundamentals of virtual reality systems
- Summarize the hardware and software of the VR
- Analyse the applications of VR

Question paper pattern:
The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbook/ Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	VIRTUAL REALITY http://vr.cs.uiuc.edu/book.html	Steven M. LaValle.	Cambridge University Press	2016
Reference Books				
1	HANDBOOK OF VIRTUAL ENVIRONMENTS: Design, Implementation, and Applications	Kelly S. Hale Kay M. Stanney	CRC Press	2nd Edition, 2015

M.TECH COMPUTER SCIENCE AND ENGINEERING (SCS)
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER – III

SOFT AND EVOLUTIONARY COMPUTING

Course Code	**20SCS323,** 20SSE31 20SAM22	CIE Marks	40
Teaching Hours/Week (L:P:S)	4:0:0	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Introduction to Soft computing: Neural networks, Fuzzy logic, Genetic algorithms, Hybrid systems and its applications.
Introduction to classical sets and fuzzy sets: Classical relations and fuzzy relations, Membership functions.

Module 2

Defuzzification, Fuzzy decision making, and applications.

Module 3

Genetic algorithms: Introduction, Basic operations, Traditional algorithms, Simple GA General genetic algorithms, The schema theorem, Genetic programming, applications.

Module 4

Swarm Intelligence System: Introduction, background of SI, Ant colony system
Working of ant colony optimization, ant colony for TSP.
(Textbook 2)

Module 5

Unit commitment problem, particle Swarm Intelligence system
Artificial bee colony system, Cuckoo search system.
(Textbook 2)

Course outcomes:
At the end of the course the student will be able to:

- Implement machine learning through neural networks.
- Design Genetic Algorithm to solve the optimization problem.
- Develop a Fuzzy expert system.

Model Neuro Fuzzy system for clustering and classification

Question paper pattern:
The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbook/ Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Principles of Soft computing	Shivanandam, Deepa S. N	Wiley India	2011
2	Soft Computing with MATLAB Programming	N. P. Padhy S.P. Simon	Oxford	2015
Reference Books				
1	Neuro-fuzzy and soft computing	.S.R. Jang, C.T. Sun, E. Mizutani	Phi (EEE edition),	2012
2	Soft Computing	SarojKaushik SunitaTiwari	McGrawHill	2018

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SEMESTER - III

MULTICORE ARCHITECTURE AND PROGRAMMING

Course Code	**20SCS324,** 20SCE22, 20SIS251	CIE Marks	40
Teaching Hours/Week (L:P:S)	4:0:0	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Classes of Computers, Trends in Technology, Power, Energy and Cost – Dependability –Measuring, Reporting and Summarizing Performance.
Single core to Multi-core architectures: Limitations of Single Core Processors - The Multi core era – Case Studies of Multi core Architectures.
System Overview of Threading: Defining Threads, System View of Threads, Threading above the Operating System, Threads inside the OS, Threads inside the Hardware, What Happens When a Thread Is Created, Application Programming Models and Threading,

Module-2

Fundamental Concepts of Parallel Programming: Designing for Threads, Task Decomposition, Data Decomposition, Data Flow Decomposition, Implications of Different Decompositions, Parallel Programming Patterns, A Motivating Problem: Error Diffusion, Analysis of the Error Diffusion Algorithm, An Alternate Approach: Parallel Error Diffusion.
Threading and Parallel Programming Constructs: Performance – Scalability – Synchronization and data sharing – Data races – Synchronization primitives (mutexes, locks, semaphores, barriers) – deadlocks and livelocks – communication between threads (condition variables, signals, message queues and pipes).

Module-3

TLP AND MULTIPROCESSORS : Symmetric and Distributed Shared Memory Architectures – Cache Coherence Issues -Performance Issues – Synchronization Issues – Models of Memory Consistency - Interconnection Networks – Buses, Crossbar and Multi-stage Interconnection Networks.

Module-4

A Portable Solution for Threading : Challenges in Threading a Loop, Loop-carried Dependence, Data-race Conditions, Managing Shared and Private Data, Loop Scheduling and Portioning, Effective Use of Reductions, Minimizing Threading Overhead, Work-sharing Sections, Performance-oriented Programming, Using Barrier and No wait, Interleaving Single-thread and Multi-thread Execution.
OpenMP: OpenMP Execution Model – Memory Model – OpenMP Directives – Work-sharing Constructs - Library functions – Handling Data and Functional Parallelism – Handling Loops – Performance Considerations.

Module-5

Solutions to Common Parallel Programming Problems : Too Many Threads, Data Races, Deadlocks, and Live Locks, Deadlock, Heavily Contended Locks, Priority Inversion, Solutions for Heavily Contended Locks, Non-blocking Algorithms, ABA Problem, Cache Line Ping-ponging, Memory Reclamation Problem, Recommendations, Thread-safe Functions and Libraries, Memory Issues, Bandwidth, Working in the Cache, Memory Contention, Cache-related Issues, False Sharing, Memory Consistency, Current IA-32 Architecture, Itanium Architecture.

Course outcomes:
At the end of the course the student will be able to:

- Identify the limitations of single core architecture and the need for multicore architectures
- Define fundamental concepts of parallel programming and its design issues
- Solve the issues related to multiprocessing and suggest solutions
- Demonstrate the role of OpenMP and programming concept
- Make out the salient features of different multicore architectures and how they exploit parallelism

Question paper pattern:
The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbook/ Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Multicore Programming, Increased Performance through Software Multi-threading	ShameemAkhter and Jason Roberts	Intel Press	2006
2	An Introduction to Parallel Programming	Peter S Pacheco	Morgan/Kuffman, Elsevier	2011
3	Multicore Application Programming for Windows, Linux, Oracle, Solaris	Darryl Gove	Pearson	2011

Reference Books

1	Parallel Programming in C with MPI and OpenMP	Michael J Quinn	Tata McGraw Hill	2003

M.TECH IN COMPUTER SCIENCE AND ENGINEERING (SCS) **Choice Based Credit System (CBCS) and Outcome Based Education (OBE)** **SEMESTER - III**			
BUSINESS INTELLIGENCE AND ITS APPLICATIONS			
Course Code	**20SCS331**, 20SIT252	CIE Marks	40
Teaching Hours/Week (L:P:S)	4:0:0	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Development Steps, BI Definitions, BI Decision Support Initiatives, Development Approaches, Parallel Development Tracks, BI Project Team Structure, Business Justification, Business Divers, Business Analysis Issues, Cost – Benefit Analysis, Risk Assessment, Business Case Assessment Activities, Roles Involved In These Activities, Risks Of Not Performing Step, Hardware, Middleware, DBMS Platform, Non Technical Infrastructure Evaluation

Module -2

Managing The BI Project, Defining And Planning The BI Project, Project Planning Activities, Roles And Risks Involved In These Activities, General Business Requirement, Project Specific Requirements, Interviewing Process

Module – 3

Differences in Database Design Philosophies, Logical Database Design, Physical Database Design, Activities, Roles And Risks Involved In These Activities, Incremental Rollout, Security Management, Database Backup And Recovery

Module-4

Growth Management, Application Release Concept, Post Implementation Reviews, Release Evaluation Activities, The Information Asset and Data Valuation, Actionable Knowledge – ROI, BI Applications, The Intelligence Dashboard

Module-5

Business View of Information technology Applications: Business Enterprise excellence, Key purpose of using IT, Type of digital data, basics f enterprise reporting, BI road ahead.

Course outcomes:

At the end of the course the student will be able to:

- Explain the complete life cycle of BI/Analytical development
- Illustrate technology and processes associated with Business Intelligence framework
- Demonstrate a business scenario, identify the metrics, indicators and make recommendations to achieve the business goal.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbook/ Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Business Intelligence Roadmap: The Complete Project Lifecycle for Decision Support Applications	Larissa T Moss and ShakuAtre	Addison Wesley Information Technology Series	2003.

2	Fundamentals of Business Analytics	R N Prasad, SeemaAcharya	Wiley India	2011.
Reference Books				
1	Business Intelligence: The Savvy Manager's Guide	David Loshin	Morgan Kaufmann	
2	Delivering Business Intelligence with Microsoft SQL Server 2005	Brian Larson	McGraw Hill	2006
3	Foundations of SQL Server 2008 Business Intelligence	Lynn Langit	Apress	2011

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SEMESTER - III

ROBOTICS AND AUTOMATION

Course Code	**20SCS332,** 20SAM251, 20SIS253	CIE Marks	40
Teaching Hours/Week (L:P:S)	4:0:0	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

History of Automation, Reasons for automation, Disadvantages of automation, Automation systems, Types of automation – Fixed, Programmable and Flexible automation, Automation strategies Automated Manufacturing Systems: Components, classification and overview of manufacturing Systems, Flexible Manufacturing Systems (FMS), Types of FMS, Applications and benefits of FMS.

Module-2

Definition of Robot, History of robotics, Robotics market and the future prospects, Robot Anatomy, Robot configurations: Polar, Cartesian, cylindrical and Jointed-arm configuration. Robot motions, Joints, Work volume, Robot drive systems, Precision of movement – Spatial resolution, Accuracy, Repeatability, End effectors – Tools and gripper

Module-3

Basic Control System concepts and Models, Transfer functions, Block diagrams, characteristic equation, Types of Controllers: on-off, Proportional, Integral, Differential, P-I, P-D, P-I-D controllers. Control system and analysis.
Robot actuation and feedback components Position sensors – Potentiometers, resolvers, encoders, velocity sensors. Actuators - Pneumatic and Hydraulic Actuators, Electric Motors, Stepper motors, Servomotors, Power Transmission systems

Module-4

Robot Sensors and Machine vision system Sensors in Robotics - Tactile sensors, Proximity and Range sensors, use of sensors in robotics. Machine Vision System: Introduction to Machine vision, the sensing and digitizing function in Machine vision, Image processing and analysis, Training and Vision systems.

Module-5

Robots Technology of the future: Robot Intelligence, Advanced Sensor capabilities, Telepresence and related technologies, Mechanical design features, Mobility, locomotion and navigation, the universal hand, system integration and networking. Artificial Intelligence: Goals of AI research, AI techniques – Knowledge representation, Problem representation and problem solving, LISP programming, AI and Robotics, LISP in the factory.

Course outcomes:
At the end of the course the student will be able to:

- Classify various types of automation & manufacturing systems
- Discuss different robot configurations, motions, drive systems and its performance parameters.
- Describe the basic concepts of control systems, feedback components, actuators and power transmission systems used in robots.
- Explain the working of transducers, sensors and machine vision systems

- Discuss the future capabilities of sensors, mobility systems and Artificial Intelligence in the field of robotics.

Question paper pattern:
The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbook/ Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Automation, Production Systems and Computer Integrated Manufacturing	M.P. Groover	Pearson Education	2nd Edition, 2007
Reference Books				
1	Robotics, control vision and Intelligence	Fu, Lee and Gonzalez	McGraw Hill International	2nd Edition, 2007.
2	Robotic Engineering - An Integrated approach	Klafter, Chmielewski and Negin	Prentice Hall of India	1st Edition, 2009.

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SEMESTER - III

SPEECH PROCESSING

Course Code	**20SCS333** 20SAM334	CIE Marks	40
Teaching Hours/Week (L:P:S)	4:0:0	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Introduction, Fundamentals of Digital Speech Processing

Module-2

Digital models for the speech signals, Time domain models for speech processing

Module-3

Digital representation of the speech waveform, short term Fourier analysis

Module-4

Homomorphic speech processing, Linear predictive coding of speech: Introduction, Basic principles of LP analyse, Computation of gain for the model, solution of LPC equation, Comparison between the methods of solution of the LPC analysis equation, the prediction error signal.

Module-5

Linear predictive coding of speech: Frequency domain interpretation of LP analysis, Relation of LP analysis, Relations between various speech parameters, applications

Digital speech for man machine communication by voice

Course outcomes:
At the end of the course the student will be able to:

- Explain the fundamentals of speech processing
- Summarize the models of speech processing
- Infer the linear predictive coding
- Illustrate the application of speech processing

Question paper pattern:
The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to

60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbook/ Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Digital Processing of Speech Signals	Lawrence R. Rabiner , Ronald W. Schafer	Pearson	
Reference Books				
1	Speech and Audio Signal Processing	Paperback, A.R. JAYAN	PHI	
2	Speech and Audio Processing	Apte Shaila D	Wiley India Pvt. Ltd	

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SEMESTER - III

WIRELESS SENSOR NETWORKS

Course Code	**20SCS334**, 20LNI324, 20SCE251, 20SCN251,20SIS13	CIE Marks	40
Teaching Hours/Week (L:P:S)	4:0:0	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

CHARACTERISTICS OF WSN
Characteristic requirements for WSN - Challenges for WSNs – WSN vsAdhoc Networks - Sensor node architecture – Commercially available sensor nodes –Imote, IRIS, Mica Mote, EYES nodes, BTnodes, TelosB, Sunspot -Physical layer and transceiver design considerations in WSNs, Energy usage profile, Choice of modulation scheme, Dynamic modulation scaling, Antenna considerations.

Module-2

MEDIUM ACCESS CONTROL PROTOCOLS
Fundamentals of MAC protocols - Low duty cycle protocols and wakeup concepts – Contention based protocols - Schedule-based protocols - SMAC - BMAC - Traffic-adaptive medium access protocol (TRAMA) - The IEEE 802.15.4 MAC protocol.

Module-3

ROUTING AND DATA GATHERING PROTOCOLS
Routing Challenges and Design Issues in Wireless Sensor Networks, Flooding and gossiping – Data centric Routing – SPIN – Directed Diffusion – Energy aware routing - Gradient-based routing - Rumor Routing – COUGAR – ACQUIRE – Hierarchical Routing - LEACH, PEGASIS – Location Based Routing – GF, GAF, GEAR, GPSR – Real Time routing Protocols – TEEN, APTEEN, SPEED, RAP - Data aggregation - data aggregation operations - Aggregate Queries in Sensor Networks - Aggregation Techniques – TAG, Tiny DB.

Module-4

EMBEDDED OPERATING SYSTEMS
Operating Systems for Wireless Sensor Networks – Introduction - Operating System Design Issues - Examples of Operating Systems – TinyOS – Mate – MagnetOS – MANTIS - OSPM - EYES OS – SenOS – EMERALDS – PicOS – Introduction to Tiny OS – NesC – Interfaces and Modules- Configurations and Wiring - Generic Components -Programming in Tiny OS using NesC, Emulator TOSSIM.

Module-5

APPLICATIONS OF WSN

WSN Applications - Home Control - Building Automation - Industrial Automation - Medical Applications - Reconfigurable Sensor Networks - Highway Monitoring - Military Applications - Civil and Environmental Engineering Applications - Wildfire Instrumentation - Habitat Monitoring - Nanoscopic Sensor Applications – Case Study: IEEE 802.15.4 LR-WPANs Standard - Target detection and tracking - Contour/edge detection - Field sampling.

Course outcomes:

At the end of the course the student will be able to:

- Know the basics , characteristics and challenges of Wireless Sensor Network
- Apply the knowledge to identify appropriate physical and MAC layer protocol
- Apply the knowledge to identify the suitable routing algorithm based on the network and user requirement
- Be familiar with the OS used in Wireless Sensor Networks and build basic modules
- Understand the applications of WSN in various fields

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have a sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbook/ Textbooks

Sl No	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Wireless Sensor Networks Technology, Protocols, and Applications	KazemSohraby, Daniel Minoli and TaiebZnati	John Wiley & Sons	2007
2	Protocols and Architectures for Wireless Sensor Network	Holger Karl and Andreas Willig	John Wiley & Sons, Ltd.	2005
Reference Books				
1	A survey of routing protocols in wireless sensor networks	K. Akkaya and M. Younis	Elsevier Ad Hoc Network Journal	Vol. 3, no. 3, pp. 325--349
2	TinyOS Programming	Philip Levis		
3	Wireless Sensor Network Designs	Anna Ha´c	John Wiley & Sons Ltd.	

PROJECT WORK PHASE – 1			
Course Code	20SCS34	CIE Marks	100
Number of contact Hours/Week	2	SEE Marks	--
Credits	02	Exam Hours	--

Course objectives:

- Support independent learning.
- Guide to select and utilize adequate information from varied resources maintaining ethics.
- Guide to organize the work in the appropriate manner and present information (acknowledging the sources) clearly.
- Develop interactive, communication, organisation, time management, and presentation skills.
- Impart flexibility and adaptability.
- Inspire independent and team working.
- Expand intellectual capacity, credibility, judgement, intuition.
- Adhere to punctuality, setting and meeting deadlines.
- Instil responsibilities to oneself and others.
- Train students to present the topic of project work in a seminar without any fear, face audience confidently, enhance communication skill, involve in group discussion to present and exchange ideas.

Project Phase-1 Students in consultation with the guide/s shall carry out literature survey/ visit industries to finalize the topic of the Project. Subsequently, the students shall collect the material required for the selected project, prepare synopsis and narrate the methodology to carry out the project work.

Seminar: Each student, under the guidance of a Faculty, is required to

- Present the seminar on the selected project orally and/or through power point slides.
- Answer the queries and involve in debate/discussion.
- Submit two copies of the typed report with a list of references.

The participants shall take part in discussion to foster friendly and stimulating environment in which the students are motivated to reach high standards and become self-confident.

Course outcomes:

At the end of the course the student will be able to:

- Demonstrate a sound technical knowledge of their selected project topic.
- Undertake problem identification, formulation, and solution.
- Design engineering solutions to complex problems utilising a systems approach.
- Communicate with engineers and the community at large in written an oral forms.
- Demonstrate the knowledge, skills and attitudes of a professional engineer.

Continuous Internal Evaluation

CIE marks for the project report (50 marks), seminar (30 marks) and question and answer (20 marks) shall be awarded (based on the quality of report and presentation skill, participation in the question and answer session by the student) by the committee constituted for the purpose by the Head of the Department. The committee shall consist of three faculty from the department with the senior most acting as the Chairperson.

MINI PROJECT			
Course Code	20SCS35	CIE Marks	40
Number of contact Hours/Week	2	SEE Marks	60
Credits	02	Exam Hours/Batch	03

Course objectives:

- To support independent learning and innovative attitude.
- To guide to select and utilize adequate information from varied resources upholding ethics.
- To guide to organize the work in the appropriate manner and present information (acknowledging the sources) clearly.
- To develop interactive, communication, organisation, time management, and presentation skills.
- To impart flexibility and adaptability.
- To inspire independent and team working.
- To expand intellectual capacity, credibility, judgement, intuition.
- To adhere to punctuality, setting and meeting deadlines.
- To instil responsibilities to oneself and others.
- To train students to present the topic of project work in a seminar without any fear, face audience confidently, enhance communication skill, involve in group discussion to present and exchange ideas.

Mini-Project: Each student of the project batch shall involve in carrying out the project work jointly in constant consultation with internal guide, co-guide, and external guide and prepare the project report as per the norms avoiding plagiarism.

Course outcomes:

At the end of the course the student will be able to:

- Present the mini-project and be able to defend it.
- Make links across different areas of knowledge and to generate, develop and evaluate ideas and information so as to apply these skills to the project task.
- Habituated to critical thinking and use problem solving skills.
- Communicate effectively and to present ideas clearly and coherently in both the written and oral forms.
- Work in a team to achieve common goal.
- Learn on their own, reflect on their learning and take appropriate actions to improve it.

CIE procedure for Mini - Project:

The CIE marks awarded for Mini - Project, shall be based on the evaluation of Mini - Project Report, Project Presentation skill and Question and Answer session in the ratio 50:25:25.The marks awarded for Mini - Project report shall be the same for all the batch mates.

Semester End Examination

SEE marks for the mini-project shall be awarded based on the evaluation of Mini-Project Report, Presentation skill and Question and Answer session in the ratio 50:25:25 by the examiners appointed by the University.

INTERNSHIP / PROFESSIONAL PRACTICE			
Course Code	20SCSI36	CIE Marks	40
Number of contact Hours/Week	2	SEE Marks	60
Credits	06	Exam Hours	03

Course objectives:

Internship/Professional practice provide students the opportunity of hands-on experience that include personal training, time and stress management, interactive skills, presentations, budgeting, marketing, liability and risk management, paperwork, equipment ordering, maintenance, responding to emergencies etc. The objective are further,

To put theory into practice.

To expand thinking and broaden the knowledge and skills acquired through course work in the field.

To relate to, interact with, and learn from current professionals in the field.

To gain a greater understanding of the duties and responsibilities of a professional.

To understand and adhere to professional standards in the field.

To gain insight to professional communication including meetings, memos, reading, writing, public speaking, research, client interaction, input of ideas, and confidentiality.

To identify personal strengths and weaknesses.

To develop the initiative and motivation to be a self-starter and work independently.

Internship/Professional practice: Students under the guidance of internal guide/s and external guide shall take part in all the activities regularly to acquire as much knowledge as possible without causing any inconvenience at the place of internship.

Seminar: Each student, is required to

- Present the seminar on the internship orally and/or through power point slides.
- Answer the queries and involve in debate/discussion.
- Submit the report duly certified by the external guide.
- The participants shall take part in discussion to foster friendly and stimulating environment in which the students are motivated to reach high standards and become self-confident.

Course outcomes:

At the end of the course the student will be able to:

- Gain practical experience within industry in which the internship is done.
- Acquire knowledge of the industry in which the internship is done.
- Apply knowledge and skills learned to classroom work.
- Develop a greater understanding about career options while more clearly defining personal career goals.
- Experience the activities and functions of professionals.
- Develop and refine oral and written communication skills.
- Identify areas for future knowledge and skill development.
- Expand intellectual capacity, credibility, judgment, intuition.
- Acquire the knowledge of administration, marketing, finance and economics.

Continuous Internal Evaluation

CIE marks for the Internship/Professional practice report (20 marks), seminar (10 marks) and question and answer session (10 marks) shall be awarded (based on the quality of report and presentation skill, participation in the question and answer session by the student) by the committee constituted for the purpose by the Head of the Department. The committee shall consist of three faculty from the department with the senior most acting as the Chairperson.

Semester End Examination

SEE marks for the internship report (30 marks), seminar (20 marks) and question and answer session (10 marks) shall be awarded (based on the quality of report and presentation skill, participation in the question and answer session) by the examiners appointed by the University.

