MAHARAJA INSTITUTE OF TECHNOLOGY MYSORE
Autonomous Institution Affiliated to VTU

Competency Based Syllabus (CBS)
for
Computer Science and Engineering (DATA SCIENCE)

(Under Outcome Based Education (OBE) and

Choice-Based Credit System (CBCS))

Offered from 7th to 8th Semesters of Study

In

Partial Fulfillment for the Award of Bachelor's Degree in

Computer Science and Engineering (DATA SCIENCE)

2023 Scheme

Scheme Effective from the academic year 2023-24

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7th Semester	Management Sciences(MS) Management and Entrepreneurship	M23BCS701

1. Prerequisites

S/L	Proficiency	Prerequisites
1.	Management skills	How the Brain Processes Information to Make Decisions: Reflective and Reactive Systems
2.	Critical Thinking Case	New Management Challenges for the New Age.
3.	Decisional roles	The responsibility of making decisions on behalf of both the organization and the stakeholders with an interest in it.
4.	Determination	Entrepreneurs look at defeat as an opportunity for success. They are determined to make all of their endeavors succeed,
5.	Creativity	Entrepreneurs will repurpose products to market them to new industries.

2. Competencies

S/L	Competency	KSA Description
1	**Management**	**Knowledge:** Management is how businesses organize and direct workflow, operations, and employees to meet company goals. **Skills:** The primary goal of management is to create an environment that empowers employees to work efficiently and productively **Attitudes:** Management is a dynamic function and evolves and adapts to changes in its environment, whether they are economic, socio-political or technological.
2	**Administration**	**Knowledge**: performance of supervising duties, management. **Skills**: Administration skills involve organization, communication, teamwork, customer service, responsibility and time management. **Attitudes:** It is a collaborative activity that involves writing, correspondence, and other administrative tasks. Administration is essential in both small, local organizations and large, complex enterprises.
3	**Planning**	**Knowledge**: Planning is essential for the establishment of goals, policies, and procedures for a social or economic unit **Skills:** Process used to develop objectives, develop tasks to meet objectives, determine needed resources, create a timeline, determine tracking and assessment, finalize the plan, and distribute the plan to the team. **Attitudes:** Planning is based on foresight, the fundamental capacity for mental time travel.
4	**Organizing and staffing**:	**Knowledge**: Arranging resources and tasks to implement the plan **Skills**: Staffing: Recruiting, selecting, evaluation and training individuals for specific roles within the organization **Attitudes**: Arrange and relate the work, so that it can be done efficiently by people – specifically.
5	**Directing**	**Knowledge**: Directing: Leading and motivating employees to work towards the organization's goals. **Skills:** The directing function of management is the process of motivating, communicating, instructing, leading, and supervising employees in order to ensure that they are working towards the accomplishment of organizational goals **Attitudes:**It is a continuous managerial process that goes on. Throughout the life of the organization.

6.	**Entrepreneur:**	**Knowledge:** Originates from a thirteenth-century French verb, entrepreneur, meaning "to do something" or "to undertake." **Skills:** Include various skill sets such as leadership, business management, time management, creative thinking and problem-solving. **Attitudes:** Entrepreneurs are business people who find their success by taking risks. In their pursuits, they often become disruptors in established industries.
7	**Small scale industries:**	**Knowledge:** In which manufacturing, providing services, productions are done on a small scale or micro scale. **Skills:** Industries that manufacture, produce and render services on a small or micro scale level. **Attitudes:** To play an active role in reducing the regional imbalances in the nation. To help in improving the standard of living for people in rural areas.
8	**Institutional support**	**Knowledge:** Refers to the assistance, frameworks, and resources provided by formal and informal institutions to individuals **Skills:** The organization is running various schemes to meet its objectives. **Attitudes:** Approved Colleges/Registered facilitators with objective for enhancing their Employment/ Self-Employment opportunities

3. Syllabus

Management and Entrepreneurship SEMESTER – VII			
Course Code	**M23BCS701**	CIE Marks	**50**
Number of Lecture Hours/Week(L: T: P: S)	**(3:0:0:0)**	SEE Marks	**50**
Total Number of Lecture Hours	**40 Hours**	**Total Marks**	**100**
Credits	**03**	Exam Hours	**03**

Course Objectives:

1. Explain fundamentals management functions of a manager. Also explain planning and decision making processes
2. Explain the organizational structure, staffing and leadership process and describe the understanding of motivation.
3. Explain understanding of Entrepreneurships and Entrepreneurship development process.
4. Illustrate Small Scale Industries, various types of supporting agencies and financing available for an entrepreneur.
5. Summarize the preparation of project report, need significance of report. Also to explain about industrial ownership.

Module -1

Management: Introduction - Meaning - nature and characteristics of Management, Scope and Functional areas of management - Management as art or science, art or profession - Management & Administration - Roles of Management, Levels of Management,

Planning: Nature, importance and purpose of planning process objectives - Types of plans (meaning only) - Decision making, Importance of planning - steps in planning & planning premises

Module -2

Organizing and staffing: Nature and purpose of organization, Principles of organization – Types of organization- Departmentation Committees-Centralization Vs Decentralization of authority and responsibility - Span of control - MBO and MBE (Meaning only) Nature and importance of staffing-- :Process of Selection & Recruitment (in brief).

Directing: Meaning and nature of directing Leadership styles, Motivation, Theories, Communication - Meaning and importance - coordination, meaning and importance and Techniques of coordination.

Module -3

Entrepreneur: Meaning of Entrepreneur; Evolution of the Concept; Functions of an Entrepreneur, Types of Entrepreneur, Entrepreneur an emerging class. Concept of Entrepreneurship - Evolution of Entrepreneurship, Development of Entrepreneurship; Stages in entrepreneurial process; Role of entrepreneurs in Economic Development;

Module -4

Small scale industries: Definition; Characteristics; Need and rationale; Objectives; Scope; roleof SSI in Economic Development. Advantages of SSI, Steps to start and SSI - Government policy towards SSI; Different Policies of SSI; Government Support for SSI during 5 year plans. Impact of Liberalization, Privatization, Globalization on SSI Effect of WTO/GATT Supporting Agencies of Government for SSI, Meaning, Nature of support; Objectives; Functions; Types of Help; Ancillary Industry and Tiny Industry (Definition Only). **Institutional support:** Different Schemes; TECKSOK; KIADB; KSSIDC;
Module -5
Preparation of project: Meaning of Project; Project Identification; Project Selection; Project Report; Need and Significance of Report; Contents; formulation; Guidelines by Planning Commission for Project report; Network Analysis; Errors of Project Report; Project Appraisal. Identification of. Business Opportunities: Market Feasibility Study; Technical Feasibility Study; Financial Feasibility Study & Social Feasibility Study. **Industrial ownership:** Definition and meaning of Partnership, Characteristics of Partnership, Kinds of Partners, Partnership Agreement or Partnership Deed
Text Books: 1. Principles of Management – P. C. Tripathi, P.N. Reddy – Tata McGraw Hill. 2. Dynamics of Entrepreneurial Development & Management-Vasant Desai,Himalaya PublishingHouse. 3. Entrepreneurship Development – Poornima. M. Charantimath, Small Business Enterprises – PearsonEducation - 2006 (2 & 4) **Reference Books:** 1. Management Fundamentals - Concepts, Application, Skill Development – RobersLusier, Thomson. 2. Entrepreneurship Development - S. S. Khanka, S. Chand & Co. New Delhi. 3. Management - Stephen Robbins, Pearson Education/PHI - 17thEdition, 2003.