PROJECT WORK PHASE -2			
Course Code	20SCS41	CIE Marks	40
Number of contact Hours/Week	4	SEE Marks	60
Credits	20	Exam Hours	03

Course objectives:

- To support independent learning.
- To guide to select and utilize adequate information from varied resources maintaining ethics.
- To guide to organize the work in the appropriate manner and present information (acknowledging the sources) clearly.
- To develop interactive, communication, organisation, time management, and presentation skills.
- To impart flexibility and adaptability.
- To inspire independent and team working.
- To expand intellectual capacity, credibility, judgement, intuition.
- To adhere to punctuality, setting and meeting deadlines.
- To instil responsibilities to oneself and others.
- To train students to present the topic of project work in a seminar without any fear, face audience confidently, enhance communication skill, involve in group discussion to present and exchange ideas.

Project Work Phase - II: Each student of the project batch shall involve in carrying out the project work jointly in constant consultation with internal guide, co-guide, and external guide and prepare the project report as per the norms avoiding plagiarism.

Course outcomes:

At the end of the course the student will be able to:

- Present the project and be able to defend it.
- Make links across different areas of knowledge and to generate, develop and evaluate ideas and information so as to apply these skills to the project task.
- Habituated to critical thinking and use problem solving skills
- Communicate effectively and to present ideas clearly and coherently in both the written and oral forms.
- Work in a team to achieve common goal.
- Learn on their own, reflect on their learning and take appropriate actions to improve it.

Continuous Internal Evaluation:

Project Report: 20 marks. The basis for awarding the marks shall be the involvement of the student in the project and in the preparation of project report. To be awarded by the internal guide in consultation with external guide if any.

Project Presentation: 10 marks.

The Project Presentation marks of the Project Work Phase -II shall be awarded by the committee constituted for the purpose by the Head of the Department. The committee shall consist of three faculty from the department with the senior most acting as the Chairperson.

Question and Answer: 10 marks.

The student shall be evaluated based on the ability in the Question and Answer session for 10 marks.

Semester End Examination

SEE marks for the project report (30 marks), seminar (20 marks) and question and answer session (10 marks) shall be awarded (based on the quality of report and presentation skill, participation in the question and answer session) by the examiners appointed by the University.

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III SEMESTER

Sl. No	Course and Course Code	Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
				Theory Lecture	Tutorial	Practical/ Drawing	Self -Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	T	P	S					
1	BSC 21MAT31	Transform Calculus, Fourier Series and Numerical Techniques	Maths	3	0	0		03	50	50	100	3
2	IPCC 21CS32	Data Structures and Applications	Any CS Board Department	3	0	2		03	50	50	100	4
3	IPCC 21CS33	Analog and Digital Electronics		3	0	2		03	50	50	100	4
4	PCC 21CS34	Computer Organization and Architecture		3	0	0		03	50	50	100	3
5	PCC 21CSL35	Object Oriented Programming with JAVA Laboratory		0	0	2		03	50	50	100	1
6	UHV 21UH36	Social Connect and Responsibility	Any Department	0	0	1		01	50	50	100	1
7	HSMC 21KSK37/47	Samskrutika Kannada	TD and PSB: HSMC	1	0	0		01	50	50	100	1
	HSMC 21KBK37/47	Balake Kannada										
	OR											
	HSMC 21CIP37/47	Constitution of India and Professional Ethics										
8	AEC 21CS38X/21 CSL38X	Ability Enhancement Course - III	TD: Concerned department PSB: Concerned Board	If offered as Theory Course				01	50	50	100	1
				1	0	0						
				If offered as lab. course				02				
				0	0	2						
								Total	**400**	**400**	**800**	**18**

9	**Scheduled activities for III to VIII semesters**	NMDC 21NS83	National Service Scheme (NSS)	NSS	All students have to register for any one of the course namely National Service Scheme, Physical Education (PE) (Sports and Athletics) and Yoga with the concerned coordinator of the course during the first week of III semester. The activities shall be carried out from (for 5 semesters) between III semester to VIII semester. SEE in the above courses shall be conducted during VIII semester examinations and the accumulated CIE marks shall be added to the SEE marks. Successful completion of the registered course is mandatory for the award of the degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the colander prepared for the NSS, PE and Yoga activities.
		NMDC 21PE83	Physical Education (PE) (Sports and Athletics)	PE	
		NMDC 21YO83	Yoga	Yoga	

Course prescribed to lateral entry Diploma holders admitted to III semester B.E./B.Tech programs

1	NCMC 21MATDIP31	Additional Mathematics - I	Maths	02	02	--	--	---	100	---	100	0

Note: BSC: Basic Science Course, **IPCC:** Integrated Professional Core Course, **PCC:** Professional Core Course, **INT** –Internship, **HSMC:** Humanity and Social Science & Management Courses, **AEC**–Ability Enhancement Courses. **UHV:** Universal Human Value Course.
L –Lecture, **T –** Tutorial, P- Practical/ Drawing, **S –** Self Study Component, **CIE:** Continuous Internal Evaluation, **SEE:** Semester End Examination. **TD-**Teaching Department, **PSB**: Paper Setting department

21KSK37/47 Samskrutika Kannada is for students who speak, read and write Kannada and **21KBK37/47** Balake Kannada is for non-Kannada speaking, reading, and writing students.

Integrated Professional Core Course (IPCC): Refers to Professional Theory Core Course Integrated with Practical's of the same course. Credit for IPCC can be 04 and its Teaching–Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper. For more details, the regulation governing the Degree of Bachelor of Engineering /Technology (BE/B.Tech.) 2021-22 may be referred.

21INT49 Inter/Intra Institutional Internship: All the students admitted to engineering programs under the lateral entry category shall have to undergo a mandatory 21INT49 Inter/Intra Institutional Internship of 03 weeks during the intervening period of III and IV semesters. The internship shall be slated for CIE only and will not have SEE. The letter grade earned through CIE shall be included in the IV semester grade card. The internship shall be considered as a head of passing and shall be considered for vertical progression and for the award of degree. Those, who do not take up / complete the internship shall be declared fail and shall have to complete during subsequently after satisfying the internship requirements. The faculty coordinator or mentor shall monitor the students' internship progress and interact with them for the successful completion of the internship.

Non–credit mandatory courses (NCMC):

(A) Additional Mathematics I and II:

(1) These courses are prescribed for III and IV semesters respectively to lateral entry Diploma holders admitted to III semester of B.E./B.Tech., programs. They shall attend the classes during the respective semesters to complete all the formalities of the course and appear for the Continuous Internal Evaluation (CIE). In case, any student fails to register for the said course/fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have secured an F grade. In such a case, the student has to fulfill the course requirements during subsequent semester/s to earn the qualifying CIE marks. These courses are slated for CIE only and has no SEE.

(2) Additional Mathematics I and II shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses shall be mandatory for the award of degree.

(3) Successful completion of the courses Additional Mathematics I and II shall be indicated as satisfactory in the grade card. Non-completion of the courses Additional Mathematics I and II shall be indicated as Unsatisfactory.

(B) National Service Scheme/Physical Education (Sport and Athletics)/ Yoga:

(1) Securing 40 % or more in CIE,35 % or more marks in SEE and 40 % or more in the sum total of CIE + SEE leads to successful completion of the registered course.

(2) In case, students fail to secure 35 % marks in SEE, they have to appear for SEE during the subsequent examinations conducted by the University.

(3) In case, any student fails to register for NSS, PE or Yoga/fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have not completed the requirements of the course. In such a case, the student has to fulfill the course requirements during subsequent semester/s to earn the qualifying CIE marks.

(4) Successful completion of the course shall be indicated as satisfactory in the grade card. Non-completion of the course shall be indicated as Unsatisfactory.

(5) These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses shall be mandatory for the award of degree.

Ability Enhancement Course - III			
21CSL381	Mastering Office	21CS383	
21CS382	Programming IN c++	21CS384	

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IV SEMESTER

Sl. No	Course and Course Code	Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
				Theory Lecture	Tutorial	Practical/ Drawing	Self -Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	T	P	S					
1	BSC 21CS41	Mathematical Foundations for Computing	Maths	2	2	0		03	50	50	100	3
2	IPCC 21CS42	Design and Analysis of Algorithms	Any CS Board Department	3	0	2		03	50	50	100	4
3	IPCC 21CS43	Microcontroller and Embedded SystemS		3	0	2		03	50	50	100	4
4	PCC 21CS44	Operating SystemS		2	2	0		03	50	50	100	3
5	AEC 21BE45	Biology For Engineers	BT, CHE, PHY	2	0	0		02	50	50	100	2
6	PCC 21CSL46	Python Programming Laboratory	Any CS Board Department	0	0	2		03	50	50	100	1
7	HSMC 21KSK37/47	Samskrutika Kannada	HSMC	1	0	0		01	50	50	100	1
	HSMC 21KBK37/47	Balake Kannada										
	OR											
	HSMC 21CIP37/47	Constitution of India & Professional Ethics										
8	AEC 21CS48X/21CSL48X	Ability Enhancement Course- IV	TD and PSB: Concerned department	If offered as theory Course: 1	0	0		01	50	50	100	1
				If offered as lab. course: 0	0	2		02				
9	UHV 21UH49	Universal Human Values	Any Department	1	0	0		01	50	50	100	1
10	INT 21INT49	Inter/Intra Institutional Internship	Evaluation By the appropriate authorities	Completed during the intervening period of II and III semesters by students admitted to first year of BE./B.Tech and during the intervening period of III and IV semesters by Lateral entry students admitted to III semester.				3	100	--	100	2
								Total	**550**	**450**	**1000**	**22**

Course prescribed to lateral entry Diploma holders admitted to III semester of Engineering programs

1	NCMC 21MATDIP41	Additional Mathematics - II	Maths	02	02	--	--	--	100	--	100	0

Note: BSC: Basic Science Course, IPCC: Integrated Professional Core Course, PCC: Professional Core Course, AEC –Ability Enhancement Courses, HSMC: Humanity and Social Science and Management Courses, UHV- Universal Human Value Courses.

L –Lecture, T – Tutorial, P- Practical/ Drawing, S – Self Study Component, CIE: Continuous Internal Evaluation, SEE: Semester End Examination.

21KSK37/47 Samskrutika Kannada is for students who speak, read and write Kannada and 21KBK37/47 Balake Kannada is for non-Kannada speaking, reading, and writing students.

Integrated Professional Core Course (IPCC): Refers to Professional Theory Core Course Integrated with Practical's of the same course. Credit for IPCC can be 04 and its Teaching – Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from practical part of IPCC shall be included in the SEE question paper. For more details the regulation governing the Degree of Bachelor of Engineering /Technology (BE/B.Tech.) 2021-22 may be referred.

Non – credit mandatory course (NCMC):

Additional Mathematics - II:

(1) Lateral entry Diploma holders admitted to III semester of B.E./B.Tech., shall attend the classes during the IV semester to complete all the formalities of the course and appear for the Continuous Internal Evaluation (CIE). In case, any student fails to register for the said course/fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have secured an F grade. In such a case, the student has to fulfil the course requirements during subsequent semester/s to earn the qualifying CIE marks. These courses are slated for CIE only and has no SEE.

(2) Additional Mathematics I and II shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses shall be mandatory for the award of degree.

(3) Successful completion of the course Additional Mathematics II shall be indicated as satisfactory in the grade card. Non-completion of the courses Additional Mathematics II shall be indicated as Unsatisfactory.

Ability Enhancement Course - IV

21CSL481	Web Programming	21CSL483	R Programming
21CS482	Unix Shell Programming	21CS484	

Internship of 04 weeks during the intervening period of IV and V semesters; 21INT68 Innovation/ Entrepreneurship/ Societal based Internship.

(1) All the students shall have to undergo a mandatory internship of 04 weeks during the intervening period of IV and V semesters. The internship shall be slated for CIE only and will not have SEE. The letter grade earned through CIE shall be included in the VI semester grade card. The internship shall be considered as a head of passing and shall be considered for vertical progression and for the award of degree. Those, who do not take up / complete the internship shall be considered under F (fail) grade and shall have to complete during subsequently after satisfying the internship requirements.

(2) Innovation/ Entrepreneurship Internship shall be carried out at industry, State and Central Government /Non-government organizations (NGOs), micro, small and medium enterprise (MSME), Innovation centers or Incubation centers. Innovation need not be a single major breakthrough; it can also be a series of small or incremental changes. Innovation of any kind can also happen outside of the business world.

Entrepreneurship internships offers a chance to gain hands on experience in the world of entrepreneurship and helps to learn what it takes to run a small entrepreneurial business by performing intern duties with an established company. This experience can then be applied to future business endeavours. Start-ups and small companies are a preferred place to learn the business tack ticks for future entrepreneurs as learning how a small business operates will serve the intern well when he/she manages his/her own company. Entrepreneurship acts as a catalyst to open the minds to creativity and innovation. Entrepreneurship internship can be from several sectors, including technology, small and medium-sized, and the service sector.

(3) Societal or social internship.

Urbanization is increasing on a global scale; and yet, half the world's population still resides in rural areas and is devoid of many things that urban population enjoy. Rural internship, is a work-based activity in which students will have a chance to solve/reduce the problems of the rural place for better living.

As proposed under the AICTE rural internship programme, activities under Societal or social internship, particularly in rural areas, shall be considered for 40 points under AICTE activity point programme.

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V SEMESTER

Sl. No	Course and Course Code	Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
				Theory Lecture	Tutorial	Practical/ Drawing	Self -Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	T	P	S					
1	BSC 21CS51	Automata Theory and compiler Design	Any CS Board Department	3	0	0		03	50	50	100	3
2	IPCC 21CS52	Computer Networks		3	0	2		03	50	50	100	4
3	PCC 21CS53	Database Management Systems		3	0	0		03	50	50	100	3
4	PCC 21CS54	Artificial Intelligence and Machine Learning		3	0	0		03	50	50	100	3
5	PCC 21CSL55	Database Management Systems Laboratory with Mini Project		0	0	2		03	50	50	100	1
6	AEC 21XX56	Research Methodology & Intellectual Property Rights	TD: Any Department PSB: As identified by university	2	0	0		02	50	50	100	2
7	HSMC 21CIV57	Environmental Studies	TD: Civil/ Environmental /Chemistry/ Biotech. PSB: Civil Engg	1	0	0		1	50	50	100	1
8	AEC 21CS58X/21 CS58LX	Ability Enhancement Course-V	Concerned Board	If offered as Theory courses: 1	0	0		01	50	50	100	1
				If offered as lab. courses: 0	0	2		02				
								Total	**400**	**400**	**800**	**18**

Ability Enhancement Course - IV

21CSL581	Angular JS and Node JS	21CS583	
21CS582	C# and .Net Framework	21CS584	

Note: BSC: Basic Science Course, PCC: Professional Core Course, IPCC: Integrated Professional Core Course, AEC –Ability Enhancement Course INT – Internship, HSMC: Humanity and Social Science & Management Courses.
L –Lecture, T – Tutorial, P- Practical/ Drawing, S – Self Study Component, CIE: Continuous Internal Evaluation, SEE: Semester End Examination.

Integrated Professional Core Course (IPCC): refers to Professional Theory Core Course Integrated with Practical of the same course. Credit for IPCC can be 04 and its Teaching – Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). Theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by CIE only and there shall be no SEE. For more details the regulation governing the Degree of Bachelor of Engineering /Technology (BE/B.Tech.) 2021-22 may be referred.

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VI SEMESTER

Sl. No	Course and Course Code	Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
				Theory Lecture	Tutorial	Practical/ Drawing	Self -Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	T	P	S					
1	HSMC 21CS61	Software Engineering & Project Management	Any CS Board Department	2	2	0		03	50	50	100	3
2	IPCC 21CS62	Fullstack Development		3	0	2		03	50	50	100	4
3	PCC 21CS63	Computer Graphics and Fundamentals of Image Processing		3	0	0		03	50	50	100	3
4	PEC 21XX64x	Professional Elective Course-I		3	0	0		03	50	50	100	3
5	OEC 21XX65x	Open Elective Course-I	Concerned Department	3	0	0		03	50	50	100	3
6	PCC 21CSL66	Computer Graphics and Image Processing Laboratory	Any CS Board Department	0	0	2		03	50	50	100	1
7	MP 21CSMP67	Mini Project		Two contact hours /week for interaction between the faculty and students.				--	100	--	100	2
8	INT 21INT68	Innovation/Entrepreneurship /Societal Internship	Completed during the intervening period of IV and V semesters.					--	100	--	100	3
								Total	**500**	**300**	**800**	**22**

Professional Elective - I

21CS641	Agile Technology	21CS643	Advanced Computer Architecture
21CS642	Advanced JAVA Programming	21CS644	Data science and Visualization

Open Electives – I offered by the Department to other Department students

21CS651	Introduction to Data Structures	21CS653	Introduction to Cyber Security
21CS652	Introduction to Database Management Systems	21CS654	Programming in JAVA

Note: HSMC: Humanity and Social Science & Management Courses, **IPCC:** Integrated Professional Core Course, **PCC:** Professional Core Course, **PEC:** Professional Elective Courses, OEC–Open Elective Course, **MP** –Mini Project, INT –Internship.
L –Lecture, T – Tutorial, P - Practical / Drawing, S – Self Study Component, CIE: Continuous Internal Evaluation, SEE: Semester End Examination.

Integrated Professional Core Course (IPCC): Refers to Professional Theory Core Course Integrated with Practical of the same course. Credit for IPCC can be 04 and its Teaching – Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by CIE only and there shall be no SEE. For more details, the regulation governing the Degree of Bachelor of Engineering /Technology (BE/B.Tech) 2021-22 may be referred.

Professional Elective Courses (PEC):
A professional elective (PEC) course is intended to enhance the depth and breadth of educational experience in the Engineering and Technology curriculum. Multidisciplinary courses that are added supplement the latest trend and advanced technology in the selected stream of engineering. Each group will provide an option to select one course out of five courses. The minimum students' strength for offering professional electives is 10. However, this conditional shall not be applicable to cases where the admission to the programme is less than 10.

Open Elective Courses:
Students belonging to a particular stream of Engineering and Technology are not entitled for the open electives offered by their parent Department. However, they can opt an elective offered by other Departments, provided they satisfy the prerequisite condition if any. Registration to open electives shall be documented under the guidance of the Program Coordinator/ Advisor/Mentor.
Selection of an open elective shall **not be allowed** if,

(i) The candidate has studied the same course during the previous semesters of the program.
(ii) The syllabus content of open electives is similar to that of the Departmental core courses or professional electives.
(iii) A similar course, under any category, is prescribed in the higher semesters of the program.

In case, any college is desirous of offering a course (not included in the Open Elective List of the University) from streams such as Law, Business

(MBA), Medicine, Arts, Commerce, etc., can seek permission, at least one month before the commencement of the semester, from the University by submitting a copy of the syllabus along with the details of expertise available to teach the same in the college.
The minimum students' strength for offering open electives is 10. However, this conditional shall not be applicable to cases where the admission to the programme is less than 10.

Mini-project work: Mini Project is a laboratory-oriented course which will provide a platform to students to enhance their practical knowledge and skills by the development of small systems/applications.
Based on the ability/abilities of the student/s and recommendations of the mentor, a single discipline or a multidisciplinary Mini- project can be assigned to an individual student or to a group having not more than 4 students.
CIE procedure for Mini-project:
(i) Single discipline: The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two faculty members of the Department, one of them being the Guide. The CIE marks awarded for the Mini-project work shall be based on the evaluation of project report, project presentation skill, and question and answer session in the ratio of 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.
(ii) Interdisciplinary: Continuous Internal Evaluation shall be group-wise at the college level with the participation of all the guides of the project.
The CIE marks awarded for the Mini-project, shall be based on the evaluation of project report, project presentation skill, and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.
No SEE component for Mini-Project.

VII semester Classwork and Research Internship /Industry Internship (21INT82)

Swapping Facility
Institutions can swap VII and VIII Semester Scheme of Teaching and Examinations to accommodate research internship/ industry internship after the VI semester**.**
(2) Credits earned for the courses of VII and VIII Semester Scheme of Teaching and Examinations shall be counted against the corresponding semesters whether VII or VIII semester is completed during the beginning of IV year or later part of IV year of the program.
Elucidation:
At the beginning of IV year of the programme i.e., after VI semester, VII semester classwork and VIII semester Research Internship /Industrial Internship shall be permitted to be operated simultaneously by the University so that students have ample opportunity for internship. In other words, a good percentage of the class shall attend VII semester classwork and similar percentage of others shall attend to Research Internship or Industrial Internship.
Research/Industrial Internship shall be carried out at an Industry, NGO, MSME, Innovation centre, Incubation centre, Start-up, Centers of Excellence (CoE), Study Centre established in the parent institute and /or at reputed research organizations / institutes. The internship can also be rural internship.
The mandatory Research internship /Industry internship is for 24 weeks. The internship shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not take up/complete the internship shall be declared fail and shall have to complete during the subsequent University examination after satisfying the internship requirements.

INT21INT82 Research Internship/ Industry Internship/Rural Internship
Research internship: A research internship is intended to offer the flavour of current research going on in the research field. It helps students get familiarized with the field and imparts the skill required for carrying out research.
Industry internship: Is an extended period of work experience undertaken by students to supplement their degree for professional development. It also helps them learn to overcome unexpected obstacles and successfully navigate organizations, perspectives, and cultures. Dealing with contingencies helps students recognize, appreciate, and adapt to organizational realities by tempering their knowledge with practical constraints.
Rural internship: A long-term goal, as proposed under the AICTE rural internship programme, shall be counted as rural internship activity.
The student can take up Interdisciplinary Research Internship or Industry Internship.
The faculty coordinator or mentor has to monitor the students' internship progress and interact with them to guide for the successful completion of the internship.
The students are permitted to carry out the internship anywhere in India or abroad. University shall not bear any expenses incurred in respect of internship.