4. Syllabus Timeline

S/L	Syllabus Timeline	Description
1	Week 1-3: Management and Planning	**Competency:** Understand the basic functions managements and planning **Knowledge:** Management is how businesses organize and direct workflow, operations, and employees to meet company goals. **Skills:** The primary goal of management is to create an environment that empowers employees to work efficiently and productively.
2	Week 4-6: Organizing and staffing: Directing**:**	**Competency:** Understand the basic functions managements, committee, centralised and decentralised authority and responsibility and directing. **Knowledge:** Arranging resources and tasks to implement the plan. **Skills**: Staffing: Recruiting, selecting, evaluation and training individuals for specific roles within the organization
3	Week 8-11: Entrepreneur**:**	**Competency:** Students will be able to do, arrange and relate the work, so that it can be done efficiently and – specifically. **Knowledge:** Entrepreneurship usually starts as a small business but the long-term vision is much greater, to seek high profits and capture market share with an innovative new idea to reach students. **Skills:** Include various skill sets such as leadership, business management, time management, creative thinking and problem-solving.
4	Week 7-8: Small scale industries and Institutional support	**Competency:** Learn the scope and manufacturing development OF SSI and institution**.** **Knowledge:** In which manufacturing, providing services, productions are done on a small scale or micro scale**.** **Skills:** Industries that manufacture produce and render services on a small or micro scale level.
5	Week 9-12: Preparation of project and Industrial ownership	**Competency:** student able to understand the project identification, selection, preparation and report, and also knowledge about industrial ownership. **Knowledge:** Studentsable to analyse differences between single and partner ownership and Identification of. Business Opportunities. **Skills:** manufacture produce and render services

5. Teaching-Learning Process Strategies

S/L	TLP Strategies:	Description
1	Lecture Method	Utilize various teaching methods within the lecture format to management and entrepreneurship.
2	Video/Animation	Incorporate visual aids like videos/animations to enhance understanding of management and entrepreneur activities.
3	Collaborative Learning	Encourage collaborative learning for improved competency application.
4	Higher Order Thinking (HOTS) Questions:	Pose HOTS questions to stimulate critical thinking related to each competency

6. 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:

Components		Number	Weightage	Max. Marks	Min. Marks
(i)	Internal Assessment-Tests (A)	2	50%	25	10
(ii)	Assignments/Quiz/Activity (B)	2	50%	25	10
	Total Marks			**50**	**20**

Final CIE Marks = (A) + (B)

Average internal assessment shall be the average of the 2 test marks conducted.

Semester End Examination:

Theory SEE will be conducted as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. Question paper pattern will be ten questions. Each question is set for 20marks. The medium of the question paper shall be English unless otherwise it is mentioned.
2. There shall be 2 questions from each module, each of the two questions under a module (with a maximum of 3 sub questions), may have a mix of topics under that module if necessary.
3. The students have to answer 5 full questions selecting one full question from each module.
4. Marks scored will be proportionally scaled down to 50 marks

7. Learning Objectives

S/L	Learning Objectives	Description
1	Management and Planning	Explain fundamentals management functions of a manager. Also explain planning and decision making processes, management, object and administration
2	Organizing and staffing: Directing	Explain the organizational structure, staffing and leadership process and describe the understanding of motivation about leadership style, communication, coordination and technique. Also learn the basic functions managements, committee, centralised and decentralised authority and responsibility and directing.
3	Entrepreneur**:**	Explain understanding of Entrepreneurships and Entrepreneurship development process and Students will be able to do, arrange and relate the work, so that it can be done efficiently and – specifically.
4	Small scale industries and Institutional support	Illustrate Small Scale Industries, various types of supporting agencies and financing available for an entrepreneur and learn the scope and manufacturing development OF SSI and institution**.**
5	Preparation of project and Industrial ownership	Summarize the preparation of project report, need significance of report. Also to explain about industrial ownership and students able to understand the project identification, selection, preparation and report, and also knowledge about industrial ownership.

8. Course Outcomes (COs) and Mapping with POs/ PSOs

Course Outcomes (COs)

COs	Description
M23BCS701.1	Explain management functions of a manager. Also explain planning and decision making processes.
M23BCS701.2	Explain the organizational structure, staffing and leadership processes and . describe the understanding of motivation
M23BCS701.3	Understanding of Entrepreneurships and Entrepreneurship development process.
M23BCS701.4	Illustrate Small Scale Industries, various types of supporting agencies and financing available for an entrepreneur.
M23BCS701.5	Summarize the preparation of project report, need significance of report.

CO-PO-PSO Mapping

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
M23BCS701.1	3	-	-	-	-	-	-	-	-	-	3	-	3	-
M23BCS701.2	-	3	-	-	-	-	-	-	-	-	-	-	3	-
M23BCS701.3	-	-	-	-	-	-	-	-	-	-	-	-	3	-
M23BCS701.4	-	-	3	3	3	-	-	-	3	-	-	-	3	-
M23BCS701.5	-	-	3	3	-	-	-	-	3	-	-	-	3	-
M23BCS701	**3**	**3**	3	3	3	-	-	-	3	-	3	-	3	-

9. Assessment Plan

Continuous Internal Evaluation (CIE)

	CO1	CO2	CO3	CO4	CO5	Total
Module 1	**10**					**10**
Module 2		**10**				**10**
Module 3			**10**			**10**
Module 4				**10**		**10**
Module 5					**10**	**10**
Total	**10**	**10**	**10**	**10**	**10**	**50**

Semester End Examination (SEE)

	CO1	CO2	CO3	CO4	CO5	Total
Module 1	**20**					**20**
Module 2		**20**				**20**
Module 3			**20**			**20**
Module 4				**20**		**20**
Module 5					**20**	**20**
Total	**20**	**20**	**20**	**20**	**20**	**100**

10. Future with this Subject:

- **Management:** With the new start-ups and ongoing businesses, the business management field in India has witnessed a steady rise in demand for skilled managers. A business management degree can open the doors to many industries and you can climb up the hierarchy if you have the necessary skill
- **Planning:** Career planning is a lifelong process that can help you manage important life and work decisions. Consider your priorities, options, and strengths to build a plan that gets you where you want to go
- **Organizing and staffing:** The scope of a management system may include the whole of the organization, specific and identified functions of the organization, specific and identified sections of the organization, or one or more functions across a group of organizations. By embracing emerging technologies, leveraging data-driven insights, and adopting ethical recruiting practices, recruiters can navigate the ever-changing landscape of staffing with confidence and drive better outcomes for both employers
- **Directing:** Directing is thus concerned with instructing, guiding and inspiring people in the organisation to achieve its objectives. Its important components are communication, supervision, motivation and leadership. Supervision involves seeing that subordinates perform the work as per instructions given.
- **Entrepreneur:** Entrepreneurs in the future will need to navigate the potential job displacement and automation resulting from technological advancements. This means being adaptable and continuously learning new skills to stay relevant in the changing landscape.