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Swappable VII and VIII SEMESTER

VII SEMESTER

Sl. No	Course and Course Code	Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
				Theory Lecture	Tutorial	Practical/ Drawing	Self -Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	T	P	S					
1	PCC 21CS71	Big Data Analytics	Any CS Board Department	3	0	0		3	50	50	100	3
2	PCC 21CS72	Cloud Computing		2	0	0		3	50	50	100	2
3	PEC 21XX73X	Professional elective Course-II		3	0	0		3	50	50	100	3
4	PEC 21XX74X	Professional elective Course-III		3	0	0		3	50	50	100	3
5	OEC 21XX75X	Open elective Course-II	Concerned Department	3	0	0		3	50	50	100	3
6	Project 21CSP76	Project work		Two contact hours /week for interaction between the faculty and students.				3	100	100	200	10
								Total	**350**	**350**	**700**	**24**

VIII SEMESTER

Sl. No	Course and Course Code		Course Title	Teaching Department	Teaching Hours /Week				Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Self -Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	Seminar 21CS81		Technical Seminar		One contact hour /week for interaction between the faculty and students.				--	100	--	100	01
2	INT 21INT82		Research Internship/ Industry Internship		Two contact hours /week for interaction between the faculty and students.				03 (Batch wise)	100	100	200	15
3	NCMC	21NS83	National Service Scheme (NSS)	NSS	Completed during the intervening period of III semester to VIII semester.				--	50	50	100	0
		21PE83	Physical Education (PE) (Sports and Athletics)	PE									
		21YO83	Yoga	Yoga									
									Total	**250**	**150**	**400**	**16**

Professional Elective - II

21CS731	Object oriented Modelling and Design	21CS734	Blockchain Technology
21CS732	Digital Image Processing	21CS735	Internet of Things
21CS733	Cryptography and Network Security		

Professional Elective - III

21CS741	Software Architecture and Design Patterns	21CS744	Robotic Process Automation Design and Development
21CS742	Multiagent Systems	21CS745	NoSQL Data Base
21CS743	Deep Learning		

Open Electives - II offered by the Department to other Department students			
21CS751	Programming in Python	21CS754	Introduction to Data Science
21CS752	Introduction to AI and ML	21CS755	
21CS753	Introduction to Big Data		

Note: PCC: Professional Core Course, **PEC:** Professional Elective Courses, **OEC**–Open Elective Course, **AEC** –Ability Enhancement Courses.
L –Lecture, T – Tutorial, P- Practical / Drawing, S – Self Study Component, CIE: Continuous Internal Evaluation, SEE: Semester End Examination.

Note: VII and VIII semesters of IV year of the programme

(1) Institutions can swap VII and VIII Semester Scheme of Teaching and Examinations to accommodate research internship/ industry internship after the VI semester**.**

(2) Credits earned for the courses of VII and VIII Semester Scheme of Teaching and Examinations shall be counted against the corresponding semesters whether VII or VIII semester is completed during the beginning of IV year or later part of IV year of the programme.

PROJECT WORK (21XXP76): The objective of the Project work is

(i) To encourage independent learning and the innovative attitude of the students.
(ii) To develop interactive attitude, communication skills, organization, time management, and presentation skills.
(iii) To impart flexibility and adaptability.
(iv) To inspire team working.
(v) To expand intellectual capacity, credibility, judgment and intuition.
(vi) To adhere to punctuality, setting and meeting deadlines.
(vii) To instil responsibilities to oneself and others.
(viii) To train students to present the topic of project work in a seminar without any fear, face the audience confidently, enhance communication skills, involve in group discussion to present and exchange ideas.

CIE procedure for Project Work:

(1) Single discipline: The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide.

The CIE marks awarded for the project work, shall be based on the evaluation of project work Report, project presentation skill, and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

(2) Interdisciplinary: Continuous Internal Evaluation shall be group-wise at the college level with the participation of all guides of the college. Participation of external guide/s, if any, is desirable. The CIE marks awarded for the project work, shall be based on the evaluation of project work Report, project presentation skill, and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

SEE procedure for Project Work: SEE for project work will be conducted by the two examiners appointed by the University. The SEE marks awarded for the project work, shall be based on the evaluation of project work Report, project presentation skill, and question and answer session in the ratio 50:25:25.

TECHNICAL SEMINAR (21XXS81): The objective of the seminar is to inculcate self-learning, present the seminar topic confidently, enhance communication skill, involve in group discussion for exchange of ideas. Each student, under the guidance of a Faculty, shall choose, preferably, a recent topic of his/her interest relevant to the programme of Specialization.

(i) Carry out literature survey, systematically organize the content.
(ii) Prepare the report with own sentences, avoiding a cut and paste act.
(iii) Type the matter to acquaint with the use of Micro-soft equation and drawing tools or any such facilities.
(iv) Present the seminar topic orally and/or through PowerPoint slides.
(v) Answer the queries and involve in debate/discussion.
(**vi)** Submit a typed report with a list of references.

The participants shall take part in the discussion to foster a friendly and stimulating environment in which the students are motivated to reach high standards and become self-confident.

Evaluation Procedure:

The CIE marks for the seminar shall be awarded (based on the relevance of the topic, presentation skill, participation in the question and answer session, and quality of report) by the committee constituted for the purpose by the Head of the Department. The committee shall consist of three teachers from the department with the senior-most acting as the Chairman.

Marks distribution for CIE of the course:

Seminar Report:50 marks
Presentation skill:25 marks
Question and Answer: 25 marks. ■ No SEE component for Technical Seminar

Non – credit mandatory courses (NCMC):

National Service Scheme/Physical Education (Sport and Athletics)/ Yoga:

(1) Securing 40 % or more in CIE,35 % or more marks in SEE and 40 % or more in the sum total of CIE + SEE leads to successful completion of the registered course.

(2) In case, students fail to secure 35 % marks in SEE, they has to appear for SEE during the subsequent examinations conducted by the University.

(3) In case, any student fails to register for NSS, PE or Yoga/fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have not completed the requirements of the course. In such a case, the student has to fulfill the course requirements during subsequently to earn the qualifying CIE marks subject to the maximum programme period.

(4) Successful completion of the course shall be indicated as satisfactory in the grade card. Non-completion of the course shall be indicated as Unsatisfactory.

(5) These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses shall be mandatory for the award of degree.

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III SEMESTER

Sl. No	Course and Course Code	Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
				Theory Lecture	Tutorial	/	Self -Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	T	P	S					
1	BSC 21MAT31	Transform Calculus, Fourier Series And Numerical Techniques	Maths	2	2	0	0	03	50	50	100	3
2	IPCC 21ME32	Metal casting, Forming and Joining Processes	TD: ME PSB: ME	3	0	2	0	03	50	50	100	4
3	IPCC 21ME33	Material Science and Engineering	TD: ME PSB ME	3	0	2	0	03	50	50	100	4
4	PCC 21ME34	Thermodynamics	TD: ME PSB ME	2	2	0	0	03	50	50	100	3
5	PCC 21MEL35	Machine Drawing and GD & T	TD: ME PSB ME	0	0	2	0	03	50	50	100	1
6	UHV 21UH36	Social Connect and Responsibility	Any Department	0	0	1	0	01	50	50	100	1
7	HSMC 21KSK37/47	Samskrutika Kannada	TD and PSB: HSMC	1	0	0	0	01	50	50	100	1
	HSMC 21KBK37/47	Balake Kannada										
	OR											
	HSMC 21CIP37/47	Constitution of India and Professional Ethics										
8	AEC 21ME38X	Ability Enhancement Course – III	TD: Concerned department PSB: Concerned Board	If offered as Theory Course				01	50	50	100	1
				0	2	0						
				If offered as lab. course				02				
				0	0	2						
								Total	**400**	**400**	**800**	**18**

9	**Scheduled activities for III to VIII semesters**	NMDC 21NS83	National Service Scheme (NSS)	NSS	All students have to register for any one of the course namely National Service Scheme, Physical Education (PE)(Sports and Athletics) and Yoga with the concerned coordinator of the course during the first week of III semester.The activities shall be carried out from (for 5 semesters) between III semester to VIII semester. SEE in the above courses shall be conducted during VIII semester examinations and the accumulated CIE marks shall be added to the SEE marks. Successful completion of the registered course is mandatory for the award of the degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the colander prepared for
		NMDC 21PE83	Physical Education (PE)(Sports and Athletics)	PE	
		NMDC 21YO83	Yoga	Yoga	

					the NSS, PE and Yoga activities.							
Course prescribed to lateral entry Diploma holders admitted to III semester B.E./B.Tech programs												
1	NCMC 21MATDIP31	Additional Mathematics - I	Maths	02	02	--	--	---	100	---	100	0

Note:BSC: Basic Science Course, **IPCC:** Integrated Professional Core Course, **PCC:** Professional Core Course,**INT** –Internship, **HSMC:** Humanity and Social Science & Management Courses, **AEC**–Ability Enhancement Courses. **UHV:** Universal Human Value Course.

L –Lecture, **T –** Tutorial, P- Practical/ Drawing, **S –** Self Study Component, **CIE:** Continuous Internal Evaluation, **SEE:** Semester End Examination.**TD-** Teaching Department, **PSB**: Paper Setting department

21KSK37/47 Samskrutika Kannada is for students who speak, read and write Kannada and **21KBK37/47** Balake Kannada is for non-Kannada speaking, reading, and writing students.

Integrated Professional Core Course (IPCC): Refers to Professional Theory Core Course Integrated with Practicals of the same course. Credit for IPCC can be 04 and its Teaching–Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper.For more details, the regulation governing the Degree of Bachelor of Engineering /Technology (BE/B.Tech.) 2021-22 may be referred.

21INT49 Inter/Intra Institutional Internship: All the students admitted to engineering programs under the lateral entry category shall have to undergo a mandatory 21INT49 Inter/Intra Institutional Internshipof 03 weeks during the intervening period of III and IV semesters. The internship shall be slated for CIE only and will not have SEE. The letter grade earned through CIE shall be included in the IV semester grade card.The internship shall be considered as a head of passing and shall be considered for vertical progression and for the award of degree. Those, who do not take up / complete the internship shall be declared fail and shall have to complete during subsequently after satisfying the internship requirements. The faculty coordinator or mentor shall monitor the students' internship progress and interact with them for the successful completion of the internship.

Non–credit mandatory courses (NCMC):

(A)Additional Mathematics I and II:

(1) These courses are prescribed for III and IV semesters respectively to lateral entry Diploma holders admitted to III semester of B.E./B.Tech., programs. They shall attend the classes during the respective semesters to complete all the formalities of the course and appear for the Continuous Internal Evaluation (CIE). In case, any student fails to register for the said course/fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have secured an F grade. In such a case, the student has to fulfill the course requirements during subsequent semester/s to earn the qualifying CIE marks. These courses are slated for CIE only and has no SEE.

(2) Additional Mathematics I and II shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses shall be mandatory for the award of degree.

(3) Successful completion of the coursesAdditional Mathematics I and IIshall be indicated as satisfactory in the grade card. Non-completion of the courses. Additional Mathematics I and IIshall be indicated as Unsatisfactory.

(B) National Service Scheme/Physical Education (Sport and Athletics)/ Yoga:

(1) Securing 40 % or more in CIE,35 % or more marks in SEE and 40 % or more in the sum total of CIE + SEE leads to successful completion of the registered course.

(2) In case, students fail to secure 35 % marks in SEE, they has to appear for SEE during the subsequent examinations conducted by the University.

(3) In case, any student fails to register for NSS, PE or Yoga/fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have not completed the requirements of the course. In such a case, the student has to fulfill the course requirements during subsequent semester/s to earn the qualifying CIE marks.

(4) Successful completion of the course shall be indicated as satisfactory in the grade card. Non-completion of the course shall be indicated as Unsatisfactory.

(5) These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses shall be mandatory for the award of degree.

Ability Enhancement Course – III			
21ME381	Introduction to PYTHON (0-0-2-0)	21ME383	Digital Society(0-2-0-0)
21ME382	Fundamentals of Virtual Reality (0-2-0-0)		

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IV SEMESTER

Sl. No	Course and Course Code	Course Title	Teaching Department (TD) and Question Paper Setting	Teaching Hours /Week				Examination				Credits
				Theory Lecture	Tutorial	Practical / Drawing	Self -Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	T	P	S					
1	BSC 21ME41	Complex Analysis, Probability and Linear Programming.	Maths	2	2	0	0	03	50	50	100	3
2	IPCC 21ME42	Machining Science and Jigs & Fixtures	TD: ME PSB: ME	3	0	2	0	03	50	50	100	4
3	IPCC 21ME43	Fluid Mechanics	TD: ME PSB: ME	3	0	2	0	03	50	50	100	4
4	PCC 21ME44	Mechanics of Materials	TD: ME PSB: ME	2	2	0	0	03	50	50	100	3
5	AEC 21BE45	Biology For Engineers	BT, CHE, PHY	2	0	0	0	02	50	50	100	2
6	PCC 21MEL46	Mechanical Measurements and Metrology Lab	TD: ME PSB: ME	0	0	2	0	03	50	50	100	1
7	HSMC 21KSK37/47	Samskrutika Kannada	HSMC	1	0	0	0	01	50	50	100	1
	HSMC 21KBK37/47	Balake Kannada										
	OR											
	HSMC 21CIP37/47	Constitution of India & Professional Ethics										
8	AEC 21XX48X	Ability Enhancement Course- IV	TD and PSB: Concerned department	If offered as theory Course: 0	2	0		01	50	50	100	1
				If offered as lab. Course: 0	0	2		02				
9	UHV 21UH49	UniversalHumanValues	Any Department	1	0	0		01	50	50	100	1
10	INT 21INT49	Inter/Intra Institutional Internship	Evaluation By the appropriate authorities	Completed during the intervening period ofII and III semesters by students admitted to first year of BE./B.Tech and during the intervening period of III and IV semesters by Lateral entry students admitted to III semester.				3	100	--	100	2

								Total	**550**	**450**	**1000**	**22**

Course prescribed to lateral entry Diploma holders admitted to III semester of Engineering programs												
1	NCMC 21MATDIP41	Additional Mathematics – II	Maths	02	02	--	--	--	100	--	100	0

Note: BSC: Basic Science Course, IPCC: Integrated Professional Core Course, PCC: Professional Core Course, AEC –Ability Enhancement Courses, HSMC: Humanity and Social Science and Management Courses, UHV- Universal Human Value Courses.

L –Lecture, T – Tutorial, P- Practical/ Drawing, S – Self Study Component, CIE: Continuous Internal Evaluation, SEE: Semester End Examination.

21KSK37/47 Samskrutika Kannada is for students who speak, read and write Kannada and 21KBK37/47 Balake Kannada is for non-Kannada speaking, reading, and writing students.

Integrated Professional Core Course (IPCC): Refers to Professional Theory Core Course Integrated with Practicals of the same course. Credit for IPCC can be 04 and its Teaching – Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from practical part of IPCCshall be included in the SEE question paper.For more details the regulation governing the Degree of Bachelor of Engineering /Technology (BE/B.Tech.) 2021-22 may be referred.

Non – credit mandatory course (NCMC):

Additional Mathematics - II:

(1) Lateral entry Diploma holders admitted to III semester of B.E./B.Tech., shall attend the classes during the IV semester to complete all the formalities of the course and appear for the Continuous Internal Evaluation (CIE). In case, any student fails to register for the said course/fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have secured an F grade. In such a case, the student has to fulfill the course requirements during subsequent semester/s to earn the qualifying CIE marks. These courses are slated for CIE only and has no SEE.

(2) Additional Mathematics I and II shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses shall be mandatory for the award of degree.

(3) Successful completion of the course Additional Mathematics IIshall be indicated as satisfactory in the grade card. Non-completion of the coursesAdditional Mathematics IIshall be indicated as Unsatisfactory.

Ability Enhancement Course – IV			
21ME481	Spread Sheets for Engineers (0-0-2-0)	21ME483	Fundamentals of Augmented Reality (0-2-0-0)
21ME482	Introduction to AI and ML (0-2-0-0)		

Internship of 04 weeks during the intervening period of IV and V semesters; 21INT68Innovation/ Entrepreneurship/ Societalbased Internship.

(1) All the students shall have to undergo a mandatory internship of 04 weeks during the intervening period of IV and V semesters. The internship shall be slated for CIE only and will not have SEE. The letter grade earned through CIE shall be included in the VI semester grade card.The internship shall be considered as a head of passing and shall be considered for vertical progression and for the award of degree. Those, who do not take up / complete the internship shall be considered under F (fail) grade and shall have to complete during subsequently after satisfying the internship requirements.

(2) Innovation/ Entrepreneurship Internshipshall be carried out at industry, State and Central Government /Non-government organizations (NGOs), micro, small and medium enterprise (MSME), Innovation centers or Incubation centers. Innovation need not be a single major breakthrough, it can also be a series of small or incremental changes.Innovation of any kind can also happen outside of the business world.

Entrepreneurship internships offers a chance to gain hands on experience in the world of entrepreneurship and helps to learn what it takes to run a small entrepreneurial business by performing intern duties with an established company. This experience can then be applied to future business endeavours.Start-ups and small companies are a preferred place to learn the business tack ticks for future entrepreneurs as learning how a small business operates will serve the intern well when he/she manages his/her own company. Entrepreneurship acts as a catalyst to open the minds to creativity and innovation.Entrepreneurship internship can be from several sectors, including technology, small and medium-sized, and the service sector.

(3) Societal or social internship.

Urbanization is increasing on a global scale; and yet, half the world's population still resides in rural areas and is devoid of

many things that urban population enjoy. Rural internship, is a work-based activity in which students will have a chance to solve/reduce the problems of the rural place for better living. As proposed under the AICTE rural internship programme, activities under Societal or social internship, particularly in rural areas, shall be considered for 40 points under AICTE activity point programme.

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V SEMESTER

Sl. No	Course and Course Code	Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
				Theory Lecture	Tutorial	/	Self -Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	T	P	S					
1	BSC 21ME51	Theory of Machines	TD: ME PSB: ME	2	2	0	0	03	50	50	100	3
2	IPCC 21ME52	Thermo-fluids Engineering	TD: ME PSB: ME	3	0	2	0	03	50	50	100	4
3	PCC 21ME53	Finite Element Analysis	TD: ME PSB: ME	2	0	2	0	03	50	50	100	3
4	PCC 21ME54	Modern Mobility and Automotive Mechanics	TD: ME PSB: ME	3	0	0	0	03	50	50	100	3
5	PCC 21MEL55	Design lab	TD: ME PSB: ME	0	0	2	0	03	50	50	100	1
6	AEC 21XX56	Research Methodology & Intellectual Property Rights	TD: Any Department PSB: As identified by University	2	0	0	0	02	50	50	100	2
7	HSMC 21CIV57	Environmental Studies	TD: Civil/ Environmental /Chemistry/ Biotech. PSB: Civil Engg	2	0	0	0	1	50	50	100	1
8	AEC 21ME58X	Ability Enhancement Course-V	Concerned Board	If offered as Theory courses: 0	2	0		01	50	50	100	1
				If offered as lab.Courses: 0	0	2		02				
								Total	**400**	**400**	**800**	**18**

Ability Enhancement Course – IV

21ME581	Basics of MATLAB(0-0-2-0)	21ME583	VFX – Visual Effects (0-2-0-0)
21ME582	Digital Marketing (0-2-0-0)		

Note: BSC: Basic Science Course, PCC: Professional Core Course, IPCC: Integrated Professional Core Course, AEC –Ability Enhancement Course INT –Internship, HSMC: Humanity and Social Science & Management Courses.
L –Lecture, T – Tutorial, P- Practical/ Drawing, S – Self Study Component, CIE: Continuous Internal Evaluation, SEE: Semester End Examination.

Integrated Professional Core Course (IPCC): refers to Professional Theory Core Course Integrated with Practical of the same course. Credit for IPCC can be 04 and its Teaching – Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). Theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by CIE only and there shall be no SEE. For more details the regulation governing the Degree of Bachelor of Engineering /Technology (BE/B.Tech.) 2021-22 may be referred.

30.08.2022

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VI SEMESTER

Sl. No	Course and Course Code	Course Title	Department (TD) and Question Paper Setting Board	Teaching Hours /Week				Examination				Credits
				Theory Lecture	Tutorial	/	Self -Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	T	P	S					
1	HSMC 21ME61	Production and Operations Management	TD: ME PSB: ME	3	0	0	0	03	50	50	100	3
2	IPCC 21ME62	Heat Transfer	TD: ME PSB: ME	3	0	2	0	03	50	50	100	4
3	PCC 21ME63	Machine design	TD: ME PSB: ME	2	2	0	0	03	50	50	100	3
4	PEC 21ME64x	ProfessionalElective Course-I	TD: ME PSB: ME	3	0	0	0	03	50	50	100	3
5	OEC 21ME65x	OpenElective Course-I	TD: ME PSB: ME	3	0	0	0	03	50	50	100	3
6	PCC 21MEL66	CNC Programming and 3-D Printing Lab	TD: ME PSB: ME	0	0	2	0	03	50	50	100	1
7	MP 21MEMP67	Mini Project		Two contact hours /week for interaction between the faculty and students.				--	100	--	100	2
8	INT 21INT68	Innovation/Entrepreneurship /Societal Internship	Completed during the intervening period of IV and V semesters.					--	100	--	100	3
								Total	**500**	**300**	**800**	**22**

Professional Elective – I			
21ME641	Supply Chain Management & Introduction to SAP	21ME643	Autonomous vehicles
21ME642	Mechatronic System Design	21ME644	Internet of Things (IoT) (2-0-2-0)

Open Electives – I offered by the Department to other Department students			
21ME651	Project Management	21ME653	Mechatronics
21ME652	Renewable Energy Power Plants	21ME654	Modern Mobility

Note: HSMC: Humanity and Social Science & Management Courses, **IPCC:** Integrated Professional Core Course, **PCC:** Professional Core Course, **PEC:** Professional Elective Courses, O**EC**–Open Elective Course, **MP** –Mini Project, INT – Internship.

L –Lecture, T – Tutorial, P - Practical / Drawing, S – Self Study Component, CIE: Continuous Internal Evaluation, SEE: Semester End Examination.

Integrated Professional Core Course (IPCC): Refers to Professional Theory Core Course Integrated with Practical of the same course. Credit for IPCC can be 04 and its Teaching – Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by CIE only and there shall be no SEE. For more details, the regulation governing the Degree of Bachelor of Engineering /Technology (BE/B.Tech) 2021-22 may be referred.