7th Semester	Integrated Professional Core Course(IPC) Natural Language processing	M23BCS702

1. Prerequisites

S/L	Proficiency	Prerequisites
1	**Mathematics**	**Linear Algebra:** Understanding of vectors, matrices, eigenvalues, and eigenvectors. **Probability and Statistics:** Basic concepts such as probability distributions, Bayes' theorem, variance, and hypothesis testing. **Calculus:** Differentiation and integration, especially in the context of optimization and gradient descent.
2	**Machine Learning Basics**	Understanding of supervised and unsupervised learning. Familiarity with key algorithms such as linear regression, logistic regression, decision trees, and clustering. Basics of neural networks and deep learning.
3	**Data Structures and Algorithms**	Knowledge of common data structures like arrays, linked lists, stacks, queues, trees, and graphs. Understanding of algorithmic concepts like sorting, searching, and dynamic programming.
4	**Text Processing:**	Familiarity with regular expressions and basic text processing techniques. Basic understanding of tokenization, stemming, lemmatization, and stop-word removal
5	**Basic of NLP Concepts**	Awareness of what NLP is and its applications. Familiarity with terms like tokenization, parsing, language models, etc.
6	**Linguistics**	Basic understanding of syntax, semantics, and morphology. Awareness of linguistic structures like parts of speech, grammar, and sentence structure.

2. Competencies

S/L	Competency	KSA Description
1	**Application of NLP Foundations**	**Knowledge:** Understand the origins, challenges, and applications of NLP, particularly in language and grammar processing, including Indian languages. **Skills:** Analyze key challenges in NLP, apply grammar-based and statistical language models, and develop basic NLP applications.
2	**Proficiency in Text Preprocessing and Analysis**	**Knowledge:** Grasp essential text preprocessing techniques like tokenization, stemming, lemmatization, and regular expressions. **Skills:** Implement text preprocessing pipelines, perform word-level morphological parsing, and correct spelling errors using advanced techniques.
3	**Language Modeling Techniques**	**Knowledge:** Understand various grammar-based and statistical language models, including modern models like Transformers. **Skills:** Develop and evaluate language models for different NLP tasks, implement n-gram models, and apply modern models like BERT or GPT.
4	**Ability to Conduct Syntactic and Semantic Analysis**	**Knowledge:** Understand syntactic structures, context-free grammars, and probabilistic parsing methods; comprehend semantic role labeling and frame semantics. **Skills:** Perform syntactic parsing using context-free grammar, constituency parsing, and dependency parsing, and execute semantic analysis through role labeling.

3. Syllabus

Natural Language Preprocessing **Semester VII**			
Course Code	**M23BCS702**	CIE Marks	**50**
Number of Lecture Hours/Week (L: T: P: S)	**(3:0:2:0)**	SEE Marks	**50**
Total Number of Lecture Hours	**40 Hours Theory+20 Hours Practical**	Total Marks	**100**
Credits	**04**	Exam Hours	**03**

Course objectives: This course will enable students to

1. Analyze the natural language text.
2. Define the importance of natural language.
3. Understand the concepts Text mining.
4. Illustrate information retrieval techniques.

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.
Text Book 1: Chapter 1,2

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.
Text Book 1: Chapter 3,4

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 Labeling, Learning to Annotate Cases with Knowledge Roles and Evaluations.
A Case Study in Natural Language Based Web Search: In Fact System Overview, The Global Security.org Experience.
Text Book 2: Chapter 3,4 and Chapter 5

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 Analyzing Texts, Latent Semantic Analysis, Predictions, Results of Experiments.
Automatic Document Separation: A Combination of Probabilistic Classification and Finite-State Sequence Modeling: 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.
Text Book 2: Chapter 6, 7, 8, 9

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.
Textbook 1: Chapter 9,12

Text Books:

1. Tanveer Siddiqui, U.S. Tiwary, "Natural Language Processing and Information Retrieval", Oxford University Press, 2008.
2. Anne Kao and Stephen R. Poteet (Eds), "Natural Language Processing and Text Mining", Springer-Verlag London Limited 2007.

Reference Books:

1. Daniel Jurafsky and James H Martin, "Speech and Language Processing: An introduction to Natural Language

Processing, Computational Linguistics & Speech Recognition", 2nd Edition, Prentice Hall, 2008.
2. James Allen, "Natural Language Understanding", 2nd edition, Benjamin/Cummings publishing company, 1995.

Lab Componenets Programs	
1	Introduction to Python for NLP: Basic string manipulation, regular expressions, and text processing.
2	Write a program to preprocess a given text document by performing tokenization, stop word removal, and stemming/lemmatization using the NLTK or SpaCy library
3	Implementing Tokenization and POS Tagging: Use NLTK or spaCy to perform tokenization and part-of-speech tagging on sample texts.
4	Define a small Context-Free grammar (CFG) for a subset of the English language. Write a parser that checks if a given sentence belongs to the language defined by your CFG.
5	Implement a basic POS tagger using the NLTK library. Compare its performance with SpaCy's pre-trained POS tagger on the same text.
6	Implement a simple Named Entity Recognition (NER) model using the NLTK library. Train it on a small custom dataset and evaluate its performance.
7	Implement Latent Semantic Analysis (LSA) to find similarity between documents in a corpus. Use the cosine similarity measure to find the most similar document to a given query document.
8	Write a program to extract subject-object-verb triplets from a given text using dependency parsing.
9	Implement a simple inverted index for a set of documents. Allow users to query the index and return ranked results based on TF-IDF.
10	Evaluation of IR Systems: Design and conduct experiments to evaluate the effectiveness of an information retrieval system using precision, recall, and F1-score.

4. Syllabus Timeline

S/L	Syllabus Timeline	Description
1	Week1-2: **Overview and Language Modeling**	**Competency:** • Understand the fundamental concepts and challenges of Natural Language Processing (NLP). • Develop a foundational understanding of language models and their application in NLP. **Knowledge:** • Origins and evolution of NLP. • Challenges in processing Indian languages. • Key applications of NLP, such as information retrieval. • Different types of grammar-based and statistical language models. **Skills:** • Analyze and differentiate between various NLP challenges and applications. • Apply knowledge of language models to develop basic NLP solutions.
2	Week 3-4: **Word Level and Syntactic Analysis**	**Competency:** • Analyze text at the word level and perform syntactic parsing for NLP tasks. • Understand and apply techniques for part-of-speech tagging and syntactic parsing. **Knowledge:** • Basics of word-level analysis, including regular expressions and finite-state automata. Techniques for morphological parsing, spelling error detection, and correction. • Syntactic analysis using context-free grammar and constituency parsing. **Skills:** • Implement regular expressions and finite-state automata for text analysis. • Perform morphological parsing and correct spelling errors in text.
		Competency:

3	Week 5-6: **Extracting Relations from Text and Case Studies**	• Extract and analyze relations from text using advanced NLP techniques. • Understand and apply knowledge roles and semantic role labeling in specific domains. **Knowledge:** • Techniques for extracting relations from word sequences and dependency paths. • Subsequence kernels and dependency-path kernels for relation extraction. **Skills:** • Apply relation extraction techniques to analyze text. • Analyze real-world case studies and apply NLP techniques for web search.
4	Week 7-8: **Evaluating Self-Explanations and Textual Signatures**	**Competency:** • Evaluate and enhance textual explanations using advanced NLP techniques. • Identify and classify text types based on cohesion and structure. **Knowledge:** • Techniques for evaluating self-explanations using word matching, latent semantic analysis (LSA), and topic models. • Introduction to iSTART feedback systems and analyzing texts using LSA to identify textual signatures and measure cohesion. **Skills:** • Implement word matching, LSA, and topic models to evaluate self-explanations. • Use Coh-Metrix to analyze the cohesion of text structures. • Apply probabilistic classification and sequence modeling for document separation. • Develop and test novel approaches for semantically-based text mining.
5	Week 9-10: **Information Retrieval and Lexical Resources**	**Competency:** • Design and evaluate information retrieval systems using various models. • Utilize lexical resources effectively in NLP applications. **Knowledge:** • Key design features of information retrieval systems. • Classical, non-classical, and alternative models of information retrieval. • Methods for evaluating information retrieval systems. • Overview of lexical resources, including WordNet, FrameNet, stemmers, POS taggers, and research corpora. **Skills:** • Design and implement information retrieval systems using different models. • Evaluate the performance and effectiveness of information retrieval systems. • Apply lexical resources like WordNet and FrameNet in NLP tasks. • Develop custom stemmers and POS taggers for specific applications.

5. Teaching-Learning Process Strategies

S/L	TLP Strategies:	Description
1	**Lecture Method**	Utilize various teaching methods within the lecture format to reinforce competencies.
2	**Video/Animation**	Incorporate visual aids like videos/animations to enhance understanding of NLP concepts.
3	**Collaborative Learning**	Encourage collaborative learning for improved competency application.
4	**Higher Order Thinking (HOTS) Questions:**	Pose HOTS questions to stimulate critical thinking related to each competency.
5	**Problem-Based Learning (PBL)**	Implement PBL to enhance analytical skills and practical application of competencies

6	**Pair Programming**	Incorporate pair programming sessions where students collaborate in pairs to solve coding tasks or work on projects together.
7	**Practical Application and Projects**	To reinforce the competencies in an NLP course, practical applications and projects are essential. These hands-on activities allow students to apply the theoretical knowledge and skills they've gained in real-world scenarios.
8	**Problem-Solving Sessions**	Organize problem-solving sessions where students can work together to solve coding challenges and overcome programming obstacles

6. 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

Theory Course with 4 credits: Integrated Professional Core Course (IPC)

Components		**Number**	**Weightage**	**Max. Marks**	**Min. Marks**
Theory (A)	Internal Assessment-Tests (A)	2	**60%**	**15**	**06**
	Assignments/Quiz/Activity (B)	2	**40%**	**10**	**04**
	Total Marks		**100%**	**25**	**10**

Components		**Number**	**Weightage**	**Max. Marks**	**Min. Marks**
Laboratory(B)	Record Writing	Continuous	**60%**	15	06
	Test at the end of the semester	1	**40%**	10	04
	Total Marks		**100%**	**25**	**10**

Final CIE Marks = (A) + (B)

Semester End Examination pattern:

- Question paper pattern will be ten questions. Each question is set for 20 marks. The medium of the question paper shall be English unless otherwise it is mentioned.
- There shall be 2 question from each module, each of the two questions under a module (with a maximum of 3 sub questions), may have mix of topics under that module if necessary.
- The students have to answer 5 full questions selecting one full question from each module.
- The question paper may include at least one question from the laboratory component.
- Marks scored will be proportionally scaled down to 50 mark

7. Learning Objectives

S/L	**Learning Objectives**	**Description**
1	**Analyze Natural Language Text**	Analyze natural language text understanding linguistic and computational techniques, enabling them to identify, extract, and interpret patterns, relationships, and structures within diverse text corpora.
2	**Define the Importance of NLP**	Explain the role of NLP in enhancing human-computer interaction through applications like virtual assistants, chatbots, and automated translation services.
3	**Understand the Concepts of Text Mining**	Apply text preprocessing techniques to clean and prepare text data for analysis, including handling noise and normalization. Use feature extraction methods to transform text data into numerical representations suitable for analysis, such as term frequency-inverse document frequency (TF-IDF) and word embeddings

4	**Illustrate Information Retrieval Techniques**	Design and build a basic search engine using information retrieval models, including vector space models and Boolean retrieval. Implement and evaluate advanced retrieval techniques, such as probabilistic models and relevance feedback, to enhance search accuracy.

8. Course Outcomes (COs) and Mapping with POs/ PSOs

Course Outcomes (COs)

COs	Description
M23BCS702.1	Articulate the Foundations of NLP by understanding linguistic structures and contextual meaning.
M23BCS702.2	Analyze the role of language and grammar in NLP, applying concepts processing and information extraction.
M23BCS702.3	Development of Document Separation Techniques and Semantically-Based Text Mining Models
M23BCS702.4	Applying both classical and alternative models of information retrieval to optimize user satisfaction and retrieval performance.

CO-PO-PSO Mapping

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
M23BCS702.1	**3**	-	-	-	-	-	-	-	-	-	3	-	-	-
M23BCS702.2	-	**3**	-	-	-	-	-	-	-	-	3	-	-	-
M23BCS702.3	-	-	**3**	-	-	-	-	-	-	-	-	**3**	**3**	**3**
M23BCS702.4	-	-	-	**3**	-	-	-	-	-	-	-	**3**	**3**	**3**
M23BCS702	**3**	**3**	**3**	**3**	-	-	-	-	-	-	**3**	**3**	**3**	**3**

9. Assessment Plan

Continuous Internal Evaluation (CIE)

	CO1	CO2	CO3	CO4	**Total**
Module 1	10				10
Module 2		10			10
Module 3			10		10
Module 4				10	10
Module 5				10	10
Total	**10**	**10**	**10**	**20**	**50**

Semester End Examination (SEE)

	CO1	CO2	CO3	CO4	**Total**
Module 1	20				20
Module 2		20			20
Module 3			20		20
Module 4				20	20
Module 5				20	20
Total	**20**	**20**	**20**	**40**	**100**

Conditions for SEE Paper Setting:

Each module of SEE question paper should be allocated with questions for 20% of the total SEE marks

10. Future with this Subject

The future of advanced Java development is poised to evolve with advancements in technology and shifts in software development practices.

1. Career Opportunities in Technology and Industry

- Artificial Intelligence and Machine Learning Roles: NLP is a core component of AI and ML. Students can pursue careers as NLP engineers, data scientists, or machine learning engineers, working on developing intelligent systems that understand and process human language.
- Speech and Voice Recognition: With the rise of voice-activated technologies (like virtual assistants), there's a growing demand for experts in speech recognition and synthesis. Careers in companies like Google, Amazon, and Apple, focusing on improving voice-controlled devices, are strong options.
- Healthcare Applications: NLP is increasingly used in healthcare for tasks like medical records analysis, predictive modeling, and patient interaction through chatbots. Careers in health tech companies or research labs focusing on medical NLP are promising.
- Financial Technology (FinTech): NLP is vital in automating tasks such as sentiment analysis for stock trading, fraud detection, and customer service automation. Careers in FinTech, working on developing NLP-based financial models, are on the rise.