Professional Elective Courses(PEC):

A professional elective (PEC) course is intended to enhance the depth and breadth of educational experience in the

Engineering and Technology curriculum. Multidisciplinary courses that are added supplement the latest trend and advanced technology in the selected stream of engineering. Each group will provide an option to select one course out of five course. The minimum students' strength for offering professional electives is 10. However, this conditional shall not be applicable to cases where the admission to the programme is less than 10.

Open Elective Courses:

Students belonging to a particular stream of Engineering and Technology are not entitled for the open electives offered by their parent Department. However, they can opt an elective offered by other Departments, provided they satisfy the prerequisite condition if any. Registration to open electives shall be documented under the guidance of the Program Coordinator/ Advisor/Mentor.

Selection of an open elective shall **not be allowed** if,

(i) The candidate has studied the same course during the previous semesters of the program.

(ii) The syllabus content of open electives is similar to that of the Departmental core courses or professional electives.

(iii) A similar course, under any category, is prescribed in the higher semesters of the program.

In case, any college is desirous of offering a course (not included in the Open Elective List of the University) from streams such as Law, Business (MBA), Medicine, Arts, Commerce, etc., can seek permission, at least one month before the commencement of the semester, from the University by submitting a copy of the syllabus along with the details of expertise available to teach the same in the college.

The minimum students' strength for offering open electives is 10. However, this conditional shall not be applicable to cases where the admission to the programme is less than 10.

Mini-project work: Mini Project is a laboratory-oriented course which will provide a platform to students to enhance their practical knowledge and skills by the development of small systems/applications.

Based on the ability/abilities of the student/s and recommendations of the mentor, a single discipline or a multidisciplinary Mini- project can be assigned to an individual student or to a group having not more than 4 students.

CIE procedure for Mini-project:

(i) Single discipline: The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two faculty members of the Department, one of them being the Guide. The CIE marks awarded for the Mini-project work shall be based on the evaluation of project report, project presentation skill, and question and answer session in the ratio of 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

(ii) Interdisciplinary: Continuous Internal Evaluation shall be group-wise at the college level with the participation of all the guides of the project.

The CIE marks awarded for the Mini-project, shall be based on the evaluation of project report, project presentation skill, and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

No SEE component for Mini-Project.

VII semester Classwork and Research Internship /Industry Internship (21INT82)

Swapping Facility

Institutions can swap VII and VIII Semester Scheme of Teaching and Examinations to accommodate research internship/ industry internship after the VI semester**.**

(2) Credits earned for the courses of VII and VIII Semester Scheme of Teaching and Examinations shall be counted against the corresponding semesters whether VII or VIII semester is completed during the beginning of IV year or later part of IV year of the program.

Elucidation:

At the beginning of IV year of the programme i.e., after VI semester, VII semester classwork and VIII semester Research Internship /Industrial Internship shall be permitted to be operated simultaneously by the University so that students have ample opportunity for internship. In other words, a good percentage of the class shall attend VII semester classwork and similar percentage of others shall attend to Research Internship or Industrial Internship.

Research/Industrial Internship shall be carried out at an Industry, NGO, MSME, Innovation centre, Incubation centre, Start-up, Centers of Excellence (CoE), Study Centre established in the parent institute and /or at reputed research organizations / institutes. The intership can also be rural internship.

The mandatory Research internship /Industry internship is for 24 weeks. The internship shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not take up/complete the internship shall be declared fail and shall have to complete during the subsequent University examination after satisfying the internship

requirements.

INT21INT82 Research Internship/ Industry Internship/Rural Internship

Research internship: A research internship is intended to offer the flavour of current research going on in the research field. It helps students get familiarized with the field and imparts the skill required for carrying out research.

Industry internship: Is an extended period of work experience undertaken by students to supplement their degree for professional development. It also helps them learn to overcome unexpected obstacles and successfully navigate organizations, perspectives, and cultures. Dealing with contingencies helps students recognize, appreciate, and adapt to organizational realities by tempering their knowledge with practical constraints.

Rural internship: A long-term goal, as proposed under the AICTE rural internship programme, shall be counted as rural internship activity.

The student can take up Interdisciplinary Research Internship or Industry Internship.

The faculty coordinator or mentor has to monitor the students' internship progress and interact with them to guide for the successful completion of the internship.

The students are permitted to carry out the internship anywhere in India or abroad. University shall not bear any expenses incurred in respect of internship.

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Swappable VII and VIII SEMESTER

VII SEMESTER

Sl. No	Course and Course Code	Course Title	Department (TD) and Question Paper Setting Board	Teaching Hours /Week				Examination				Credits
				Theory Lecture	Tutorial	Practical / Drawing	Self -Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	T	P	S					
1	PCC 21ME71	Automation and Robotics	TD: ME PSB: ME	3	0	0	0	3	50	50	100	3
2	PCC 21ME72	Control Engg	TD: ME PSB: ME	3	0	0	0	3	50	50	100	2
3	PEC 21ME73X	Professional elective Course-II	TD: ME PSB: ME	3	0	0	0	3	50	50	100	3
4	PEC 21ME74X	Professional elective Course-III	TD: ME PSB: ME	3	0	0	0	3	50	50	100	3
5	OEC 21ME75X	Open elective Course-II	TD: ME PSB: ME	3	0	0	0	3	50	50	100	3
6	Project 21MEP76	Project work		Two contact hours /week for interaction between the faculty and students.				3	100	100	200	10
								Total	**350**	**350**	**700**	**24**

VIII SEMESTER

Sl. No	Course and Course Code		Course Title	Teaching Department	Teaching Hours /Week				Examination				Credits
					Theory Lecture	Tutorial	Practical / Drawing	Self -Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	Seminar 21XX81		Technical Seminar		One contact hour /week for interaction between the faculty and students.				--	100	--	100	01
2	INT 21INT82		Research Internship/ Industry Internship		Two contact hours /week for interaction between the faculty and students.				03 (Batch wise)	100	100	200	15
3	NCMC	21NS83	National Service Scheme (NSS)	NSS	Completed during the intervening period of III semester to VIII semester.				--	50	50	100	0
		21PE83	Physical Education (PE) (Sports and Athletics)	PE									
		21YO83	Yoga	Yoga									
									Total	**250**	**150**	**400**	**16**

Professional Elective – II

21ME731	Additive Manufacturing	21ME734	MEMS and Microsystem Technology
21ME732	Total Quality Management	21ME735	Design for Manufacturing and Assembly
21ME733	Refrigeration and Air conditioning		

Professional Elective – III			
21ME741	Advanced Vibrations and Condition Monitoring	21ME744	Product Design and Ergonomics
21ME742	Theory and Design of IC Engines		
21ME743	Advanced Turbomachines		

Open Electives - II offered by the Department to other Department students			
21ME751	Non-traditional Machining	21ME7533	Operations Research
21ME752	Hydraulics and Pneumatics		

Note: PCC: Professional Core Course, **PEC:** Professional Elective Courses, **OEC**–Open Elective Course, **AEC** –Ability Enhancement Courses.

L –Lecture, T – Tutorial, P- Practical / Drawing, S – Self Study Component, CIE: Continuous Internal Evaluation, SEE: Semester End Examination.

Note: VII and VIII semesters of IV year of the programme

(1) Institutions can swap VII and VIII Semester Scheme of Teaching and Examinations to accommodate research internship/ industry internship after the VI semester**.**

(2) Credits earned for the courses of VII and VIII Semester Scheme of Teaching and Examinations shall be counted against

PROJECT WORK (21XXP75): The objective of the Project work is

(i) To encourage independent learning and the innovative attitude of the students.

(ii) To develop interactive attitude, communication skills, organization, time management, and presentation skills.

(iii) To impart flexibility and adaptability.

(iv) To inspire team working.

(v) To expand intellectual capacity, credibility, judgment and intuition.

(vi) To adhere to punctuality, setting and meeting deadlines.

(vii) To instill responsibilities to oneself and others.

(viii) To train students to present the topic of project work in a seminar without any fear, face the audience confidently, enhance communication skills, involve in group discussion to present and exchange ideas.

CIE procedure for Project Work:

(1) Single discipline: The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide.

The CIE marks awarded for the project work, shall be based on the evaluation of project work Report, project presentation skill, and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

(2) Interdisciplinary: Continuous Internal Evaluation shall be group-wise at the college level with the participation of all

TECHNICAL SEMINAR (21XXS81): The objective of the seminar is to inculcate self-learning, present the seminar topic confidently, enhance communication skill, involve in group discussion for exchange of ideas. Each student, under the guidance of a Faculty, shall choose, preferably, a recent topic of his/her interest relevant to the programme of Specialization.

(i) Carry out literature survey, systematically organize the content.

(ii) Prepare the report with own sentences, avoiding a cut and paste act.

(iii) Type the matter to acquaint with the use of Micro-soft equation and drawing tools or any such facilities.

(iv) Present the seminar topic orally and/or through PowerPoint slides.

(v) Answer the queries and involve in debate/discussion.

(**vi)** Submit a typed report with a list of references.

The participants shall take part in the discussion to foster a friendly and stimulating environment in which the students are motivated to reach high standards and become self-confident.

Evaluation Procedure:

The CIE marks for the seminar shall be awarded (based on the relevance of the topic, presentation skill, participation in the question and answer session, and quality of report) by the committee constituted for the purpose by the Head of the Department. The committee shall consist of three teachers from the department with the senior-most acting as the Chairman.

Marks distribution for CIE of the course:

Seminar Report:50 marks

Presentation skill:25 marks

Question and Answer: 25 marks. ■ No SEE component for Technical Seminar

Non – credit mandatory courses (NCMC):

National Service Scheme/Physical Education (Sport and Athletics)/ Yoga:

(1) Securing 40 % or more in CIE,35 % or more marks in SEE and 40 % or more in the sum total of CIE + SEE leads to successful completion of the registered course.

(2) In case, students fail to secure 35 % marks in SEE, they has to appear for SEE during the subsequent examinations conducted by the University.

(3) In case, any student fails to register for NSS, PE or Yoga/fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have not completed the requirements of the course. In such a case, the student has to fulfill the course requirements during subsequently to earn the qualifying CIE marks subject to the maximum programme period.

(4) Successful completion of the course shall be indicated as satisfactory in the grade card. Non-completion of the course shall be indicated as Unsatisfactory.

(5) These course shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses shall be mandatory for the award of degree.

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI
Scheme of Teaching and Examinations – 2020 - 21
Choice Based Credit System (CBCS) and Outcome Based Education(OBE)

Programme: M.TECH IN SIGNAL PROCESSING (ESP)

I SEMESTER

Sl. No	Course	Course Code	Course Title	Teaching Hours /Week		Examination				Credits
				Theory	Practical/ Field work/ Assignment	Duration in hours	CIE Marks	SEE Marks	Total Marks	
1	PCC	20ELD11	Advanced Engineering Mathematics	04	--	03	40	60	100	4
2	PCC	20ECS12	Advanced Digital Signal Processing	04	--	03	40	60	100	4
3	PCC	20EVE13	Advanced Embedded System	04	--	03	40	60	100	4
4	PCC	20ESP14	Multirate Systems and Filter Banks	04	--	03	40	60	100	4
5	PCC	20ESP15	Digital Compression	04	--	03	40	60	100	4
6	PCC	20ESPL16	Advanced Digital Signal Processing Lab	-	04	03	40	60	100	2
7	PCC	20RMI17	Research Methodology and IPR	02	--	03	40	60	100	2
			TOTAL	**22**	**04**	**21**	**280**	**420**	**700**	**24**

Note: PCC: Professional core.

Internship: All the students have to undergo mandatory internship of 6 weeks during the vacation of I and II

semesters and /or II and III semesters. A University examination shall be conducted during III semester and the prescribed credit shall be counted for the same semester. Internship shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not take-up/complete the internship shall be declared as fail in internship course and have to complete the same during the subsequent University examination after satisfying the internship requirements.
Note: (i) Four credit courses are designed for 50 hours Teaching – Learning process. (ii) Three credit courses are designed for 40 hours Teaching – Learning process.

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI

Scheme of Teaching and Examinations – 2020 - 21

Choice Based Credit System (CBCS) and Outcome Based Education(OBE)

Programme: M.TECH IN SIGNAL PROCESSING (ESP)

II SEMESTER

Sl. No	Course	Course Code	Course Title	Teaching Hours /Week		Examination				Credits
				Theory	Practical/ Field work/ Assignment/ Project	Duration in hours	CIE Marks	SEE Marks	Total Marks	
1	PCC	20ESP21	Image Processing and Machine Vision	04	--	03	40	60	100	4
2	PCC	20ESP22	DSP System Design	04	--	03	40	60	100	4
3	PCC	20ECS23	Error Control Coding	04	--	03	40	60	100	4
4	PEC	20XXX24X	Professional elective 1	04	--	03	40	60	100	4
5	PEC	20XXX25X	Professional elective 2	04	--	03	40	60	100	4
6	PCC	20ESPL26	Image Processing Lab	--	04	03	40	60	100	2
7	PCC	20ESP27	Technical Seminar	--	02	--	100	--	100	2
TOTAL				**20**	**06**	**20**	**340**	**360**	**700**	**24**

Note: PCC: Professional core, PEC: Professional Elective.

Professional Elective 1		Professional Elective 2	
Course Code under 20XXX24X	**Course title**	**Course Code under 20XXX25X**	**Course title**
20ECS241	Wireless Sensor Networks	20ESP251	Biomedical Signal Processing
20EVE242	Nanoelectronics	20ECS252	Statistical Signal Processing
20ECS243	Cryptography and Network Security (20EVE334)	20ELD253	Micro Electro Mechanical Systems
20ELD244	Reconfigurable Computing	20ESP254	Detection and Estimation

Note:

1. Technical Seminar: CIE marks shall be awarded by a committee comprising of HoD as Chairman, Guide/co-guide, if any, and a senior faculty of the department. Participation in the seminar by all postgraduate students of the same and other semesters of the programme shall be mandatory.

The CIE marks awarded for Technical Seminar, shall be based on the evaluation of Seminar Report, Presentation skill and Question and Answer session in the ratio 50:25:25.

2. Internship: All the students shall have to undergo mandatory internship of 6 weeks during the vacation of I and II semesters and /or II and III semesters. A University examination shall be conducted during III semester and the prescribed credit shall be counted in the same semester. Internship shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not take-up/complete the internship shall be declared as fail in internship course and have to complete the same during the subsequent University examination after satisfying the internship requirements.

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI
Scheme of Teaching and Examinations – 2020 - 21
Choice Based Credit System (CBCS) and Outcome Based Education(OBE)

Programme: M.TECH IN SIGNAL PROCESSING (ESP)

III SEMESTER

Sl. No	Course	Course Code	Course Title	Teaching Hours /Week		Examination				Credits
				Theory	Practical/ Field work/ Assignment	Duration in hours	CIE Marks	SEE Marks	Total Marks	
1	PCC	20ESP31	Adaptive Signal Processing	04	--	03	40	60	100	4
2	PEC	20XXX32X	Professional elective 3	03	--	03	40	60	100	3
3	PEC	20XXX33X	Professional elective 4	03	--	03	40	60	100	3
4	PROJ	20ESP34	Project Work phase -1	--	02	--	100	--	100	2
5	PROJ	20ESP35	Mini-Project	--	02	--	100	--	100	2
6	INT	20ESPI36	Internship	(Completed during the intervening vacation of I and II semesters and /or II and III semesters.)		03	40	60	100	6
TOTAL				**10**	**04**	**12**	**360**	**240**	**600**	**20**

Note: PCC: Professional core, PEC: Professional Elective. PROJ-Project, INT-Internship

Professional elective 3		Professional elective 4	
Course Code under 20XXX32X	**Course title**	**Course Code under 20XXX33X**	**Course title**
20ESP321	Array Signal Processing	20EVE331	VLSI Design for Signal Processing
20EIE322	Medical Imaging	20ESP332	Pattern Recognition & Machine Learning
20ELD323	Business Intelligence and its Applications	20ECS333	Internet of Things
20ESP324	Speech and Audio Processing	20ESP334	Communication System Design using DSP Algorithms

Note:

1. **Project Work Phase-1:** Students in consultation with the guide & co-guide if any, shall pursue literature survey and complete the preliminary requirements of selected Project work. Each student shall prepare relevant introductory project phase-I report, and make a project presentation.
   CIE marks shall be awarded by a committee comprising of HoD as Chairman, Guide/co-guide if any, and a senior faculty of the department. The CIE marks awarded for project work phase -1, shall be based on the evaluation of Project Report, Project Presentation skill and Question and Answer session in the ratio 50:25:25.
   SEE (University examination) shall be as per the University norms.
2. **Mini-Project**: Each student shall involve in carrying out the Mini-project work in constant consultation with internal guide, prepare the project report as per the norms avoiding plagiarism. A mini project is an assignment that you try to complete at the end of semester to strengthen the understanding of his/her fundamentals through effective application of theoretical concepts.
3. **Internship:** Those, who have not pursued /completed the internship shall be declared as fail in internship

course and have to complete the same during subsequent University examinations after satisfying the internship requirements. Internship SEE (University examination) shall be as per the University norms.

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI
Scheme of Teaching and Examinations – 2020 - 21
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)

Programme: M.TECH IN SIGNAL PROCESSING (ESP)

IV SEMESTER

Sl. No	Course	Course Code	Course Title	Teaching Hours /Week		Examination				Credits
				Theory	Practical/ Field work/ Assignment	Duration in hours	CIE Marks	SEE Marks Viva voce	Total Marks	
1	Project	20ESP41	Project work phase -2	--	04	03	40	60	100	20
			TOTAL	--	**04**	**03**	**40**	**60**	**100**	**20**

Note:

1. Project Phase-2:

CIE marks shall be awarded by a committee comprising of HoD as Chairman, Guide/co-guide, if any, and a Senior faculty of the department. The CIE marks awarded for project work phase -2, shall be based on the evaluation of Project Report subjected to plagiarism check, Project Presentation skill and Question and Answer session in the ratio 50:25:25.

SEE shall be at the end of IV semester. Project work evaluation and Viva-Voce examination (SEE), after satisfying the plagiarism check, shall be as per the University norms.

VISVESVARAYA TECHNOLOGICAL UNIVERSITY
BELAGAVI

Scheme of Teaching and Examinations and Syllabus
M.Tech in Signal Processing (ESP)
(Effective from Academic year 2020 - 21)

M.TECH IN Signal Processing (ESP)

Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
(Effective from the academic year 2020-21)

SEMESTER -I

ADVANCED ENGINEERING MATHEMATICS

Course Code	**20ELD11**	CIE Marks	40
Lecture Hours/Week	**04**	SEE Marks	60
Total Number of Lecture Hours	**50**	Exam Hours	03
Credits - 04			

Module-1

Linear Algebra-I
Introduction to vector spaces and sub-spaces, definitions, illustrative example. Linearly independent and dependent vectors- Basis-definition and problems. Linear transformations-definitions. Matrix form of linear transformations-Illustrative examples (Text Book 1).

Module-2

Linear Algebra-II
Computation of eigen values and eigen vectors of real symmetric matrices-Given's method. Orthogonal vectors and orthogonal bases. Gram-Schmidt orthogonalization process (Text Book 1).

Module-3

Calculus of Variations
Concept of functional- Eulers equation. Functional dependent on first and higher order derivatives, Functional on several dependent variables. Isoperimetric problems-variation problems with moving boundaries. (Text Book 2).

Module-4

Probability Theory: Review of basic probability theory. Definitions of random variables and probability distributions, probability mass and density functions, expectation, moments, central moments, characteristic functions, probability generating and moment generating functions-illustrations. Poisson, Gaussian and Erlang distributions examples (Text Book 3).

Module-5

Engineering Applications on Random processes: Classification. Stationary, WSS and ergodic random process. Auto-correlation function - properties, Gaussian random process (Text Book 3).

Course outcomes:

At the end of the course the student will be able to:

1. Understand vector spaces, basis, linear transformations and the process of obtaining matrix of linear transformations arising in magnification and rotation of images.
2. Apply the technique of singular value decomposition for data compression, least square approximation in solving inconsistent linear systems.
3. Utilize the concepts of functional and their variations in the applications of communication systems, decision theory, synthesis and optimization of digital circuits.
4. Learn the idea of random variables (discrete/continuous) and probability distributions in analyzing the probability models arising in control systems and system communications.
5. Analyze random process through parameter-dependent variables in various random processes.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbooks:

1. 'Linear Algebra and its Applications', David C Lay, Steven R Lay and J J McDonald, Pearson Education Ltd., 5th Edition, 2015
2. 'Differential Equations and Calculus of Variations', Elsgolts L, MIR Publications, 3rd Edition, 1977
3. 'Probability, Statistics and Random Process', T Veerarajan, Tata Mc-Graw Hill Co., 3rd Edition, 2016

Reference Books:

1. 'Introduction to Linear Algebra', Gilbert Strang, Wellesley-Cambridge Press, 5th Edition, 2016
2. 'Schaum's Outlines of Theory and Problems of Matrix Operations', Richard Bronson, McGraw-Hill, 1988
3. 'Probability and Random Process with application to Signal Processing', Scott L Miller, Donald G Childers, Elsevier Academic Press, 2nd Edition, 2013

Advanced Digital Signal Processing

Course Code	**20ECS12**	CIE Marks	40
Lecture Hours/Week	**04**	SEE Marks	60
Total Number of Lecture Hours	**50**	Exam Hours	03
Credits - 04			

Module-1

Multirate Digital Signal Processing: Introduction, decimation by a factor 'D', Interpolation by a factor 'I', sampling rate conversion by a factor 'I/D', Implementation of sampling rate conversion, Multistage implementation of sampling rate conversion, Applications of multirate signal processing, Digital filter banks, two channel quadrature mirror filter banks, M-channel QMF bank (Text 1).

Module-2

Linear prediction and Optimum Linear Filters: Random signals, Correlation Functions and Power Spectra, Innovations Representation of a Stationary Random Process. Forward and Backward Linear Prediction. Solution of the Normal Equations. The Levinson-Durbin Algorithm. Properties of the Linear Prediction-Error Filters (Text 1).