2. Research and Academic Opportunities

- **Advanced NLP Research:** Students can pursue advanced degrees (Master's or Ph.D.) to engage in cutting-edge research in areas like deep learning for NLP, multilingual NLP, or cognitive modeling. Universities and research institutions worldwide are constantly exploring new frontiers in NLP.
- **Cross-disciplinary Research:** NLP intersects with psychology, cognitive science, and linguistics, offering opportunities to explore how language processing aligns with human cognition, language acquisition, and communication patterns.

3. Entrepreneurship and Innovation

- **Startup Opportunities:** NLP is a hotbed for innovation, with numerous startups focusing on areas like chatbots, automated customer service, and content creation tools. Students with entrepreneurial aspirations can leverage their NLP skills to develop new products and services.
- **Product Development:** Companies across industries are looking to integrate NLP into their products. Students can lead or contribute to product development teams, creating NLP-driven applications like personalized recommendations, automated content generation, or advanced analytics tools.

4. Societal Impact and Global Challenges

- **Bridging Language Barriers:** NLP is crucial for developing translation services that help bridge language barriers globally, promoting cross-cultural communication and understanding. This can have profound effects on education, diplomacy, and global business.
- **Information Accessibility:** NLP can make information more accessible by improving search engines, summarization tools, and content recommendation systems, ensuring that people can find and understand information more efficiently.
- **Fighting Misinformation:** NLP techniques are essential in the fight against misinformation by automating fact-checking, analyzing the credibility of sources, and detecting fake news.

7th Semester	Professional course (PC) NEURAL NETWORK AND DEEP LEARNING	M23BIS703

1. Prerequisites

S/L	Proficiency	Prerequisites
1	**Fundamental Machine Learning Concepts**	**Basic Machine Learning**: **Concepts**: Supervised learning, unsupervised learning, overfitting, under-fitting, model evaluation metrics (accuracy, precision, recall, F1-score). **Reason**: Provides a foundation for understanding how neural networks fit into the broader context of machine learning. **Basic Algorithms**: **Algorithms**: Linear regression, logistic regression, decision trees, and clustering algorithms. **Reason**: Helps in grasping the evolution from basic machine learning models to more complex neural network models.
2	**Understanding Neural Networks**	**Basic Neural Networks**: **Concepts**: Structure of a neural network (neurons, layers, activation functions), feedforward networks, and the basics of backpropagation. **Reason**: Provides an introductory understanding of how neural networks operate and are trained.
3.	**Computer Science Fundamentals**	**Algorithms and Data Structures**: **Concepts**: Complexity analysis, basic data structures (arrays, lists, trees), and common algorithms. **Reason**: Useful for understanding the computational aspects of implementing and optimizing neural network algorithms. **Software Engineering Principles**: **Concepts**: Code organization, version control (e.g., Git), and debugging. **Reason**: Helps in managing code effectively, collaborating on projects, and ensuring quality and reproducibility in experiments.
4	**Mathematics**	**Linear Algebra**: **Concepts**: Vectors, matrices, eigenvalues, eigenvectors, matrix operations, and singular value decomposition. **Reason**: Essential for understanding the workings of neural networks, especially for matrix operations and transformations in layers. **Calculus**: **Concepts**: Differentiation, partial derivatives, gradients, and optimization techniques. **Reason**: Crucial for understanding backpropagation and optimization algorithms used in training neural networks. **Probability and Statistics**: **Concepts**: Probability distributions, expectation, variance, Bayesian methods, hypothesis testing, and statistical inference. **Reason**: Important for understanding probabilistic models, loss functions, and performance evaluation metrics.
5	**Programming Skills**	**Programming Languages**: **Languages**: Python is highly recommended due to its extensive use in the field, along with libraries such as TensorFlow, Keras, and PyTorch. **Reason**: Essential for implementing neural network architectures, training models, and performing data manipulation and visualization. **Libraries and Frameworks**: **Libraries**: Familiarity with libraries like NumPy (for numerical computations), Pandas (for data manipulation), and Matplotlib/Seaborn (for visualization). **Reason**: These libraries are fundamental for data preprocessing, model implementation, and results visualization.

2. Competencies

S/L	Competency	KSA Description
1	**Theoretical Understanding**	**Knowledge:** Understand and articulate how learning algorithms such as backpropagation and gradient descent work to adjust weights and minimize loss functions. **Skills:** Demonstrate an understanding of how these algorithms contribute to the training and optimization of neural networks. **Attitudes:** Develop and implement neural network models using popular frameworks such as TensorFlow, Keras, or PyTorch.
2	**Practical Skills**	**Knowledge:** Build, train, and evaluate neural network models for various tasks (e.g., image classification, natural language processing). **Skills:** Demonstrate an understanding of how these algorithms contribute to the training and optimization of neural networks. **Attitudes:** Perform data preprocessing tasks such as normalization, data augmentation, and feature extraction.
3	**Programming and Computational Skills**	**Knowledge:** Write clean, efficient code in Python for neural network development and experimentation. **Skills:** Make informed decisions about model architecture and training processes to balance performance with computational resources. **Attitudes:** Utilize Python libraries and tools for implementing and testing deep learning models.
4	**Research and Innovation**	**Knowledge:** Keep up-to-date with the latest research and developments in neural networks and deep learning. **Skills:** Apply state-of-the-art techniques and approaches to current problems and projects based on recent advancements. **Attitudes:** Innovate and experiment with new approaches to enhance model performance or address specific challenges.
5	**Ethical and Practical Considerations**	**Knowledge:** Understand and address ethical concerns related to neural networks and deep learning, including bias, fairness, and privacy issues. **Skills:** Implement practices to ensure responsible and ethical use of AI technologies. **Attitudes:** Develop and deploy models in real-world applications, ensuring they operate effectively and efficiently in production settings.

3. Syllabus

Neural Network and Deep Learning SEMESTER – VII			
Course Code	M23BIS703	CIE Marks	**50**
Number of Lecture Hours/Week(L: T: P: S)	**(4:0:0:0)**	SEE Marks	**50**
Total Number of Lecture Hours	**50 hours Theory**	Total Marks	**100**
Credits	**04**	Exam Hours	**03**

Course objectives:

- Figure out the context of neural networks and deep learning
- Know how to use a neural network
- Explore the data needs of deep learning
- Have a working knowledge of neural networks and deep learning
- Explore the parameters for neural networks

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, And 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.

Text Books:

1. Deep Learning , Ian Good fellow and YoshuaBengio MIT Press https://www.deeplearn ingbook.org/ 2016.

Reference Books:

2. Neural Networks: A systematic Introduction, Raúl Rojas 1996.
3. Pattern Recognition and machine Learning, Chirstopher Bishop 2007.

4. Syllabus Timeline

S/L	Syllabus Timeline	Description
1	Week 1-3: **Module 1**	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.

2	Week 3-7: **Module 2**	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.
3	Week 7-11: **Module 3**	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.
4	Week 10-12: **Module 4**	Unfolding Computational Graphs, Recurrent Neural Networks, Bidirectional RNNs, Encoder-Decoder Sequence-to-Sequence Architectures, Deep Recurrent Networks, Recursive Neural Networks. Long short-term memory
5	Week 12-15: **Module 5**	Performance Metrics, Default Baseline Models, Determining Whether to Gather More Data, Selecting Hyperparameters, Debugging Strategies, Example: Multi-Digit Number Recognition. Applications: Vision, NLP, Speech.