Module-3

Adaptive filters: Applications of Adaptive Filters-Adaptive Channel Equalization, Adaptive noise cancellation, Linear Predictive coding of Speech Signals, Adaptive direct form FIR filters-The LMS algorithm, Properties of LMS algorithm. Adaptive direct form filters- RLS algorithm (Text 1).

Module-4

Power Spectrum Estimation: Non parametric Methods for Power Spectrum Estimation - Bartlett Method, Welch Method, Blackman and Tukey Methods.
Parametric Methods for Power Spectrum Estimation: Relationship between the auto correlation and the model parameters, Yule and Walker methods for the AR Model Parameters, Burg Method for the AR Model parameters, Unconstrained least-squares method for the AR Model parameters, Sequential estimation methods for the AR Model parameters, ARMA Model for Power Spectrum Estimation (Text 1).

Module-5

WAVELET TRANSFORMS: The Age of Wavelets, The origin of Wavelets, Wavelets and other reality transforms, History of wavelets, Wavelets of the future.

Continuous Wavelet and Short Time Fourier Transform: Wavelet Transform, Mathematical preliminaries, Properties of wavelets.

Discrete Wavelet Transform: Haar scaling functions, Haar wavelet function, Daubechies Wavelets (Chapters 1, 3 & 4 of Text 2).

Course outcomes:

At the end of the course the student will be able to:

1. Design adaptive filters for a given application
2. Design multirate DSP Systems
3. Implement adaptive signal processing algorithm
4. Design active networks
5. Understand advanced signal processing techniques, including multi-rate processing and time-frequency analysis techniques

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbooks:

1. 'Digital Signal Processing, Principles, Algorithms and Applications', John G. Proakis, Dimitris G.Manolakis, Pearson, Fourth edition, 2007
2. 'Insight into Wavelets- from Theory to Practice', K P Soman, Ramachandran, Resmi, PHI, Third Edition, 2010

Advanced Embedded System

Course Code	**20EVE13**	CIE Marks	40
Lecture Hours/Week	**04**	SEE Marks	60
Total Number of Lecture Hours	**50**	Exam Hours	03
Credits - 04			

Module-1

Embedded System: Embedded vs General computing system, classification, application and purpose of ES. Core of an Embedded System, Memory, Sensors, Actuators, LED, Opto coupler, Communication Interface, Reset circuits, RTC, WDT, Characteristics and Quality Attributes of Embedded Systems (Text 1: Selected Topics from Ch -1, 2, 3).

Module-2

Hardware Software Co-Design, embedded firmware design approaches, computational models, embedded firmware development languages, Integration and testing of Embedded Hardware and firmware, Components in embedded system development environment (IDE), Files generated during compilation, simulators, emulators and debugging (Text 1: Selected Topics from Ch-7, 9, 12, 13).

Module-3

ARM-32 bit Microcontroller: Thumb-2 technology and applications of ARM, Architecture of ARM Cortex M3, Various Units in the architecture, General Purpose Registers, Special Registers, exceptions, interrupts, stack operation, reset sequence (Text 2: Ch 1, 2, 3).

Module-4

Instruction Sets: Assembly basics, Instruction list and description, useful instructions, Memory Systems, Memory maps, Cortex M3 implementation overview, pipeline and bus interface (Text 2: Ch-4, 5, 6).

Module-5

Exceptions, Nested Vector interrupt controller design, Systick Timer, Cortex-M3 Programming using assembly and C language, CMSIS (Text 2: Ch-7, 8, 10).

Course outcomes:

At the end of the course the student will be able to:

1. Understand the basic hardware components and their selection method based on the characteristics and attributes of an embedded system.
2. Explain the hardware software co-design and firmware design approaches.
3. Understand the suitability of the instruction sets of ARM processors to design of embedded systems.
4. Acquire the knowledge of the architectural features of ARM CORTEX M3, a 32-bit microcontroller including memory map, interrupts and exceptions.
5. Apply the knowledge gained for Programming ARM CORTEX M3 for different applications.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Students have to conduct the following experiments as a part of CIE marks along with other Activities:

ARM Cortex M3 Programs - Programming to be done using Keil uVision 4 and download the program on to a M3 evaluation board such as NXP LPC1768 or ATMEL ARM

a) Write an Assembly language program to calculate the sum and display the result for the addition of first ten numbers. SUM = 10+9+8+.....+1

b) Write an Assembly language program to store data in RAM

c) Write a C program to output the “Hello World” message using UART

d) Write a C program to operate a buzzer using Cortex M3

e) Write a C program to display the temperature sensed using Cortex M3.

f) Write a C program to control stepper motor using Cortex M3.

Textbooks:

1. 'Introduction to embedded systems', K. V. Shibu, TMH education Pvt. Ltd., 2009
2. 'The Definitive Guide to the ARM Cortex-M3', Joseph Yiu, Newnes, (Elsevier), 2nd edn, 2010.

Reference Book:

'Embedded systems - A contemporary design tool', James K. Peckol, John Wiley, 2008

Multirate Systems and Filter Banks

Course Code	**20ESP14**	CIE Marks	40
Lecture Hours/Week	**04**	SEE Marks	60
Total Number of Lecture Hours	**50**	Exam Hours	03
Credits - 04			

Module-1

Fundamentals of Multirate Systems: Basic multi-rate operations, interconnection of building blocks, poly-phase representation, multistage implementation, applications of multi-rate systems, special filters and filter banks (Text 1).

Module-2

Maximally decimated filter banks: Errors created in the QMF bank, alias-free QMF system, power symmetric QMF banks, M-channel filter banks, poly-phase representation, perfect reconstruction systems, alias-free filter banks, tree structured filter banks, trans-multiplexers (Text 1).

Module-3

Para-unitary Perfect Reconstruction Filter Banks: Lossless transfer matrices, filter bank properties induced by paraunitariness, two channel Para-unitary lattices, M-channel FIR Para-unitary QMF banks, transform coding (Text 1).

Module-4

Linear Phase Perfect Reconstruction QMF Banks: Necessary conditions, lattice structures for linear phase FIR PR QMF banks, formal synthesis of linear phase FIR PR QMF lattice (Text 1).

cosine Modulated Filter Banks: Pseudo-QMF bank and its design, efficient poly-phase structures, properties of cosine matrices, cosine modulated perfect reconstruction systems (Text 1).

Module-5

Wavelet Transform: Short-time Fourier transform, Wavelet transform, discrete-time Ortho-normal wavelets, continuous time Ortho-normal wavelets (Text 2).

Course outcomes:

At the end of the course the student will be able to:

1. Comprehend the theory of sampling rate conversion, fundamentals of multirate signal processing and its applications,
2. Develop methods for decimation, interpolation & realization of efficient polyphase implementations of sampling rate converters.
3. Explain multirate filter banks, the theoretical and practical aspects of multirate signal processing and the applications of filter banks.
4. Design perfect reconstruction filter bank system.
5. Assess the computational efficiency of multirate systems & also Analyze the quantization effects in filter banks.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbooks:

1. 'Multirate Systems and Filter Banks', P P Vaidyanathan, Pearson Education (Asia) Pvt. Ltd, 2004.
2. 'Wavelets and Filter Banks', Gilbert Strang and Truong Nguyen, Wellesley-Cambridge Press, 1996.

Reference Books:

1. 'Multirate Digital Signal Processing', N. J. Fliege, John Wiley & Sons, 2000.
2. 'Multiresolution and Multirate Signal Processing: Introduction, Principles and Applications', Vikram Gadre & Aditya Abhyankar, McGraw Hill Education, First edition, 2017.
3. 'Modern Spectral Estimation', Steven M. Kay Pearson Education, First edition, 2017.

Digital Compression

Course Code	**20ESP15**	CIE Marks	40
Lecture Hours/Week	**04**	SEE Marks	60
Total Number of Lecture Hours	**50**	Exam Hours	03
Credits - 04			

Module-1

Introduction: Compression techniques, Modelling & coding, Distortion criteria, Differential Entropy, Rate Distortion Theory, Vector Spaces, Information theory, Models for sources, Coding uniquely decodable codes, Prefix codes, Kraft McMillan Inequality.
Quantization: Quantization problem, Uniform Quantizer, Adaptive Quantization, Non-uniform Quantization; Entropy coded Quantization, Vector Quantization, LBG algorithm, Tree structured VQ, Structured VQ.

Module-2

Differential Encoding: Basic algorithm, Prediction in DPCM, Adaptive DPCM, Delta Modulation, Speech coding–G.726, Image coding.
Transform Coding: Transforms – KLT, DCT, DST, DWHT; Quantization and coding of transform coefficients, Application to Image compression – JPEG, Application to audio compression.

Module-3

Sub-band Coding: Filters, Sub-band coding algorithm, Design of filter banks, Perfect reconstruction using two channel filter banks, M-band QMF filter banks, Poly-phase decomposition, Bit allocation, Speech coding– G.722, Audio coding–MPEG audio, Image compression.

Module-4

Wavelet Based Compression: Wavelets, Multi resolution analysis & scaling function, Implementation using filters, Image compression–EZW, SPIHT, JPEG 2000.
Analysis/Synthesis Schemes: Speech compression–LPC10, CELP, MELP.
Video Compression: Motion compensation, Video signal representation, Algorithms for video conferencing & video phones–H.261, H.263, Asymmetric applications–MPEG 4, MPEG 7, Packet video.

Module-5

Loss less Coding: Huffman coding, Adaptive Huffman coding, Golomb codes, Rice codes, Tunstall codes, Applications of Huffman coding, Arithmetic

coding, Algorithm implementation, Applications of Arithmetic coding, Dictionary techniques–LZ77, LZ78, Applications of LZ78– JBIG, JBIG2, Predictive coding– Prediction with partial match, Burrows Wheeler Transform, Applications– CALIC, JPEG-LS.

Course outcomes:

At the end of the course the student will be able to:

1. Explain the evolution and fundamental concepts of Data Compression and Coding techniques.
2. Acquire contemporary knowledge in Data Compression and Coding.
3. Analyze the operation of a range of commonly used Coding and Compression techniques
4. Identify the basic software and hardware tools used for data compression.
5. Analyze and evaluate the performance of different Data Compression and Coding methods.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbook:

'Introduction to Data Compression', K Sayood, Harcourt India Pvt. Ltd. & Morgan Kaufmann Publishers, 1996.

Reference Books:

1. 'Digital Coding of Waveforms: Principles and Applications to Speech and Video', N Jayant and P Noll, Prentice Hall, USA, 1984.
2. 'Data Compression: The Complete Reference', D Salomon, Springer, 2000.
3. 'Fundamentals of Multimedia', Z Li and M S Drew, Pearson Education (Asia) Pvt. Ltd., 2004.

Advanced Digital Signal Processing Lab

Course Code	**20ESPL16**	CIE Marks	40
Teaching Hours/Week	**04** (2 Hrs Tutorial + 2 Hrs Practical)	SEE Marks	60
		Exam Hours	03
Credits - 02			

Sl.No	**Experiments**
1	Generate various fundamental discrete time signals.
2	Basic operations on signals (Multiplication, Folding, Scaling).
3	Find out the DFT & IDFT of a given sequence without using inbuilt instructions.
4	Interpolation & decimation of a given sequence.
5	Generation of DTMF (Dual Tone Multiple Frequency) signals.
6	Estimate the PSD of a noisy signal using periodogram and modified periodogram.
7	Estimation of PSD using different methods (Bartlett, Welch, Blackman-Tukey).
8	Design of Chebyshev Type I, II Filters.
9	Cascade Digital IIR Filter Realization.
10	Parallel Realization of IIR filter.
11	Estimation of power spectrum using parametric methods (Yule-Walker & Burg).
12	Design of LPC filter using Levinson-Durbin algorithm.
13	Time-Frequency Analysis with the Continuous Wavelet Transform.
14	Signal Reconstruction from Continuous Wavelet Transform Coefficients.

Course outcomes:

At the end of the course the student will be able to carry out:

1. Filter design.
2. Filter Realization
3. Signal Manipulations
4. Wavelet Transforms
5. Estimating the PSD using various techniques

Conduct of Practical Examination:

1. All laboratory experiments are to be included for practical examination.
2. Students are allowed to pick one experiment from the lot.
3. Strictly follow the instructions as printed on the cover page of answer script for breakup of marks.
4. Change of experiment is allowed only once and Marks allotted to the procedure part to be made zero.

Research Methodology and IPR

Course Code	**20RMI17**	CIE Marks	40
Lecture Hours/Week	**02**	SEE Marks	60
		Exam Hours	03
Credits - 02			

Module-1

Research Methodology: Introduction, Meaning of Research, Objectives of Research, Motivation in Research, Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Importance of Knowing How Research is Done, Research Process, Criteria of Good Research, and Problems Encountered by Researchers in India.

Defining the Research Problem: Research Problem, Selecting the Problem, Necessity of Defining the Problem, Technique Involved in Defining a Problem, An Illustration.

Module-2

Reviewing the literature: Place of the literature review in research, Bringing clarity and focus to your research problem, Improving research methodology, Broadening knowledge base in research area, Enabling contextual findings, How to review the literature, searching the existing literature, reviewing the selected literature, Developing a theoretical framework, Developing a conceptual framework, Writing about the literature reviewed.

Research Design: Meaning of Research Design, Need for Research Design, Features of a Good Design, Important Concepts Relating to Research Design, Different Research Designs, Basic Principles of Experimental Designs, Important Experimental Designs.

Module-3

Design of Sampling: Introduction, Sample Design, Sampling and Non-sampling Errors, Sample Survey versus Census Survey, Types of Sampling Designs.

Measurement and Scaling: Qualitative and Quantitative Data, Classifications of Measurement Scales, Goodness of Measurement Scales, Sources of Error in Measurement Tools, Scaling, Scale Classification Bases, Scaling Technics, Multidimensional Scaling, Deciding the Scale.

Data Collection: Experimental and Surveys, Collection of Primary Data, Collection of Secondary Data, Selection of Appropriate Method for Data Collection, Case Study Method.

Module-4

Testing of Hypotheses: Hypothesis, Basic Concepts Concerning Testing of Hypotheses, Testing of Hypothesis, Test Statistics and Critical Region, Critical Value and Decision Rule, Procedure for Hypothesis Testing, Hypothesis Testing for Mean, Proportion, Variance, for Difference of Two Mean, for Difference of Two Proportions, for Difference of Two Variances, P-Value approach, Power of Test, Limitations of the Tests of Hypothesis.

Chi-square Test: Test of Difference of more than Two Proportions, Test of Independence of Attributes, Test of Goodness of Fit, Cautions in Using Chi Square Tests.

Module-5

Interpretation and Report Writing: Meaning of Interpretation, Technique of Interpretation, Precaution in Interpretation, Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Precautions for Writing Research Reports.

Intellectual Property: The Concept, Intellectual Property System in India, Development of TRIPS Complied Regime in India, Patents Act, 1970, Trade Mark Act, 1999,The Designs Act, 2000, The Geographical Indications of Goods (Registration and Protection) Act1999, Copyright Act,1957,The Protection of Plant Varieties and Farmers' Rights Act, 2001,The Semi-Conductor Integrated Circuits Layout Design Act, 2000, Trade Secrets, Utility Models, IPR and Biodiversity, The Convention on Biological Diversity (CBD) 1992, Competing Rationales for Protection of IPRs, Leading International Instruments Concerning IPR, World Intellectual Property Organisation (WIPO),WIPO and WTO, Paris Convention for the Protection of Industrial Property, National Treatment, Right of Priority, Common Rules, Patents, Marks, Industrial Designs, Trade Names, Indications of Source, Unfair Competition, Patent Cooperation Treaty (PCT), Advantages of PCT Filing, Berne Convention for the Protection of Literary and Artistic Works, Basic Principles, Duration of Protection, Trade Related Aspects of Intellectual Property Rights (TRIPS) Agreement, Covered under TRIPS Agreement, Features of the Agreement, Protection of Intellectual Property under TRIPS, Copyright and Related Rights, Trademarks, Geographical indications, Industrial Designs, Patents, Patentable Subject Matter, Rights Conferred, Exceptions, Term of protection, Conditions on Patent Applicants, Process Patents, Other Use without Authorization of the Right Holder, Layout-Designs of Integrated Circuits, Protection of Undisclosed Information, Enforcement of Intellectual Property Rights, UNSECO.

Course outcomes:

At the end of the course the student will be able to:

1. Discuss research methodology and the technique of defining a research problem
2. Explain the functions of the literature review in research, carrying out a literature search, developing theoretical and conceptual frameworks and writing a review.
3. Explain various research designs, sampling designs, measurement and scaling techniques and also different methods of data collections.
4. Explain several parametric tests of hypotheses, Chi-square test, art of interpretation and writing research reports
5. Discuss various forms of the intellectual property, its relevance and business impact in the changing global business environment and leading International Instruments concerning IPR.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbooks:

1. 'Research Methodology: Methods and Techniques', C.R. Kothari, Gaurav Garg, New Age International, 4th Edition, 2018
2. 'Research Methodology a step-by-step guide for beginners. (For the topic Reviewing the literature under module 2)', Ranjit Kumar, SAGE Publications, 3rd Edition, 2011
3. Study Material (For the topic Intellectual Property under module 5) Professional Programme Intellectual Property Rights, Law and Practice, The Institute of Company Secretaries of India, Statutory Body Under an Act of Parliament, September 2013.

Reference Books:

1. 'Research Methods: the concise knowledge base', Trochim, Atomic Dog Publishing, 2005
2. 'Conducting Research Literature Reviews: From the Internet to Paper', Fink A, Sage Publications, 2009

M.TECH IN Signal Processing (ESP)

Choice Based Credit System (CBCS) and Outcome Based Education(OBE)
(Effective from the academic year 2020-21)

SEMESTER -II

Image Processing and Machine Vision

Course Code	**20ESP21**	CIE Marks	40
Lecture Hours/Week	**04**	SEE Marks	60
Total Number of Lecture Hours	**50**	Exam Hours	03
Credits - 04			

Module-1

The image mathematical and physical background: Linearity, The Dirac distribution and convolution, Linear integral transforms, Images as linear systems,
Introduction to linear integral transforms: 2D Fourier transform, Sampling and the Shannon constraint, Discrete cosine transform, Wavelet transform, Eigen-analysis, Singular value decomposition, Principal component analysis, Other orthogonal image transforms, Images as stochastic processes.

Module-2

Image pre-processing: Scale in image processing, Canny edge detection, Parametric edge models, Edges in multi-spectral images, Pre-processing in frequency domain, Line detection, Corner detection, Maximally stable extremal regions,
Image restoration: Degradations that are easy to restore, Inverse filtration, Wiener filtration.

Module-3

Image segmentation: Threshold detection methods, Optimal thresholding, Multi-spectral thresholding, Edge-based segmentation, Edge image thresholding, Edge relaxation, Border tracing, Border detection as graph searching, Border detection as dynamic programming, Hough transforms, Border detection using border location information, Region construction from borders, Region-based segmentation, Region merging, Region splitting, Splitting and merging, Watershed segmentation, Region growing post-processing. **Matching**: Matching criteria, Control strategies of matching.
Evaluation issues in segmentation: Supervised evaluation, Unsupervised evaluation

Module-4

Advanced segmentation: Mean Shift Segmentation, Active contour models-snakes, Traditional snakes and balloons, Extensions, Gradient vector flow snakes, Geometric deformable models-level sets and geodesic active contours, Fuzzy Connectivity,

Contour-based shape representation and description: Chain codes, Simple geometric border representation, Fourier transforms of boundaries, Boundary description using segment sequences, B-spline representation, Other contour-based shape description approaches, Shape invariants.

Module-5

Knowledge representation: Statistical pattern recognition, Classification principles, Classifier setting, Classifier learning, Support Vector Machines, Cluster analysis

Neural nets: Feed-forward networks, Unsupervised learning, Hopfield neural nets

Optimization techniques in recognition: Genetic algorithms, Simulated annealing

Fuzzy systems: Fuzzy sets and fuzzy membership functions, Fuzzy set operators, Fuzzy reasoning, Fuzzy system design and training.

Course outcomes:

At the end of the course the student will be able to:

1. Comprehend the basics of image analysis and computer vision.
2. Relate to low-level vision (early processing) techniques such as binary image analysis, filtering, edge detection and texture analysis.
3. Understand mid-level vision topics such as image segmentation and feature extraction.
4. Apply Image processing techniques to image retrieval, image classification, and object recognition with emphasis on feature extraction and image representations for recognition.
5. Implement a complete image-processing package using standard concepts.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.

- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbook:

'Image Processing, Analysis, and Machine Vision', Milan Sonka, Vaclav Hlavac, Roger Boyle, Cengage Learning, ISBN: 978-81-315-1883-0, 2013

Reference Books:

1. 'Computer Vision and Image Processing', Scott E Umbaugh, Prentice Hall, 1997.
2. 'Fundamentals of Digital Image Processing', A K Jain, Pearson, 2004.
3. 'Digital Image Processing', S Jayaraman, S Esakkirajan, T Veerakumar, Tata McGraw Hill, 2011.

DSP System Design

Course Code	**20ESP22**	CIE Marks	40
Lecture Hours/Week	**04**	SEE Marks	60
Total Number of Lecture Hours	**50**	Exam Hours	03
Credits - 04			

Module-1

Introduction to popular DSP CPU Architecture: CPU Data Paths and Control-Timers-Internal Data/Program Memory External Memory Interface-Programming –Instruction set and Addressing Modes-Code Composer Studio-Code Generation Tools –Code Composer Studio Debug tools –Simulator (Text 1).

Module-2

SHARC Digital Signal Processor: A popular DSP from Analog Devices - SHARC- Architecture - IOP Registers - Peripherals - Synchronous Serial Port Interrupts - Internal/External/ Multiprocessor Memory Space - Multiprocessing - Host Interface - Link Ports (Text 2).

Module-3

Digital Signal Processing Applications: FIR and IIR Digital Filter Design, Filter Design Programs using MATLAB- Fourier Transform: DFT, FFT programs using MATLAB (Text 1).

Module-4

Real Time Implementation: Implementation of Real Time Digital Filters using DSP-Implementation of FFT Applications using DSP – DTMF Tone Generation and Detection (Text 1).