5. Teaching-Learning Process Strategies

S/L	TLP Strategies:	Description
1	Project-Based Learning	Design courses around real-world projects that students can work on individually or in teams.
2	Design Sprints	Incorporate design sprints to teach students the iterative process of prototyping, testing, and refining designs.
3	Empathy Exercises	Implement activities that help students develop empathy for users, such as user persona creation and journey mapping.
4	Higher Order Thinking (HOTS) Questions:	Pose HOTS questions to stimulate critical thinking related to each competency.
5	Team Projects	Promote collaboration through group projects that mimic real-world team dynamics.
6	Peer Reviews	Encourage peer reviews and critiques to develop critical thinking and feedback skills.
7	Guest Speakers	Invite industry professionals to share their experiences and insights.

6.Assessment Details (both CIE and SEE)

Continuous Internal Evaluation:

The minimum CIE marks requirement is 40% of maximum marks in each component.

CIE Split up

Components		Number	Weightage	Max. Marks	Min. Marks
(i)	Internal Assessment-Tests (A)	2	50%	25	10
(ii)	Assignments/Quiz/Activity (B)	2	50%	25	10
	Total Marks			**50**	**20**

Final CIE Marks = (A) + (B)

Average internal assessment shall be the average of the 2 test marks conducted

Semester End Examination:

1. Question paper pattern will be ten questions. Each question is set for 20marks. The medium of the question paper shall be English unless otherwise it is mentioned.
2. There shall be 2 question from each module, each of the two questions under a module (with a maximum of

3 sub questions), may have mix of topics under that module if necessary.

3. The students have to answer 5 full questions selecting one full question from each module. Marks scored will be proportionally scaled down to 50 mark

7.Learning Objectives

S/L	Learning Objectives	Description
1	**Fundamental Concepts**	**Understand Neural Network Basics** **Objective**: Explain the architecture of neural networks, including neurons, layers (input, hidden, output), activation functions, and how data flows through the network. **Outcome**: Students will be able to describe the basic components and structure of neural networks and their functions. **Grasp the Principles of Deep Learning** **Objective**: Define deep learning and differentiate it from traditional machine learning approaches, focusing on the use of deep neural networks with multiple layers. **Outcome**: Students will understand what constitutes deep learning and its advantages over shallow neural networks.
2	**Mathematical Foundations**	**Apply Linear Algebra in Neural Networks** **Objective**: Use linear algebra concepts such as matrices, vectors, and operations to explain neural network computations. **Outcome**: Students will be able to perform matrix operations required for neural network training and understand their implications. **Utilize Calculus for Optimization** **Objective**: Apply calculus concepts, including differentiation and gradients, to understand how neural networks are optimized during training. **Outcome**: Students will be proficient in computing gradients and using them to optimize neural network parameters. **Implement Probability and Statistics** **Objective**: Use probability and statistical concepts to understand loss functions, regularization techniques, and model evaluation metrics. **Outcome**: Students will be able to apply statistical methods to evaluate and improve neural network performance.
3	**Neural Network Design and Training**	**Build and Train Neural Networks** **Objective**: Develop and train basic neural network models using popular frameworks such as TensorFlow, Keras, or PyTorch. **Outcome**: Students will be able to implement and train neural network models for various tasks, including classification and regression. **Apply Regularization Techniques** **Objective**: Implement regularization methods like dropout, L1/L2 regularization, and batch normalization to improve model generalization. **Outcome**: Students will be able to apply these techniques to prevent overfitting and enhance model performance.
4	**Practical Applications and Deployment**	**Implement Neural Networks for Real-World Problems** **Objective**: Apply neural network models to solve real-world problems in domains such as image recognition, speech processing, and recommendation systems. **Outcome**: Students will be able to design and deploy neural network solutions for practical applications. **Deploy and Maintain Models** **Objective**: Understand the process of deploying neural networks into production environments and maintaining their performance over time. **Outcome**: Students will be able to deploy models and address challenges related to scalability, integration, and real-time processing.
5	**Advanced Architectures and Techniques**	**Understand and Implement Convolutional Neural Networks (CNNs)** **Objective**: Explain the architecture and application of CNNs for image and video processing tasks. **Outcome**: Students will be able to build and deploy CNNs for tasks like image classification and object detection. **Explore Recurrent Neural Networks (RNNs) and LSTMs**

		Objective: Describe the structure and use cases of RNNs and Long Short-Term Memory (LSTM) networks for sequence modeling. **Outcome**: Students will be able to apply RNNs and LSTMs to problems involving sequential data, such as time series forecasting and natural language processing. **Utilize Transformer Models** **Objective**: Understand the architecture and applications of transformer models and attention mechanisms in tasks such as language translation and text generation. **Outcome**: Students will be able to work with transformer models and apply them to advanced natural language processing tasks.

8. Course Outcomes (COs) and Mapping with POs/ PSOs

Course Outcomes (COs)

COs	Description
M23BIS703.1	Understand & Apply basic concepts of digital image processing & its applications
M23BIS703.2	Illustrate the use of image enhancement technique using Spatial and frequency domain for various image transformations.
M23BIS703.3	Infer image compression standards, segmentation and representation techniques.
M23BIS703.4	Analyze basic image processing algorithms for specific applications.

CO-PO-PSO Mapping

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
M23BIS703.1	3	3	-	-	3	-	-	-	-	-	-	-	3	-
M23BIS703.2	3	-	3	-	3	-	-	-	-	-	-	-	3	-
M23BIS703.3	-	-	-	3	-	-	-	-	-	-	-	-	-	3
M23BIS703.4	-	-	-	3	-	3	-	-	-	-	-	-	-	3
M23BIS703	**3**	**3**	**3**	**3**	**3**	**3**							**3**	**3**

Continuous Internal Evaluation (CIE)

	CO1	CO2	CO3	CO4	**Total**
All modules	**10**	**10**	**10**	**20**	**50**
Total	**10**	**10**	**10**	**20**	**50**

Semester End Examination (SEE)

	CO1	CO2	CO3	CO4	**Total**
All modules	**20**	**20**	**20**	**40**	**100**
Total	**20**	**20**	**25**	**40**	**100**

9. Assessment Plan

Continuous Internal Evaluation:

The minimum CIE marks requirement is 40% of maximum marks in each component.

CIE Split up

Components		Number	Weightage	Max. Marks	Min. Marks
(i)	Internal Assessment-Tests (A)	2	50%	25	10
(ii)	Assignments/Quiz/Activity (B)	2	50%	25	10
	Total Marks			**50**	**20**

Final CIE Marks = (A) + (B)

Average internal assessment shall be the average of the 2 test marks conducted

Semester End Examination:

1. Question paper pattern will be ten questions. Each question is set for 20marks. The medium of the question paper shall be English unless otherwise it is mentioned.
2. There shall be 2 question from each module, each of the two questions under a module (with a maximum

of 3 sub questions), may have mix of topics under that module if necessary.