Module-5

Current trends: Current trends in Digital Signal Processor, DSP Controller-Architecture and their applications (Text 1).

Course outcomes:

At the end of the course the student will be able to:

1. Understand fundamental concepts of 'DSP Architecture' and 'SHARC Digital Signal Processor'
2. Analyze the concept of IIR type digital filters, FIR type digital filters, DFT and FFT

3. Apply a design technique of Real-Time Digital Filters, FFT.
4. Use the "MATLAB" language and "signal processing toolboxes" for analyzing, designing and implementing Digital Signal Processing (DSP) systems such as digital filters.
5. Design real-time signal processing algorithms using the latest fixed-point processor.

Question paper pattern:
The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbooks:

1. 'Digital Signal Processing and Application with C6713 and C6416 DSK', Rulph Chassaing, Wiley-Interscience Publication
2. 'Digital Signal Processing- A Student Guide', T.J. Terrel and Lik- Kwan Shark, 1st Edition; Macmillan Press Ltd.

Reference Books:

1. 'Digital Signal Processing: A System Design Approach', David J DeFatta J, Lucas Joseph G & Hodkiss William S, 1st Edition, John Wiley.
2. 'Digital Signal Processing-A Practical Guide for Engineers and Scientists', Steven K Smith, Newnes, Elsevier Science.
3. 'DSP Applications using 'C' and the TMS320C6X DSK', Rulph Chassaing, 1st Edition.
4. 'Digital Signal Processing Design', Andrew Bateman, Warren Yates, 1st Edition
5. 'Digital Signal Processing Implementation using the TMS320C6000 DSP Platform', Naim Dahnoun, 1st Edition.

Error Control Coding

Course Code	**20ECS23**	CIE Marks	40
Lecture Hours/Week	**04**	SEE Marks	60
Total Number of Lecture Hours	**50**	Exam Hours	03
Credits - 04			

Module-1

Information theory: Introduction, Entropy, Source coding theorem, discrete memoryless channel, Mutual Information, Channel Capacity Channel coding theorem (Chap. 5 of Text 1).

Introduction to algebra: Groups, Fields, binary field arithmetic, Construction of Galois Fields GF (2^m) and its properties, (Only statements of theorems without proof) Computation using Galois field GF (2^m) arithmetic, Vector spaces and Matrices (Chap. 2 of Text 2).

Module-2

Linear block codes: Generator and parity check matrices, Encoding circuits, Syndrome and error detection, Minimum distance considerations, Error detecting and error correcting capabilities, Standard array and syndrome decoding, Single Parity Check Codes (SPC), Repetition codes, Self dual codes, Hamming codes, Reed-Muller codes. Product codes and Interleaved codes (Chap. 3 of Text 2).

Module-3

Cyclic codes: Introduction, Generator and parity check polynomials, Encoding of cyclic codes, Syndrome computing and error detection, Decoding of cyclic codes, Error trapping Decoding, Cyclic hamming codes, Shortened cyclic codes (Chap. 4 of Text 2).

Module-4

BCH codes: Binary primitive BCH codes, Decoding procedures, Implementation of Galois field arithmetic. (6.1, 6.2, 6.7 of Text 2) Primitive BCH codes over GF (q),

Reed -Solomon codes (7.2, 7.3 of Text 2).

Majority Logic decodable codes: One -step majority logic decoding, Multiple-step majority logic (8.1, 8.4 of Text 2).

Module-5

Convolution codes: Encoding of convolutional codes: Systematic and Nonsystematic Convolutional Codes, Feedforward encoder inverse, A

catastrophic encoder, Structural properties of convolutional codes: state diagram, state table, state transition table, tree diagram, trellis diagram.
Viterbi algorithm, Sequential decoding: Log Likelihood Metric for Sequential Decoding (11.1,11.2, 12.1,13.1 of Text 2).

Course outcomes:
At the end of the course the student will be able to:
1. Understand the concept of the Entropy, information rate and capacity for the Discrete memoryless channel.
2. Apply modern algebra and probability theory for the coding.
3. Compare Block codes such as Linear Block Codes, Cyclic codes, etc. and Convolutional codes.
4. Detect and correct errors for different data communication and storage systems.
5. Analyze and implement different Block code encoders and decoders, and also convolutional encoders and decoders including soft and hard Viterbi algorithm.

Question paper pattern:
The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.
- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Students have to conduct the following experiments as a part of CIE marks along with other Activities:
Software to be used: SCILAB/MATLAB

1. Simulate the BER performance of (7, 4) Hamming code on AWGN channel. Use QPSK modulation scheme. Channel decoding is to be performed through maximum-likelihood decoding. Plot the bit error rate versus SNR (dB), i.e. $P_{e,b}$ versus E_b/N_0. Consider binary input vector of size 5 lakh bits. Use the following parity check matrix for the (7, 4) Hamming code.

$$H = \begin{bmatrix} 1 & 0 & 0 & 1 & 1 & 1 & 0 \\ 0 & 1 & 0 & 0 & 1 & 1 & 1 \\ 0 & 0 & 1 & 1 & 1 & 0 & 1 \end{bmatrix}$$

Also find the coding gain.
(Refer: http://www.dsplog.com/2012/03/15/hamming-code-soft-hard-decode/)

2. Simulate the BER performance of (2, 1, 3) binary convolutional code with generator sequences $g^{(1)}$ =(1 0 1 1) and $g^{(2)}$ =(1 1 1 1) on AWGN channel. Use QPSK modulation scheme. Channel decoding is to be performed through Viterbi decoding. Plot the bit error rate versus SNR(dB), i.e. $P_{e,b}$ versus E_b/N_0. Consider binary input vector of size 3 lakh bits. Also find the coding gain.

3. Simulate the BER performance of rate 1/3 Turbo code. Turbo encoder uses two recursive systematic encoders with $G(D) = \left[1, \frac{1+D^4}{1+D+D^2+D^3+D^4}\right]$ and pseudo-random interleaver. Use QPSK modulation scheme. Channel decoding is to be performed through maximum a-posteriori (MAP) decoding algorithm. Plot the bit error rate versus SNR(dB), i.e. $P_{e,b}$ versus E_b/N_0. Consider binary input vector of size of around 3 lakh bits and the block length as 10384 bits. Also find the coding gain.

4. Use a MATLAB simulation to confirm that SOVA (Soft Output Viterbi Algorithm) is inferior to MAP decoding in terms of bit error performance, and give the reason why. Consider a rate ½ Turbo code punctured from the rate 1/3 Turbo code. The puncturing matrix is [1 0 ; 0 1] . Demonstrate the decoding process of the code. (Refer: Example 6.1 from 'A Practical Guide to Error-control Coding Using MATLAB', Yuan Jiang, ISBN: 9781608070886, Artech House Publishers, 2010)

Textbooks:

1. 'Digital Communication systems', Simon Haykin, Wiley India Private. Ltd, ISBN 978-81-265-4231-4, First edition, 2014
2. 'Error control coding', Shu Lin and Daniel J. Costello. Jr, Pearson, Prentice Hall, 2nd edition, 2004

Reference Books:

1. 'Theory and practice of error control codes', Blahut. R. E, Addison Wesley, 1984
2. 'Introduction to Error control coding', Salvatore Gravano, Oxford University Press, 2007
3. 'Digital Communications - Fundamentals and Applications', Bernard Sklar, Pearson Education (Asia) Pvt. Ltd., 2nd Edition, 2001

Professional Elective 1

Wireless Sensor Networks

Course Code	**20ECS241**	CIE Marks	40
Lecture Hours/Week	**04**	SEE Marks	60
Total Number of Lecture Hours	**50**	Exam Hours	03
Credits - 04			

Module-1

Introduction: Sensor Mote Platforms, WSN Architecture and Protocol Stack (Chap. 1 Text 1).
WSN Applications: Military Applications, Environmental Applications, Health Applications, Home Applications, Industrial Applications (Chap. 2 Text 1).

Module-2

Factors Influencing WSN Design: Hardware Constraints Fault Tolerance Scalability Production Costs WSN Topology, Transmission Media, Power Consumption (Chap. 3 Text 1).
Physical Layer: Physical Layer Technologies, Overview of RF Wireless Communication, Channel Coding (Error Control Coding), Modulation, Wireless Channel Effects, PHY Layer Standards (Chap. 4 of Text 1).

Module-3

Medium Access Control: Challenges for MAC, CSMA Mechanism, Contention-Based Medium Access, Reservation-Based Medium Access, Hybrid Medium Access (Chap. 5 of Text 1).
Network Layer: Challenges for Routing, Data-centric and Flat Architecture Protocols, Hierarchical Protocols, Geographical Routing Protocols (Chap. 7 of Text 1).

Module-4

Transport Layer: Challenges for Transport Layer, Reliable MultiSegment Transport (RMST) Protocol, Pump Slowly, Fetch Quickly (PSFQ) Protocol, Congestion Detection and Avoidance (CODA) Protocol, Event-to-Sink Reliable Transport (ESRT) Protocol, GARUDA (Chap. 8 Text 1).

Application Layer: Source Coding (Data Compression), Query Processing, Network Management (Chap. 9 Text 1).

Module-5

Time Synchronization: Challenges for Time Synchronization, Network Time Protocol, Timing-Sync Protocol for Sensor Networks (TPSN), Reference-Broadcast Synchronization (RBS), Adaptive Clock Synchronization (ACS) (Chap. 11 of Text 1).

Localization; Challenges in Localization, Ranging Techniques, Range-Based Localization Protocols, Range-Free Localization Protocols. (Chap. 12 Text 1).

Course outcomes:

At the end of the course the student will be able to:

1. Acquire knowledge of characteristics of mobile/wireless communication channels
2. Apply statistical models of multipath fading
3. Understand the multiple radio access techniques, radio standards and communication protocols to be used for wireless sensor
4. Design wireless sensor network system for different applications under consideration.
5. Understand the hardware details of different types of sensors and select right type of sensor for various applications.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbooks:

1. 'Wireless Sensor Networks', Ian F. Akyildiz and Mehmet Can Vuran, John Wiley & Sons Ltd. ISBN 978-0-470-03601-3 (H/B), 2010
2. 'Wireless Sensor Networks: Signal Processing and Communications Perspectives', Ananthram Swami, et. al., John Wiley & Sons Ltd., ISBN 978-0470-03557-3, 2007

Nanoelectronics

Course Code	**20EVE242**	CIE Marks	40
Lecture Hours/Week	**04**	SEE Marks	60
Total Number of Lecture Hours	**50**	Exam Hours	03
Credits - 04			

Module-1

Introduction: Overview of nanoscience and engineering. Development milestones in microfabrication and electronic industry. Moores' law and continued miniaturization, Classification of Nanostructures, Electronic properties of atoms and solids: Isolated atom, Bonding between atoms, Giant molecular solids, Free electron models and energy bands, crystalline solids, Periodicity of crystal lattices, Electronic conduction, effects of nanometer length scale, Fabrication methods: Top down processes, Bottom up processes methods for templating the growth of nanomaterials, ordering of nanosystems (Text 1).

Module-2

Characterization: Classification, Microscopic techniques, Field ion microscopy, scanning probe techniques, diffraction techniques: bulk and surface diffraction techniques, spectroscopy techniques: photon, radiofrequency, electron, surface analysis and dept profiling: electron, mass, Ion beam, Reflectometry, Techniques for property measurement: mechanical, electron, magnetic, thermal properties (Text 1).

Module-3

Inorganic semiconductor nanostructures: overview of semiconductor physics. Quantum confinement in semiconductor nanostructures: quantum wells, quantum wires, quantum dots, super-lattices, band offsets, electronic density of states (Text 1).
Carbon Nanostructures: Carbon molecules, Carbon Clusters, Carbon Nanotubes, application of Carbon Nanotubes (Text 2).

Module-4

Fabrication techniques: requirements of ideal semiconductor, epitaxial growth of quantum wells, lithography and etching, cleaved-edge over growth, growth of vicinal substrates, strain induced dots and wires, electrostatically induced dots and wires, Quantum well width fluctuations, thermally annealed quantum

wells, semiconductor nanocrystals, colloidal quantum dots, self-assembly techniques.

Physical processes: modulation doping, quantum hall effect, resonant tunneling, charging effects, ballistic carrier transport, Inter band absorption, intra band absorption, Light emission processes, phonon bottleneck, quantum confined stark effect, nonlinear effects, coherence and dephasing, characterization of semiconductor nanostructures: optical electrical and structural (Text 1).

Module-5

Methods of measuring properties: atomic, crystallography, microscopy, spectroscopy (Text 2).

Applications: Injection lasers, quantum cascade lasers, single-photon sources, biological tagging, optical memories, coulomb blockade devices, photonic structures, QWIPs, NEMS, MEMS (Text 1).

Course outcomes:

At the end of the course the student will be able to:

1. Know the principles behind Nanoscience engineering and Nanoelectronics.
2. Apply the knowledge to prepare and characterize nanomaterials.
3. Know the effect of particles size on mechanical, thermal, optical and electrical properties of nanomaterials.
4. Design the process flow required to fabricate state of the art transistor technology.
5. Analyze the requirements for new materials and device structure in the future technologies.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbooks:

1. 'Nanoscale Science and Technology', Ed Robert Kelsall, Ian Hamley, Mark Geoghegan, John Wiley, 2007
2. 'Introduction to Nanotechnology', Charles P Poole, Jr, Frank J Owens, John Wiley, Copyright 2006, Reprint 2011.

Reference Book:

'Hand Book of Nanoscience Engineering and Technology', Ed William A Goddard III, Donald W Brenner, Sergey E. Lyshevski, Gerald J Iafrate, CRC Press, 2003

Cryptography and Network Security

Course Code	**20ECS243**	CIE Marks	40
Lecture Hours/Week	**04**	SEE Marks	60
Total Number of Lecture Hours	**50**	Exam Hours	03
Credits - 04			

Module-1

Foundations: Terminology, Steganography, substitution ciphers and transpositions ciphers, Simple XOR, One-Time Pads, Computer Algorithms (Text 2: Chapter 1: Section 1.1 to 1.6).
SYMMETRIC CIPHERS: Traditional Block Cipher structure, Data encryption standard (DES), The AES Cipher. (Text 1: Chapter 2: Section2.1, 2.2, Chapter 4).

Module-2

Introduction to modular arithmetic, Prime Numbers, Fermat's and Euler's theorem, primality testing, Chinese Remainder theorem, discrete logarithm. (Text 1: Chapter 7: Section 1, 2, 3, 4, 5).
Principles of Public-Key Cryptosystems, The RSA algorithm, Diffie - Hellman Key Exchange, Elliptic Curve Arithmetic, Elliptic Curve Cryptography (Text 1: Chapter 8, Chapter 9: Section 9.1, 9.3, 9.4).

Module-3

Pseudo-Random-Sequence Generators and Stream Ciphers: Linear Congruential Generators, Linear Feedback Shift Registers, Design and analysis of stream ciphers, Stream ciphers using LFSRs, A5, Hughes XPD/KPD, Nanoteq, Rambutan, Additive generators, Gifford, Algorithm M, PKZIP (Text 2: Chapter 16).

Module-4

One-Way Hash Functions: Background, Snefru, N-Hash, MD4, MD5, Secure Hash Algorithm [SHA], One way hash functions using symmetric block algorithms, Using public key algorithms, Choosing a one-way hash functions, Message Authentication Codes. Digital Signature Algorithm, Discrete Logarithm Signature Scheme (Text 2: Chapter 18: Section 18.1 to 18.5, 18.7, 18.11 to 18.14 and Chapter 20: Section 20.1, 20.4).

Module-5

E-mail Security: Pretty Good Privacy-S/MIME (Text 1: Chapter 17: Section 17.1, 17.2).
IP Security: IP Security Overview, IP Security Policy, Encapsulation Security Payload (ESP), Combining security Associations. (Text 1: Chapter 18: Section 18.1 to 18.4).
Web Security: Web Security Considerations, SSL (Text 1: Chapter 15: Section 15.1, 15.2).

Course outcomes:
At the end of the course the student will be able to:

1. Understand the basics of symmetric key and public key cryptography.
2. Use basic cryptographic algorithms to encrypt the data.
3. Generate some pseudorandom numbers required for cryptographic applications.
4. Provide authentication and protection for encrypted data.
5. Understand the techniques and features of Email, IP and Web security.

Question paper pattern:
The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbooks:

1. 'Cryptography and Network Security Principles and Practice', William Stallings, Pearson Education Inc., ISBN: 978-93325-1877-3, 6th Edition, 2014
2. 'Applied Cryptography Protocols, Algorithms, and Source code in C', Bruce Schneier, Wiley Publications ISBN: 9971-51348-X, 2nd Edition

Reference Books:

1. 'Cryptography and Network Security', Behrouz A. Forouzan, TMH, 2007
2. 'Cryptography and Network Security', Atul Kahate, TMH, 2003

Reconfigurable Computing

Course Code	**20ELD244**	CIE Marks	40
Lecture Hours/Week	**04**	SEE Marks	60
Total Number of Lecture Hours	**50**	Exam Hours	03
Credits - 04			

Module -1

Introduction: History, Reconfigurable vs Processor based system, RC Architecture.
Reconfigurable Logic Devices: Field Programmable Gate Array, Coarse Grained Reconfigurable Arrays.
Reconfigurable Computing System: Parallel Processing on Reconfigurable Computers, A survey of Reconfigurable Computing System (Text 1).

Module-2

Languages and Compilation: Design Cycle, Languages, HDL, High Level Compilation, Low level Design flow, Debugging Reconfigurable Computing Applications (Text 1).

Module -3

Implementation: Integration, FPGA Design flow, Logic Synthesis.
High Level Synthesis for Reconfigurable Devices: Modelling, Temporal Partitioning Algorithms (Text 2).

Module-4

Partial Reconfiguration Design: Partial Reconfiguration Design, Bitstream Manipulation with JBits, The modular Design flow, The Early Access Design Flow, Creating Partially Reconfigurable Designs, Partial Reconfiguration using Hansel-C Designs, Platform Design (Text 2).

Module -5

Signal Processing Applications: Reconfigurable computing for DSP, DSP application building blocks, Examples: Beamforming, Software Radio, Image and video processing, Local Neighbourhood functions, Convolution (Text 1).
System on a Programmable Chip: Introduction to SoPC, Adaptive Multiprocessing on Chip (Text 2).

Course Outcomes:

At the end of the course the student will be able to:

1. Understand the fundamental principles and practices in reconfigurable architecture.
2. Simulate and synthesize the reconfigurable computing architectures.
3. Understand the FPGA design principles, and logic synthesis
4. Integrate hardware and software technologies for reconfiguration computing focusing on partial reconfiguration design.
5. Design digital systems for a variety of applications on signal processing and system on chip configurations.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Text Books:

1. 'Reconfigurable Computing: Accelerating Computation with Field-Programmable Gate Arrays', M. Gokhale and P. Graham, Springer, ISBN: 978-0-387-26105-8, 2005.
2. 'Introduction to Reconfigurable Computing: Architectures, Algorithms and Applications', C. Bobda, Springer, ISBN: 978-1-4020-6088-5, 2007.

Reference Books:

1. 'Practical FPGA Programming in C', D. Pellerin and S. Thibault, Prentice-Hall, 2005.
2. 'FPGA Based System Design', W. Wolf, Prentice-Hall, 2004.
3. 'Rapid System Prototyping with FPGAs: Accelerating the Design Process', R. Cofer and B. Harding, Newnes, 2005.

Professional Elective 2

Biomedical Signal Processing

Course Code	**20ESP251**	CIE Marks	40
Lecture Hours/Week	**04**	SEE Marks	60
Total Number of Lecture Hours	**50**	Exam Hours	03
Credits - 04			

Module-1

Introduction-Genesis and significance of bio electric potentials, ECG, EEG, EMG and their monitoring and measurement, Spectral analysis.

Module-2

Filtering- Digital and Analog filtering, Correlation and Estimation techniques, AR / ARMA models.

Module-3

ECG-Pre-processing, Measurements of amplitude and time intervals, Classification, QRS detection, ST segment analysis, Base line wander removal, waveform recognition, morphological studies and rhythm analysis, automated diagnosis based on decision theory ECT compression, Evoked potential estimation.

Module-4

EEG: Evoked responses, Epilepsy detection, Spike detection, Hjorth parameters, averaging techniques, removal of Artifacts by averaging and adaptive algorithms, pattern recognition of alpha, beta, theta and delta waves in EEG waves, sleep stages.

Module-5

EMG-Wave pattern studies, bio feedback, Zero crossings, Integrated EMG. Time frequency methods and Wavelets in Biomedical Signal Processing.

Course outcomes:

At the end of the course the student will be able to:

1. Model a biomedical system.
2. Understand various methods of acquiring bio signals.
3. Understand various sources of bio signal distortions and its remedial techniques.

4. Analyze ECG and EEG signal with characteristic feature points.
5. Understand use of bio signals in diagnosis, patient monitoring and physiological investigation.

Question paper pattern:
The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbook:

'Biomedical Digital Signal Processing', Willis J Tompkins, Prentice Hall of India, 1996.

Reference Books:

1.'Biomedical Signal Processing (in IV parts)', R E Challis and RI Kitney, Medical and Biological Engg. and current computing, 1990-91.
2. Special issue on 'Biological Signal Processing', Proc. IEEE 1972.
3.'Biomedical Signal Processing', Arnon Cohen, Volumes I & II, CRC Press.
4.'Time frequency and Wavelets in Biomedical Signal Processing', Metin Akay, IEEE Press, 1999. Current Published literature.

Statistical Signal Processing

Course Code	**20ECS252**	CIE Marks	40
Lecture Hours/Week	**04**	SEE Marks	60
Total Number of Lecture Hours	**50**	Exam Hours	03
Credits - 04			

Module-1

Random Processes: Random variables, random processes, white noise, filtering random processes, spectral factorization, ARMA, AR and MA processes (Text 1).

Module 2

Signal Modeling: Least squares method, Padé approximation, Prony's method, finite data records, stochastic models, Levinson-Durbin recursion; Schur recursion; Levinson recursion (Text 1).

Module 3

Spectrum Estimation: Nonparametric methods, minimum-variance spectrum estimation, maximum entropy method, parametric methods, frequency estimation, principal components spectrum estimation (Text 1).