3. The students have to answer 5 full questions selecting one full question from each module. Marks scored will be proportionally scaled down to 50 mark

10. Future with this Subject

The future of neural networks and deep learning is poised to be dynamic and impactful, driven by ongoing research, technological advancements, and expanding applications across various fields. Here are some key areas where neural networks and deep learning are expected to shape the future:

1. Advancements in Model Architectures

More Sophisticated Architectures: Future developments will likely introduce even more advanced neural network architectures beyond current models like CNNs, RNNs, and transformers. Innovations may include new types of neural networks designed to handle complex tasks more efficiently.

Efficient Models: There will be a focus on creating more efficient models that require less computational power and memory, making deep learning more accessible and sustainable.

2. Increased Integration with AI and Robotics

Autonomous Systems: Deep learning will play a crucial role in the development of autonomous systems, including self-driving cars, drones, and robots. These systems will become increasingly capable of performing complex tasks in real-world environments.

Human-Robot Interaction: Enhanced deep learning models will improve how robots understand and interact with humans, leading to more natural and intuitive human-robot collaboration.

3. Expansion into New Domains

Healthcare: Deep learning will advance personalized medicine, diagnostic tools, and drug discovery. Models will become more adept at analyzing medical images, genetic data, and patient records to provide tailored healthcare solutions.

Finance: In finance, deep learning will be used for fraud detection, algorithmic trading, and risk management. Improved models will enhance predictive accuracy and decision-making processes.

4. Ethical and Responsible AI

Fairness and Bias Mitigation: Future research will focus on developing techniques to reduce bias in deep learning models and ensure fairness in AI systems. This will involve creating transparent and accountable AI solutions.

Privacy Preservation: Methods like federated learning and differential privacy will become more prevalent, allowing models to be trained on decentralized data while preserving user privacy.

5. Improved Natural Language Processing (NLP)

Contextual Understanding: Advances in NLP will lead to models with better contextual understanding and generation capabilities, improving applications such as conversational agents, translation services, and content

7th Semester	Professional Elective (PE) III INTERNET OF THINGS	M23BIS704A

1. Prerequisites

S/L	Proficiency	Prerequisites
1	Basic Science	Basic understanding of electronic components (e.g., resistors, capacitors, transistors). Knowledge of fundamental physics concepts like electricity, magnetism, and electromagnetic waves. Familiarity with basic principles of energy conversion and signal processing.
2	Mathematics	Proficiency in algebra, including solving linear and quadratic equations. Understanding of differential and integral calculus, including applications. Familiarity with probability, statistics, and matrix operations.
3	Computer Science	Experience with programming languages such as Python or C/C++. Basic understanding of data structures and algorithms. Knowledge of networking fundamentals, including TCP/IP, HTTP, and other relevant protocols.
4	Embedded Systems	Familiarity with microcontroller platforms like Arduino or Raspberry Pi. Experience with interfacing sensors and actuators to hardware platforms. Basic knowledge of embedded software development and debugging tools.
5	Communication Systems	Understanding of wireless communication technologies (e.g., Wi-Fi, Bluetooth, Zigbee). Familiarity with IoT communication protocols like MQTT, CoAP. Knowledge of basic networking and communication theory.

2. Competencies

S/L	Competency	KSA Description
1	Introduction to IoT	**Knowledge:** Understanding the evolution of IoT, enabling technologies, and key networking components. **Skills:** Ability to identify and describe IoT components and addressing strategies. **Attitudes**: Curiosity about the interdependence of technologies and a willingness to explore new concepts in IoT.
2	IoT Sensing and Actuation	**Knowledge:** In-depth knowledge of various sensors and actuators, including their characteristics and types. **Skills:** Proficiency in selecting and interfacing sensors and actuators with IoT hardware platforms. **Attitudes:** Precision in sensor calibration and a problem-solving approach to handling sensorial deviations**.**
3	IoT Processing Topologies	**Knowledge:** Understanding of IoT processing topologies, data formats, and processing requirements. **Skills:** Ability to design and optimize IoT device processing strategies and make decisions on processing offloading**.** **Attitudes:** Attention to efficiency and optimization in processing design.
4	IoT Connectivity Technologies	**Knowledge:** Comprehensive knowledge of various IoT connectivity technologies (e.g., Zigbee, LoRa, NB-IoT, Wi-Fi, Bluetooth). **Skills:** Proficiency in selecting and configuring appropriate communication technologies for IoT applications**.** **Attitudes:** Proactiveness in learning and implementing emerging communication protocols and standards.
5	IoT Case Studies and Future Trends	**Knowledge:** Familiarity with the application of IoT in sectors like agriculture and transportation, and an understanding of future IoT trends**.** **Skills:** Ability to analyze case studies and draw insights for practical IoT applications**.** **Attitudes:** Open-mindedness toward new IoT trends and a desire to innovate.

3. Syllabus

INTERNET OF THINGS SEMESTER – VII			
Course Code	**M23BIS704A**	CIE Marks	**50**
Number of Lecture Hours/Week(L: T: P: S)	**(3:0:0)**	SEE Marks	**50**
Total Number of Lecture Hours	**40 hours Theory**	Total Marks	**100**
Credits	**03**	Exam Hours	**03**

Course Objectives:

- Understand about the fundamentals of Internet of Things and its building blocks along with their characteristics.
- Understand the recent application domains of IoT in everyday life.
- Understand the protocols and standards designed for IoT and the current research on it.
- Understand the other associated technologies like cloud and fog computing in the domain of IoT.
- Improve their knowledge about the various cutting-edge technologies in the field IoT and machine learning applications.
- Gain insights about the current trends of machine learning and AI techniques used in IoT to orient towards the present industrial scenario.

Module-1

Introduction to IoT: Introduction, Evolution of IoT, Enabling IoT and the Complex Interdependence of Technologies, IoT Networking Components, Addressing Strategies in IoT.
Textbook 1: Chapter 4 – 4.1 to 4.5

Module-2

IoT Sensing and Actuation: Introduction, Sensors, Sensor Characteristics, Sensorial Deviations, Sensing Types, Sensing Considerations, Actuators, Actuator Types, Actuator Characteristics.
Textbook 1: Chapter 5 – 5.1 to 5.9

Module-3

IoT Processing Topologies and Types: Data Format, Importance of Processing in IoT, Processing Topologies, IoT Device Design and Selection Considerations, Processing Offloading.
Textbook 1: Chapter 6 – 6.1 to 6.5

Module-4

IoT Connectivity Technologies: Introduction, IEEE 802.15.4, Zigbee, Thread, ISA100.11A, Wireless HART, RFID, NFC, DASH7, Z-Wave, Weightless, Sigfox, LoRa, NB-IoT, Wi-Fi, Bluetooth.
Textbook 1: Chapter 7 – 7.1 to 7.16

Module-5

IOT Case Studies And Future Trends: Introduction, Components of an agricultural IoT, Advantages of IoT in agriculture, Smart irrigation management system, Introduction to Vehicular IoT Components of vehicular IoT, Advantages of vehicular IoT.
Textbook 1: Chapter 12-12.1.1, 12.1.2, 12.2.2, Chapter 13- 13.1.1, 13.1.2
IoT Hardware Projects: Introduction to Arduino Boards, LED interface with Arduino, LED interface with Arduino, MQ-2 Gas sensor interface with NodeMCU
Textbook 1: Chapter 16 – 16.1 to 16.3

TEXTBOOKS:

1. Sudip Misra, Anandarup Mukherjee, Arijit Roy, "Introduction to IoT", Cambridge University Press 2021.
2. S. Misra, C. Roy, and A. Mukherjee, 2020. Introduction to Industrial Internet of Things and Industry 4.0. CRC Press.