Module 4

Optimal and Adaptive Filtering: FIR and IIR Wiener filters, Discrete Kalman filter, FIR Adaptive filters: Steepest descent, LMS, LMS-based algorithms (Text 1).

Module 5

Array Processing: Array fundamentals, beam-forming, optimum array processing, performance considerations, adaptive beamforming, linearly constrained minimum-variance beam-formers, side-lobe cancellers (Text 2).

Course Outcomes:

At the end of the course the student will be able to:

1. Design statistical DSP algorithms to meet desired needs
2. Apply vector space methods to statistical signal processing problems
3. Understand Wiener filter theory and design discrete and continuous Wiener filters
4. Understand Kalman Filter theory and design discrete Kalman filters

5. Use computer tools (such as MATLAB) in developing and testing stochastic DSP algorithms

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Text Books:

1. 'Statistical Digital Signal Processing and Modeling', Monson H Hayes, John Wiley & Sons (Asia) Pvt. Ltd., 2002.
2. 'Statistical and Adaptive Signal Processing: Spectral Estimation, Signal Modeling, Adaptive Filtering and Array Processing', Dimitris G. Manolakis, Vinay K. Ingle, and Stephen M. Kogon, McGraw Hill International Edition, 2000.

Micro Electro Mechanical Systems

Course Code	**20ELD253**	CIE Marks	40
Lecture Hours/Week	**04**	SEE Marks	60
Total Number of Lecture Hours	**50**	Exam Hours	03
Credits - 04			

Module 1

Overview of MEMS and Microsystems: MEMS and Microsystem, Typical MEMS and Microsystems Products, Evolution of Microfabrication, Microsystems and Microelectronics, Multidisciplinary Nature of Microsystems, Miniaturization. Applications and Markets.

Module 2

Working Principles of Microsystems: Introduction, Microsensors, Microactuation, MEMS with Microactuators, Microaccelerometers, Microfluidics.

Engineering Science for Microsystems Design and Fabrication: Introduction, Atomic Structure of Matters, Ions and Ionization, Molecular Theory of Matter and Inter-molecular Forces, Doping of Semiconductors, The Diffusion Process, Plasma Physics, Electrochemistry.

Module 3

Engineering Mechanics for Microsystems Design: Introduction, Static Bending of Thin Plates, Mechanical Vibration, Thermomechanics, Fracture Mechanics, Thin Film Mechanics, Overview on Finite Element Stress Analysis.

Module 4

Scaling Laws in Miniaturization:
Introduction, Scaling in Geometry, Scaling in Rigid-Body Dynamics, Scaling in Electrostatic Forces, Scaling of Electromagnetic Forces, Scaling in Electricity, Scaling in Fluid Mechanics, Scaling in Heat Transfer.

Module 5

Overview of Micro-manufacturing: Introduction, Bulk Micro-manufacturing, Surface Micromachining, The LIGA Process, Summary on Micromanufacturing.
Microsystem Design: Introduction, Design Considerations, Process Design, Mechanical Design, Using Finite Element Method.

Course Outcomes:

At the end of the course the student will be able to:

1. Understand the technologies related to Micro Electro Mechanical Systems.
2. Relate to the scaling laws in miniaturization.
3. Analyse the MEMS devices and develop suitable mathematical models
4. Understand the various application areas for MEMS devices
5. Describe the design and fabrication processes involved with MEMS devices.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Text Book:

'MEMS and Micro systems: Design, Manufacture and Nanoscale Engineering', Tai-Ran Hsu, John Wiley & Sons, ISBN: 978-0470-08301-7, 2nd Edition, 2008

Reference Books:

1. 'Micro and Nano Fabrication: Tools and Processes', Hans H. Gatzen, Volker Saile, Jurg Leuthold, Springer, 2015
2. 'Micro Electro Mechanical Systems (MEMS)', Dilip Kumar Bhattacharya, Brajesh Kumar Kaushik, Cengage Learning.

Detection and Estimation

Course Code	**20ESP254**	CIE Marks	40
Lecture Hours/Week	**04**	SEE Marks	60
Total Number of Lecture Hours	**50**	Exam Hours	03
Credits - 04			

Module 1

Classical Detection and Estimation Theory: Introduction, simple binary hypothesis tests, M Hypotheses, estimation theory, composite hypotheses, general Gaussian problem, performance bounds and approximations (Text 1).

Module 2

Representations of Random Processes: Introduction, orthogonal representations, random process characterization, homogenous integral equations and Eigen functions, periodic processes, spectral decomposition, vector random processes (Text 2).

Module 3

Detection of Signals & Estimation of Signal Parameters: Introduction, detection and estimation in white Gaussian noise, detection and estimation in nonwhite Gaussian noise, signals with unwanted parameters, multiple channels and multiple parameter estimation (Text 1).

Module 4

Estimation of Continuous Waveforms: Introduction, derivation of estimator equations, lower bound on the mean-square estimation error, multidimensional waveform estimation, non-random waveform estimation (Text 1).

Module 5

Linear Estimation: Properties of optimum processors, realizable linear filters, Kalman-Bucy filters, fundamental role of optimum linear filters. (Text 1).

Course Outcomes:

At the end of the course the student will be able to:

1. Acquire basics of statistical decision theory used for signal detection and estimation.
2. Examine the detection of deterministic and random signals using statistical models.
3. Comprehend the elements and structure of nonparametric detection.

4. Examine the performance of signal parameters using optimal estimators.
5. Analyze signal estimation in discrete-time domain using filters.

Question paper pattern:
The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Text Books:

1. 'Detection, Estimation, and Modulation Theory', Part I, Harry L. Van Trees, John Wiley & Sons, USA, 2001.
2. 'Random Signals: Detection, Estimation and Data Analysis', K Sam Shanmugam, Arthur M Breipohl, John Wiley & Sons, 1998.

Reference Books:

1. 'Introduction to Statistical Signal Processing with Applications', M.D. Srinath, P.K. Rajasekaran and R. Viswanathan, Pearson Education (Asia) Pvt. Ltd. /Prentice Hall of India, 2003.
2. 'Fundamentals of Statistical Signal Processing,' Volume I: 'Estimation Theory', Steven M. Kay, Prentice Hall, USA, 1998.
3. 'Fundamentals of Statistical Signal Processing', Volume II: 'Detection Theory,' Steven M. Kay, Prentice Hall, USA, 1998.

Image Processing Lab

Course Code	**20ESPL26**	CIE Marks	40
Teaching Hours/Week	**04** (2 Hrs Tutorial + 2 Hrs Practical)	SEE Marks	60
		Exam Hours	03
Credits - 02			

Laboratory Experiments:

Sl. No.	Experiments
1	Study the effects of a) Boolean operations on binary images b) Quantization of gray level images
2	Study the effects of Contrast enhancement using a) Histogram equalization b) Histogram stretching.
3	Using connected component labelling algorithms, express Pixel neighborhood relationships in terms of a graph
4	Create a binary image from image by replacing all values above a determined threshold level using a) global thresholding b) adaptive thresholding technique
5	Transform an image given using Spatial Transformation
6	Study how to compute forward 2D FFT and a) Find the log magnitude & phase and the inverse 2D FFT of an image. b) Compute the forward 2D FFT of the filter kernel. c) Design a Laplacian High Pass Filter d) Study the Two Dimensional Filter Design using filter design functions
7	Determine the suitability of homomorphic filtering using a low pass filter for image enhancement to fix non- uniform of illumination
8	Implement inverse, Wiener, Regular, and Lucy-Richardson for image restoration. And formulate how noise information in an image can be used to restore a degraded image.
9	Study different methods of edge detection for use on noisy images, specifically, a) Motion blur b) Gaussian noise c) Filtered Gaussian noise via averaging.
10	Write an algorithm for recognizing of circles and triangles.

Course outcomes:

At the end of the course the student will be able to:

1. Perform basic transformations for Image enhancement
2. Apply histogram equalization for image enhancement
3. Model the image restoration problem in both time and frequency domains
4. Describe spatial transformations using images
5. Implement different recognition tasks using image processing.

Conduct of Practical Examination:

1. All laboratory experiments are to be included for practical examination.
2. The experiments can be conducted in MATLAB or using any other related tools.
3. Strictly follow the instructions as printed on the cover page of answer script for breakup of marks.
4. Change of experiment is allowed only once and Marks allotted to the procedure part to be made zero.

Technical Seminar

Course Code	**20ESP27**	CIE Marks	100
Number of Contact Hours/Week	**02**	SEE Marks	-
		Exam Hours	-
Credits - 02			

Course objectives:
The objective of the seminar is to inculcate self-learning, face audience confidently, enhance communication skill, involve in group discussion and present and exchange ideas.

Each student, under the guidance of a Faculty, is required to

- Choose, preferably through peer reviewed journals, a recent topic of his/her interest relevant to the Course of Specialization.
- Carryout literature survey, organize the Course topics in a systematic order.
- Prepare the report with own sentences.
- Type the matter to acquaint with the use of Micro-soft equation and drawing tools or any such facilities.
- Present the seminar topic orally and/or through power point slides.
- Answer the queries and involve in debate/discussion.
- Submit two copies of the typed report with a list of references.

The participants shall take part in discussion to foster friendly and stimulating environment in which the students are motivated to reach high standards and become self-confident.

The CIE marks for the seminar shall be awarded (based on the relevance of the topic, presentation skill, participation in the question and answer session and quality of report) by the committee constituted for the purpose by the Head of the Department. The committee shall consist of three faculties from the department with the senior most acting as the Chairperson.

Marks distribution for CIE of the course 20ESP27 seminar:

Seminar Report: 50 marks
Presentation skill: 25 marks
Question and Answer: 25 marks

M.TECH IN Signal Processing (ESP)

Choice Based Credit System (CBCS) and Outcome Based Education(OBE)
(Effective from the academic year 2020-21)

SEMESTER -III

Adaptive Signal Processing

Course Code	**20ESP31**	CIE Marks	40
Lecture Hours/Week	**04**	SEE Marks	60
Total Number of Lecture Hours	**50**	Exam Hours	03
Credits - 04			

Module -1

Adaptive systems: Definitions and characteristics - applications - properties-examples - adaptive linear combiner input signal and weight vectors - performance function-gradient and minimum mean square error - introduction to filtering-smoothing and prediction - linear optimum filtering-orthogonality - Wiener – Hopf equation performance Surface.

Module -2

Searching performance surface-stability and rate of convergence: learning curve-gradient search - Newton's method - method of steepest descent - comparison - gradient estimation - performance penalty - variance - excess MSE and time constants – mis adjustments.

Module -3

LMS algorithm convergence of weight vector: LMS/Newton algorithm - properties - sequential regression algorithm – adaptive recursive filters - random-search algorithms - lattice structure - adaptive filters with orthogonal signals.

Module -4

Applications-adaptive modeling: Multipath communication channel, geophysical exploration, FIR digital filter synthesis.

Module -5

Applications: inverse adaptive modelling, deconvolution and equalization, General Description of Inverse Modeling, Adaptive Equalization of Telephone Channels, Adapting Poles and Zeros for IIR Digital Filter Synthesis.

Course Outcomes:

At the end of the course the student will be able to:

1. Design optimal minimum mean square estimators and in particular linear estimators.
2. Implement adaptive filters (FIR, IIR, non-causal, causal) and evaluate their performance.
3. Identify applications in which it would be possible to use the different adaptive filtering approaches.
4. Analyze basic non-recursive adaptive filter, that is, the adaptive linear combiner.
5. Understand adaptive modelling and system identification; inverse adaptive modelling, de-convolution and equalization.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Text Books:

'Adaptive Signal Processing', Bernard Widrow and Samuel D Stearns, Pearson Education, 2005.

Reference Books:

1. 'Theory and Design of Adaptive Filters', John R Treichler, C Richard Johnson, Michael G Larimore, Prentice-Hall of India, 2002
2. 'Adaptive Signal Processing-Theory and Application', S Thomas Alexander, Springer-Verlag.
3. 'Statistical and Adaptive Signal Processing', D. G. Manolakis, V. K. Ingle and S. M. Kogar, McGraw Hill International Edition, 2000.
4. 'Adaptive Filter Theory', Simon Haykin, Pearson Education, 2003.

Professional Elective 3

Array Signal Processing

Course Code	**20ESP321**	CIE Marks	40
Lecture Hours/Week	**03**	SEE Marks	60
Total Number of Lecture Hours	**40**	Exam Hours	03
Credits - 03			

Module 1

Spatial Signals: Signals in space and time, Spatial Frequency vs Temporal Frequency, Review of Co-ordinate Systems, Maxwell's Equation, Wave Equation. Solution to Wave equation in Cartesian Co-ordinate system –Wave number vector, Slowness vector.

Module 2

Wave number-Frequency Space Spatial Sampling: Spatial Sampling Theorem-Nyquist Criteria, Aliasing in Spatial frequency domain, Spatial sampling of multidimensional signals.

Module 3

Sensor Arrays: Linear Arrays, Planar Arrays, Frequency – Wave number Response and Beam pattern, Array manifold vector, Conventional Beam former, Narrowband beam former.

Module 4

Uniform Linear Arrays: Beam pattern in θ, u and ψ -space, Uniformly Weighted Linear Arrays.

Beam Pattern Parameters: Half Power Beam Width, Distance to First Null, Location of side lobes and Rate of Decrease, Grating Lobes, Array Steering.

Module 5

Array Design Methods: Visible region, Duality between Time -Domain and Space -Domain Signal Processing, Schelkunoff's Zero Placement Method, Fourier Series Method with windowing, Woodward -Lawson Frequency-Sampling Design.

Non parametric method -Beam forming, Delay and sum Method, Capons Method.

Course outcomes:

At the end of the course the student will be able to:

1. Comprehend the basics of signals in space and time.

2. Understand the important concepts of array signal processing.
3. Describe the various array design techniques.
4. Understand the basic principle of direction of arrival estimation techniques.
5. Explain the Concepts of Spatial Frequency along with the Spatial Samplings.

Question paper pattern:
The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Text Book:

'Optimum Array Processing Part IV of Detection, Estimation, and Modulation Theory', Harry L. Van Trees, John Wiley & Sons, ISBN: 9780471093909, 2002.

Reference Books:

1. 'Array Signal Processing: Concepts and Techniques', Don H. Johnson, Dan E. Dugeon, Prentice Hall Signal Processing Series, 1st Edition, ISBN-13: 978-0130485137.
2. 'Spectral Analysis of Signals', Petre Stoica and Randolph L. Moses, Prentice Hall, ISBN: 0-13-113956-8, 2005.
3. 'Electromagnetic Waves and Antennas', Sophocles J. Orfanidis, ECE Department, Rutgers University, 94 Brett Road Piscataway, NJ 88548058. http://www.ece.rutgers.edu/~orfanidi/ewa/

Medical Imaging

Course Code	**20EIE322**	CIE Marks	40
Lecture Hours/Week	**03**	SEE Marks	60
Total Number of Lecture Hours	**40**	Exam Hours	03
Credits - 03			

Module 1

Generation and Detection of X-Rays: X-Ray generation and X-Ray generators, Filters, Beam Restrictors and Grids, Screens, X-Ray Detectors.
X-Ray Diagnostic Methods: Conventional X-Ray Radiography, Fluoroscopy, Angiography, Mammography, Xeroradiography, Image Subtraction.
X-Ray Image Characteristics: Spatial Resolution, Image Noise, Image contrast.
Biological Effects of Ionizing Radiation: Determination of biological effects, Short term and Long term effects.

Module 2

X-Ray Tomography: Conventional Tomography, Computed Tomography - Projection function, Algorithms for Image Reconstruction, CT number, Image Artifacts.
Digital Radiography: Digital Subtraction Angiography (DSA), Dual Energy Subtraction, K-Edge subtraction, 3-D Reconstruction.
Recent Developments: Dynamic Spatial Reconstructor (DSR), Imatron or Fastrac Electron Beam CT.

Module 3

Generation and Detection of Ultrasound: Piezoelectric effect, Ultrasonic Transducers, Transducer Beam Characteristics, Axial and Lateral resolution, Focusing and Arrays.
Ultrasonic Diagnostic Methods: Pulse Echo systems - A mode, B mode, M mode and C mode, Transmission Methods, Doppler methods, Duplex Imaging.
Biological Effects of Ultrasound: Acoustic phenomena at high intensity levels, Ultrasound Bioeffects.

Module 4

Generation and Detection of Nuclear Emission: Nuclear Sources, Radionuclide Generators, Nuclear Radiation Detectors, Collimators.
Diagnostic methods using Radiation Detector Probes: Thyroid Function test, Renal function test, Blood volume measurement.

New Radio Nuclide Imaging methods: Longitudinal Section Tomography, SPECT and PET
Characteristics of Radionuclide Images: Spatial Resolution, Image contrast, Image Noise.

Module 5

Generation and Detection of NMR signal: The NMR Coil/Probe, The transmitter and the Receiver, Data acquisition.
Magnetic Resonance Imaging methods: Spin Echo Imaging, Gradient Echo Imaging, Blood flow Imaging.
Characteristics of MRI images: Spatial Resolution, Image Contrast.
Imaging Safety.

Course outcomes:
At the end of the course the student will be able to:
1. Understand the Generation and Detection of X-Rays, the Diagnostic Methods, Characteristics of X-ray images and Biological effects of X-rays.
2. Analyze Computed tomography and Digital Radiography.
3. Learn the techniques of Generation and Detection of Ultrasound, Pulse Echo Systems and Ultrasonic Diagnostic Methods.
4. Understand the principles of various radiological imaging techniques such as SPECT and PET.
5. Understand the principles of Magnetic Resonance Imaging, the concepts of Radionuclide Generation and Detection.

Question paper pattern:
The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.
- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Text Book:
'Principles of Medical Imaging', Kirk Shung, Michael B Smith, Benjamin M W Tsui, Academic Press, 2012.

Reference Books:

1. 'Fundamentals of Medical Imaging', Zhong Hicho and Manbir Singh, John Wiley, 1993.
2. 'Nuclear Medicine Introductory Text', Peter Josefell & Edwards Sydney, William Blackwell Scientific Publishers, London.

Business Intelligence and its Applications

Course Code	**20ELD323**	CIE Marks	40
Lecture Hours/Week	**03**	SEE Marks	60
Total Number of Lecture Hours	**40**	Exam Hours	03
Credits - 03			

Module 1

Development Steps, BI Definitions, BI Decision Support Initiatives, Development Approaches, Parallel Development Tracks, BI Project Team Structure, Business Justification, Business Divers, Business Analysis Issues, Cost – Benefit Analysis, Risk Assessment, Business Case Assessment Activities, Roles Involved In These Activities, Risks of Not Performing Step, Hardware, Middleware, DBMS Platform, Non-Technical Infrastructure Evaluation

Module 2

Managing The BI Project, Defining And Planning The BI Project, Project Planning Activities, Roles And Risks Involved In These Activities, General Business Requirement, Project Specific Requirements, Interviewing Process.

Module 3

Differences in Database Design Philosophies, Logical Database Design, Physical Database Design, Activities, Roles And Risks Involved In These Activities, Incremental Rollout, Security Management, Database Backup And Recovery.

Module 4

Growth Management, Application Release Concept, Post Implementation Reviews, Release Evaluation Activities, The Information Asset and Data Valuation, Actionable Knowledge – ROI, BI Applications, The Intelligence Dashboard.

Module 5

Business View of Information technology Applications: Business Enterprise excellence, Key purpose of using IT, Type of digital data, basics of enterprise reporting, BI road ahead.

Course outcomes:

At the end of the course the students will be able to:

1. Evaluate the key elements of a successful business intelligence (BI) program
2. Apply a BI meta model that turns outcomes into actions
3. Extract and transform data from an operational data to a data business data
4. Evaluate business analytics and performance measurement tools
5. Demonstrate a business scenario, identify the metrics, indicators and make recommendations to achieve the business goal.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Text Books:

1. 'Business Intelligence Roadmap: The Complete Project Lifecycle for Decision Support Applications', Larissa T Moss and Shaku Atre, Addison Wesley Information Technology Series, 2003.
2. 'Fundamentals of Business Analytics', R N Prasad, Seema Acharya, Wiley India, 2011.

Reference Books:

1. 'Business Intelligence: The Savvy Manager's Guide', David Loshin, Publisher: Morgan Kaufmann, ISBN 1-55860-196-4.
2. 'Delivering Business Intelligence with Microsoft SQL Server 2005', Brian Larson, McGraw Hill, 2006.
3. 'Foundations of SQL Server 2008', Lynn Langit, Business Intelligence – Apress, ISBN13: 978-14302-3324-4, 2011.

Speech and Audio Processing

Course Code	**20ESP324**	CIE Marks	40
Lecture Hours/Week	**03**	SEE Marks	60
Total Number of Lecture Hours	**40**	Exam Hours	03
Credits - 03			

Module 1

Digital Models for the Speech Signal: Process of speech production, Acoustic theory of speech production, Lossless tube models, and Digital models for speech signals (Text 1).

Time Domain Models for Speech Processing: Time dependent processing of speech, Short time energy and average magnitude, Short time average zero crossing rate, Speech vs silence discrimination using energy & zero crossings, Pitch period estimation, Short time autocorrelation function, Short time average magnitude difference function, Pitch period estimation using autocorrelation function, Median smoothing (Text 1).

Module 2

Digital Representations of the Speech Waveform: Sampling speech signals, Instantaneous quantization, Adaptive quantization, Differential quantization, Delta Modulation, Differential PCM, Comparison of systems, direct digital code conversion (Text 1).

Short Time Fourier Analysis: Linear Filtering interpretation, Filter bank summation method, Overlap addition method, Design of digital filter banks, Implementation using FFT, Spectrographic displays, Pitch detection, Analysis by synthesis, Analysis synthesis systems (Text 1).

Module 3

Homomorphic Speech Processing: Homomorphic systems for convolution, Complex cepstrum, Pitch detection, Formant estimation, Homomorphic vocoder.

Linear Predictive Coding of Speech: Basic principles of linear predictive analysis, Solution of LPC equations, Prediction error signal, Frequency domain interpretation, Relation between the various speech parameters, Synthesis of speech from linear predictive parameters, Applications (Text 1).

Module 4

Speech Enhancement: Spectral subtraction & filtering, Harmonic filtering, parametric re-synthesis, Adaptive noise cancellation.
Speech Synthesis: Principles of speech synthesis, Synthesizer methods, Synthesis of intonation, Speech synthesis for different speakers, Speech synthesis in other languages, Evaluation, Practical speech synthesis (Text 1).

Module 5

Automatic Speech Recognition: Introduction, Speech recognition vs. Speaker recognition, Signal processing and analysis methods, Pattern comparison techniques, Hidden Markov Models, Artificial Neural Networks (Text 2).

Audio Processing: Auditory perception and psychoacoustics - Masking, frequency and loudness perception, spatial perception, Digital Audio, Audio Coding - High quality, low-bitrate audio coding standards, MPEG, AC- 3, Multichannel audio - Stereo, 3D binaural and Multichannel surround sound (Text 3).

Course outcomes:
At the end of the course the students will be able to:

1. Understand basic concepts of speech production, speech analysis and synthesis
2. Analyze Speech coding techniques, Speech and speaker recognition systems.
3. Explain Concepts of Audio Processing and learn modelling
4. Implement Applications such as New audiogram matching techniques
5. Develop systems for various applications of speech processing.

Question paper pattern:
The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Text Books:

1. 'Digital Processing of Speech Signals', L. R. Rabiner and R. W. Schafer, Pearson Education (Asia) Pvt. Ltd., 2004.
2. 'Fundamentals of Speech Recognition', L. R. Rabiner and B. Juang, Pearson Education (Asia) Pvt. Ltd., 2004.
3. 'Fundamentals of Multimedia', Z. Li and M.S. Drew, Pearson Education (Asia) Pvt. Ltd., 2004.

Reference Book:

'Speech Communications: Human and Machine', D. O'Shaughnessy, Universities Press, 2001.

Professional elective 4

VLSI Design for Signal Processing

Course Code	**20EVE331**	CIE Marks	40
Lecture Hours/Week	**03**	SEE Marks	60
Total Number of Lecture Hours	**40**	Exam Hours	03
Credits - 03			

Module 1

Introduction to DSP Systems: Typical DSP Algorithms, DSP Application Demands and Scaled CMOS Technologies, Representations of DSP Algorithms.

Iteration Bounds: Data flow graph Representations, loop bound and Iteration bound. Algorithms for Computing Iteration Bound, Iteration Bound of multi rate data flow graphs.

Module 2

Pipelining and Parallel Processing: pipelining of FIR Digital Filters, parallel processing, Pipelining and parallel processing for low power.

Retiming: Definition and Properties, Solving Systems of Inequalities, Retiming Techniques.

Module 3

Unfolding: An Algorithm for Unfolding, Properties of Unfolding, Critical path, Unfolding and Retiming, Application of Unfolding.

Folding: Folding Transformation, Register Minimization Techniques, Register Minimization in Folded Architectures, Folding of Multirate Systems.

Module 4

Systolic Architecture Design: systolic array design Methodology, FIR systolic array, Selection of Scheduling Vector, Matrix-Matrix Multiplication and 2D systolic Array Design, Systolic Design for space representation containing Delays.

Fast convolution: Cook-Toom Algorithm, Winograd Algorithm, Iterated convolution, cyclic convolution Design of fast convolution Algorithm by Inspection.

Module 5

Pipelined and Parallel Recursive and Adaptive Filter: Pipeline Interleaving in Digital Filter, first order IIR digital Filter, Higher order IIR digital Filter, parallel processing for IIR filter, Combined pipelining and parallel processing for IIR Filter, Low power IIR Filter Design Using Pipelining and parallel processing, pipelined adaptive digital filter.

Course outcomes:

At the end of the course the students will be able to:

1. Illustrate the use of various DSP algorithms and addresses their representation using block diagrams, signal flow graphs and data-flow graphs.
2. Use pipelining and parallel processing in design of high-speed /low-power applications.
3. Apply unfolding in the design of parallel architecture.
4. Evaluate the use of look-ahead techniques in parallel and pipelined IIR Digital filters.
5. Develop an algorithm or architecture or circuit design for DSP applications.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Text Book:

'VLSI Digital Signal Processing systems, Design and implementation', Keshab K Parthi, Wiley, 1999.

Reference Books:

1. 'Analog VLSI Signal and Information Processing', Mohammed Isamail and Terri Fiez, Mc Graw-Hill, 1994.
2. 'VLSI and Modern Signal Processing', S.Y. Kung, H.J. White House, T. Kailath, Prentice Hall, 1985.
3. 'Design of Analog - Digital VLSI Circuits for Telecommunication and Signal Processing', Jose E. France, Yannis Tsividis, Prentice Hall, 1994.
4. 'DSP Integrated Circuits', Lars Wanhammar, Academic Press Series in Engineering, 1st Edition.

Pattern Recognition & Machine Learning

Course Code	**20ESP332**	CIE Marks	40
Lecture Hours/Week	**03**	SEE Marks	60
Total Number of Lecture Hours	**40**	Exam Hours	03
Credits - 03			

Module 1

Introduction: Probability Theory, Model Selection, The Curse of Dimensionality, Decision Theory, Information Theory
Distributions: Binary and Multinomial Variables, The Gaussian Distribution, The Exponential Family, Nonparametric Methods (Ch. 1, 2).

Module-2

Supervised Learning
Linear Regression Models: Linear Basis Function Models, The Bias-Variance Decomposition, Bayesian Linear Regression, Bayesian Model Comparison
Classification & Linear Discriminant Analysis: Discriminant Functions, Probabilistic Generative Models, Probabilistic Discriminative Mode (Ch. 3, 4).

Module-3

Supervised Learning
Kernels: Dual Representations, Constructing Kernels, Radial Basis Function Network, Gaussian Processes
Support Vector Machines: Maximum Margin Classifiers, Relevance Vector Machines
Neural Networks: Feed-forward Network, Network Training, Error Backpropagation (Ch. 5, 6, 7).

Module-4

Unsupervised Learning
Mixture Models: K-means Clustering, Mixtures of Gaussians, Maximum likelihood, EM for Gaussian mixtures, Alternative View of EM.
Dimensionality Reduction: Principal Component Analysis, Factor/Component Analysis, Probabilistic PCA, Kernel PCA, Nonlinear Latent Variable Models (Ch. 9, 12).

Module-5

Probabilistic Graphical Models: Bayesian Networks, Conditional Independence, Markov Random Fields, Inference in Graphical Models, Markov Model, Hidden Markov Models (Ch.8,13).

Course outcomes:

At the end of the course the students will be able to:

1. Identify areas where Pattern Recognition and Machine Learning can offer a solution.
2. Describe the strength and limitations of some techniques used in computational Machine Learning for classification, regression and density estimation problems.
3. Describe and model data.
4. Solve problems in Regression and Classification.
5. Discuss main and modern concepts for model selection and parameter estimation in recognition, decision making and statistical learning problems.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Text Book:

'Pattern Recognition and Machine Learning', Christopher Bishop, Springer, 2006.

Internet of Things

Course Code	**20ECS333**	CIE Marks	40
Lecture Hours/Week	**03**	SEE Marks	60
Total Number of Lecture Hours	**40**	Exam Hours	03
Credits - 03			

Module-1

What is IoT ?
Genesis, Digitization, Impact, Connected Roadways, Buildings, Challenges
IoT Network Architecture and Design
Drivers behind new network Architectures, Comparing IoT Architectures, M2M architecture, IoT world forum standard, IoT Reference Model, Simplified IoT Architecture.

Module-2

IoT Network Architecture and Design
Core IoT Functional Stack, Layer1 (Sensors and Actuators), Layer 2 (Communications Sublayer), Access network sublayer, Gateways and backhaul sublayer, Network transport sublayer, IoT Network management.
Layer 3 (Applications and Analytics) – Analytics vs Control, Data vs Network Analytics, IoT Data Management and Compute Stack

Module-3

Engineering IoT Networks
Things in IoT – Sensors, Actuators, MEMS and smart objects.
Sensor networks, WSN, Communication protocols for WSN
Communications Criteria, Range, Frequency bands, power consumption, Topology, Constrained Devices, Constrained Node Networks
IoT Access Technologies, IEEE 802.15.4
Competitive Technologies – Overview only of IEEE 802.15.4g, 4e, IEEE 1901.2a
Standard Alliances – LTE Cat 0, LTE-M, NB-IoT

Module-4

Engineering IoT Networks
IP as IoT network layer, Key Advantages, Adoption, Optimization, Constrained Nodes, Constrained Networks, IP versions, Optimizing IP for IoT.

Application Protocols for IoT – Transport Layer, Application Transport layer, Background only of SCADA, Generic web based protocols, IoT Application Layer
Data and Analytics for IoT – Introduction, Structured and Unstructured data, IoT Data Analytics overview and Challenges.

Module-5

IoT in Industry (Three Use cases)
IoT Strategy for Connected manufacturing, Architecture for Connected Factory Utilities – Power utility, IT/OT divide, Grid blocks reference model, Reference Architecture, Primary substation grid block and automation.
Smart and Connected cities –Strategy, Smart city network Architecture, Street layer, city layer, Data center layer, services layer, Smart city security architecture, Smart street lighting.

Course outcomes:
At the end of the course the student will be able to:

1. Understand the basic concepts IoT Architecture and devices employed.
2. Analyze the sensor data generated and map it to IoT protocol stack for transport.
3. Apply communications knowledge to facilitate transport of IoT data over various available communications media.
4. Design a use case for a typical application in real life ranging from sensing devices to analyzing the data available on a server to perform tasks on the device.
5. Apply knowledge of Information technology to design of IoT applications (Operational Technology).

Question paper pattern:
The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Text Book:

‘CISCO, IoT Fundamentals – Networking Technologies, Protocols, Use Cases for IoT’, David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry, Pearson Education, ISBN: 978-9386873743, First edition, 2017

Reference Book:

‘Internet of Things – A Hands on Approach’, Arshdeep Bahga and Vijay Madisetti, Orient Blackswan Private Limited - New Delhi, First edition, 2015

Communication System Design using DSP algorithm

Course Code	**20ESP334**	CIE Marks	40
Lecture Hours/Week	**03**	SEE Marks	60
Total Number of Lecture Hours	**40**	Exam Hours	03
Credits - 03			

Module 1

Introduction to the course: Digital filters, Discrete time convolution and frequency responses, FIR filters - Using circular buffers to implement FIR filters in C and using DSP hardware, Interfacing C and assembly functions, Linear assembly code and the assembly optimizer. IIR filters - realization and implementation, FFT and power spectrum estimation: DTFT window function, DFT and IDFT, FFT, Using FFT to implement power spectrum.

Module 2

Analog modulation scheme: Amplitude Modulation - Theory, generation and demodulation of AM, Spectrum of AM signal, Envelope detection and square law detection, Hilbert transform and complex envelope, DSP implementation of amplitude modulation and demodulation.
DSBSC: Theory generation of DSBSC, Demodulation, and demodulation using coherent detection and Costas loop. Implementation of DSBSC using DSP hardware.
SSB: Theory, SSB modulators, Coherent demodulator, Frequency translation, Implementation using DSP hardware.

Module 3

Frequency modulation: Theory, Single tone FM, Narrow band FM, FM bandwidth, FM demodulation, Discrimination and PLL methods, Implementation using DSP hardware.
Digital Modulation scheme: PRBS, and data scramblers: Generation of PRBS, Self-synchronizing data scramblers, Implementation of PRBS and data scramblers. RS-232C protocol and BER tester: The protocol, error rate for binary signaling on the Gaussian noise channels, Three-bit error rate tester and implementation.

Module 4

PAM and QAM: PAM theory, baseband pulse shaping and ISI, Implementation of transmit filter and interpolation filter bank. Simulation and theoretical exercises for PAM, Hardware exercises for PAM.

QAM fundamentals: Basic QAM transmitter, 2 constellation examples, QAM structures using passband shaping filters, Ideal QAM demodulation, QAM experiment. QAM receivers-Clock recovery and other frontend sub-systems. Equalizers and carrier recovery systems.

Module 5

Experiment for QAM receiver frontend, Adaptive equalizer, Phase splitting, Fractionally spaced equalizer. Decision directed carrier tracking, Blind equalization, Complex cross coupled equalizer and carrier tracking experiment. Echo cancellation for full duplex modems: Multicarrier modulation, ADSL architecture, Components of simplified ADSL transmitter, A simplified ADSL receiver, Implementing simple ADSL Transmitter and Receiver.

Course outcomes:

At the end of the course the students will be able to:

1. Realize communication systems, including algorithms that are particularly suited to DSP implementation
2. Implement DSP algorithms on TI DSP processors
3. Implement FIR, IIR digital filtering and FFT methods
4. Implement modulators and demodulators for AM, DSBSC-AM, SSB and FM
5. Design digital communication methods leading to the implementation of a line communication system.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Text Book:

'Communication System Design using DSP Algorithms with Laboratory Experiments for the TMS320C6713 DSK', Steven A Tretter, Springer, 2008.

Reference Books:

1. 'Modern Digital Signal Processing', Roberto Cristi, Cengage Publishers, India, 2003.
2. 'Digital Signal Processing: A Computer Based Approach', S. K. Mitra, TMH, India, 3rd edition, 2007.
3. 'Digital Signal Processing: A Practitioner's approach', E.C. Ifeachor, and B. W. Jarvis, Pearson Education, India, Second Edition, 2002,
4. 'Digital Signal Processing', Proakis and Manolakis, Prentice Hall, 3rd edition, 1996.

Project Work Phase – 1

Course Code	**20ESP34**	CIE Marks	100
Number of contact Hours/Week	**02**	SEE Marks	-
		Exam Hours	-
Credits - 02			

Course objectives:

- Support independent learning.
- Guide to select and utilize adequate information from varied resources maintaining ethics.
- Guide to organize the work in the appropriate manner and present information (acknowledging the sources) clearly.
- Develop interactive, communication, organisation, time management, and presentation skills.
- Impart flexibility and adaptability.
- Inspire independent and team working.
- Expand intellectual capacity, credibility, judgement, intuition.
- Adhere to punctuality, setting and meeting deadlines.
- Instil responsibilities to oneself and others.
- Train students to present the topic of project work in a seminar without any fear, face audience confidently, enhance communication skill, involve in group discussion to present and exchange ideas.

Project Phase-1 Students in consultation with the guide/s shall carry out literature survey/ visit industries to finalize the topic of the Project. Subsequently, the students shall collect the material required for the selected project, prepare synopsis and narrate the methodology to carry out the project work.

Seminar: Each student, under the guidance of a Faculty, is required to

- Present the seminar on the selected project orally and/or through power point slides.
- Answer the queries and involve in debate/discussion.
- Submit two copies of the typed report with a list of references.

The participants shall take part in discussion to foster friendly and stimulating environment in which the students are motivated to reach high standards and become self-confident.

Revised Bloom's Taxonomy Level	L_3 – Applying, L_4 – Analysing, L_5 – Evaluating, L_6 – Creating.

Course outcomes:

At the end of the course the student will be able to:

1. Demonstrate a sound technical knowledge of their selected project topic.
2. Undertake problem identification, formulation and solution.
3. Design engineering solutions to complex problems utilising a systems approach.
4. Communicate with engineers and the community at large in written an oral forms.
5. Demonstrate the knowledge, skills and attitudes of a professional engineer.

Continuous Internal Evaluation

CIE marks for the project report (50 marks), seminar (25 marks) and question and answer (25 marks) shall be awarded (based on the quality of report and presentation skill, participation in the question and answer session by the student) by the committee constituted for the purpose by the Head of the Department. The committee shall consist of three faculty from the department with the senior most acting as the Chairperson.

MINI PROJECT

Course Code	**20ESP35**	CIE Marks	100
Number of contact Hours/Week	**02**	SEE Marks	---
		Exam Hours/ Batch	03
Credits - 02			

Course objectives:

- To support independent learning and innovative attitude.
- To guide to select and utilize adequate information from varied resources upholding ethics.
- To guide to organize the work in the appropriate manner and present information (acknowledging the sources) clearly.
- To develop interactive, communication, organisation, time management, and presentation skills.
- To impart flexibility and adaptability.
- To inspire independent and team working.
- To expand intellectual capacity, credibility, judgement, intuition.
- To adhere to punctuality, setting and meeting deadlines.
- To instil responsibilities to oneself and others.
- To train students to present the topic of project work in a seminar without any fear, face audience confidently, enhance communication skill, involve in group discussion to present and exchange ideas.

Mini-Project: Each student of the project batch shall involve in carrying out the project work jointly in constant consultation with internal guide, co-guide, and external guide and prepare the project report as per the norms avoiding plagiarism.

Course outcomes:

At the end of the course the student will be able to:

1. Present the mini-project and be able to defend it.
2. Make links across different areas of knowledge and to generate, develop and evaluate ideas and information so as to apply these skills to the project task.
3. Habituated to critical thinking and use problem solving skills.
4. Communicate effectively and to present ideas clearly and coherently in both the written and oral forms.
5. Work in a team to achieve common goal.
6. Learn on their own, reflect on their learning and take appropriate actions to improve it.

CIE procedure for Mini - Project:
The CIE marks awarded for Mini - Project, shall be based on the evaluation of Mini - Project Report, Project Presentation skill and Question and Answer session in the ratio 50:25:25. The marks awarded for Mini - Project report shall be the same for all the batch mates.

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Internship / Professional Practice

Course Code	**20ESPI36**	CIE Marks	40
Number of contact Hours/Week	**02**	SEE Marks	60
		Exam Hours	03
Credits - 06			

Course objectives:
Internship/Professional practice provide students the opportunity of hands-on experience that include personal training, time and stress management, interactive skills, presentations, budgeting, marketing, liability and risk management, paperwork, equipment ordering, maintenance, responding to emergencies etc. The objectives are further,

- To put theory into practice.
- To expand thinking and broaden the knowledge and skills acquired through course work in the field.
- To relate to, interact with, and learn from current professionals in the field.
- To gain a greater understanding of the duties and responsibilities of a professional.
- To understand and adhere to professional standards in the field.
- To gain insight to professional communication including meetings, memos, reading, writing, public speaking, research, client interaction, input of ideas, and confidentiality.
- To identify personal strengths and weaknesses.
- To develop the initiative and motivation to be a self-starter and work independently

Internship/Professional practice: Students under the guidance of internal guide/s and external guide shall take part in all the activities regularly to acquire as much knowledge as possible without causing any inconvenience at the place of internship.

Seminar: Each student, is required to

- Present the seminar on the internship orally and/or through power point slides.
- Answer the queries and involve in debate/discussion.
- Submit the report duly certified by the external guide.

The participants shall take part in discussion to foster friendly and stimulating environment in which the students are motivated to reach high standards and become self-confident.

Course outcomes:

At the end of the course the student will be able to:

- Gain practical experience within industry in which the internship is done.
- Acquire knowledge of the industry in which the internship is done.
- Apply knowledge and skills learned to classroom work.
- Develop a greater understanding about career options while more clearly defining personal career goals.
- Experience the activities and functions of professionals.
- Develop and refine oral and written communication skills.
- Identify areas for future knowledge and skill development.
- Expand intellectual capacity, credibility, judgment, intuition.
- Acquire the knowledge of administration, marketing, finance and economics.

Continuous Internal Evaluation

CIE marks for the Internship/Professional practice report (20 marks), seminar (10 marks) and question and answer session (10 marks) shall be awarded (based on the quality of report and presentation skill, participation in the question and answer session by the student) by the committee constituted for the purpose by the Head of the Department. The committee shall consist of three faculty from the department with the senior most acting as the Chairperson.

Semester End Examination

SEE marks for the Internship Report (30 Marks), Seminar (15 Marks) and Question and Answer Session (15 marks) shall be awarded (based on the quality of report and presentation skill, participation in the question and answer session) by the examiners appointed by the University.

M.TECH IN Signal Processing (ESP)

Choice Based Credit System (CBCS) and Outcome Based Education(OBE)
(Effective from the academic year 2020-21)

SEMESTER -IV

PROJECT WORK PHASE -2

Course Code	**20ESP41**	CIE Marks	40
Number of contact Hours/Week	**04**	SEE Marks	60
		Exam Hours	03
Credits - 20			

Course objectives:

- To support independent learning.
- To guide to select and utilize adequate information from varied resources maintaining ethics.
- To guide to organize the work in the appropriate manner and present information (acknowledging the sources) clearly.
- To develop interactive, communication, organisation, time management, and presentation skills.
- To impart flexibility and adaptability.
- To inspire independent and team working.
- To expand intellectual capacity, credibility, judgement, intuition.
- To adhere to punctuality, setting and meeting deadlines.
- To instil responsibilities to oneself and others.
- To train students to present the topic of project work in a seminar without any fear, face audience confidently, enhance communication skill, involve in group discussion to present and exchange ideas.

Project Work Phase - II: Each student of the project batch shall involve in carrying out the project work jointly in constant consultation with internal guide, co-guide, and external guide and prepare the project report as per the norms avoiding plagiarism.

Course outcomes:
At the end of the course the student will be able to:

- Present the project and be able to defend it.

- Make links across different areas of knowledge and to generate, develop and evaluate ideas and information so as to apply these skills to the project task.
- Habituated to critical thinking and use problem solving skills
- Communicate effectively and to present ideas clearly and coherently in both the written and oral forms.
- Work in a team to achieve common goal.
- Learn on their own, reflect on their learning and take appropriate actions to improve it.

Continuous Internal Evaluation:

Project Report: 20 marks. The basis for awarding the marks shall be the involvement of the student in the project and in the preparation of project report. To be awarded by the internal guide in consultation with external guide if any.

Project Presentation: 10 marks.

The Project Presentation marks of the Project Work Phase -II shall be awarded by the committee constituted for the purpose by the Head of the Department. The committee shall consist of three faculty from the department with the senior most acting as the Chairperson.

Question and Answer: 10 marks.

The student shall be evaluated based on the ability in the Question and Answer session for 10 marks.

Semester End Examination

SEE marks for the project report (30 marks), seminar (15 marks) and question and answer session (15 marks) shall be awarded (based on the quality of report and presentation skill, participation in the question and answer session) by the examiners appointed by the University.