REFERENCE BOOKS:

1. Vijay Madisetti and Arshdeep Bahga, "Internet of Things (A Hands-on-Approach)",1st Edition, VPT, 2014.
2. Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1st Edition, Apress Publications, 2013.

Weblinks and Video Lectures (e-Resources):
1. https://nptel.ac.in/noc/courses/noc19/SEM1/noc19-cs31/

4.Syllabus Timeline

S/L	Syllabus Timeline	Description
1	Week 1-3: Introduction to IoT	Introduction, Evolution of IoT, Enabling IoT and the Complex Interdependence of Technologies, IoT Networking Components, Addressing Strategies in IoT.
2	Week 4-6: IoT Sensing and Actuation	Introduction, Sensors, Sensor Characteristics, Sensorial Deviations, Sensing Types, Sensing Considerations, Actuators, Actuator Types, Actuator Characteristics.
3	Week 7-9: IoT Processing Topologies and Types	Data Format, Importance of Processing in IoT, Processing Topologies, IoT Device Design and Selection Considerations, Processing Offloading.
4	Week 10-11: IoT Connectivity Technologies	Introduction, IEEE 802.15.4, Zigbee, Thread, ISA100.11A, Wireless HART, RFID, NFC, DASH7, Z-Wave, Weightless, Sigfox, LoRa, NB-IoT, Wi-Fi, Bluetooth.
5	Week 12-14: IOT Future Trends and Hardware Projects	Introduction, Components of an agricultural IoT, Advantages of IoT in agriculture, Smart irrigation management system, Introduction to Vehicular IoT Components of vehicular IoT, Advantages of vehicular IoT. Introduction to Arduino Boards, LED interface with Arduino, LED interface with Arduino, MQ-2 Gas sensor interface with NodeMCU

5.Teaching-Learning Process Strategies

S/L	TLP Strategies:	Description
1	Lecture Method	Deliver structured lectures to introduce IoT concepts, architecture, protocols, and applications. Use clear explanations and real-life examples to reinforce learning.
2	Video/Animation	Incorporate visual aids like videos and animations to illustrate complex IoT systems, sensor interactions, and communication protocols, enhancing student understanding.
3	Collaborative Learning	Encourage collaborative learning for improved competency application.
4	Real-World Application	Incorporate case studies and practical examples of IoT applications, such as smart homes and industrial IoT, to connect theoretical concepts with real-world scenarios.
5	Flipped Class Technique	Implement a flipped classroom approach by providing pre-class resources (e.g., articles, videos) on IoT topics. Use class time for hands-on activities and deeper discussions.
6	Laboratory Learning	Conduct laboratory sessions where students work with IoT hardware platforms (e.g., Arduino, Raspberry Pi) to build and test IoT projects. Provide hands-on experience with sensor and actuator integration.
7	Guest Lectures/Workshops	Invite industry experts to deliver guest lectures or conduct workshops on emerging IoT technologies and trends. This provides students with insights into current industry practices and innovations.

6.Assessment Details (both CIE and SEE)

Continuous Internal Evaluation:

The minimum CIE marks requirement is 40% of maximum marks in each component.

CIE Split up

Components		Number	Weightage	Max. Marks	Min. Marks
(i)	Internal Assessment-Tests (A)	2	50%	25	10
(ii)	Assignments/Quiz/Activity (B)	2	50%	25	10
	Total Marks			**50**	**20**

Final CIE Marks = (A) + (B)

Average internal assessment shall be the average of the 2 test marks conducted.

Semester End Examination:

- Question paper pattern will be ten questions. Each question is set for 20marks. The medium of the question paper shall be English unless otherwise it is mentioned.
- There shall be 2 question from each module, each of the two questions under a module (with a maximum of 3 sub questions), may have mix of topics under that module if necessary.
- The students have to answer 5 full questions selecting one full question from each module.
- Marks scored will be proportionally scaled down to 50 marks

7.Learning Objectives

S/L	Learning Objectives	Description
1	Understand IoT Fundamentals	Understand the fundamentals of IoT, including its evolution, enabling technologies, key components, and addressing strategies..
2	Integration of Sensors and Actuators	Develop practical skills in interfacing various sensors and actuators with IoT hardware platforms like Arduino and Raspberry Pi, laying the foundation for building functional IoT projects.
3	Analyze IoT Processing Techniques	Analyze different IoT processing topologies, data formats, and processing strategies, including processing offloading.
4	Explore IoT Connectivity Technologies	Explore various IoT connectivity technologies and communication protocols, and understand their application in IoT systems.
5	Study IoT Applications and Trends	Study case studies and future trends in IoT, focusing on agricultural and vehicular applications to understand practical uses and emerging developments
6	Build and Implement IoT Projects	Build and implement practical IoT projects using hardware components, such as Arduino boards and sensors, to apply theoretical knowledge in real-world scenarios.

8.Course Outcomes (COs) and Mapping with POs/ PSOs

Course Outcomes (COs)

COs	Description
M23BIS704A.1	Identify the evolution, networking components, addressing strategies and processing in IoT.
M23BIS704A.2	Apply different connectivity technologies.
M23BIS704A.3	Analyze various sensing devices and actuator types.
M23BIS704A.4	Examine the IOT Case Studies and Future Trends

CO-PO Mapping

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
M23BIS704A.1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
M23BIS704A.2	-	3	-	-	-	-	-	-	-	-	-	-	-	-
M23BIS704A.3	-	3	-	-	-	-	-	-	-	-	-	-	-	-
M23BIS704A.4	-	-	-	-	3	-	-	-	-	-	-	-	-	-
M23BIS704A	**3**	**3**	-	-	**3**	-	-	-	-	-	-	-	-	-

9.Assessment Plan

Continuous Internal Evaluation (CIE)

	CO1	CO2	CO3	CO4	Total
Module 1	**10**				**10**
Module 2			**10**		**10**
Module 3	**10**				**10**
Module 4		**10**			**10**
Module 5				**10**	**10**
Total	**20**	**10**	**10**	**10**	**50**

Semester End Examination (SEE)

	CO1	CO2	CO3	CO4	Total
Module 1	**20**				**20**
Module 2			**20**		**20**
Module 3	**20**				**20**
Module 4		**20**			**20**
Module 5				**20**	**20**
Total	**40**	**20**	**20**	**20**	**100**

10.Future with this Subject:

Embracing Advanced Tools: Expect to see IoT courses incorporating cutting-edge computational tools and software. These will help you simulate and design IoT systems more effectively, letting you experiment and refine your ideas before you bring them to life.

Incorporating Edge Computing and AI: The future of IoT will likely include a focus on edge computing and artificial intelligence. This means learning how to build smarter systems that process data instantly and make intelligent decisions right at the edge, where the action happens.

Exploring Interdisciplinary Applications: IoT isn't just about connecting devices—it's about solving real-world problems. You might find yourself integrating IoT with fields like smart cities, healthcare, or industrial automation, where you can see how your work impacts everyday life.

Focusing on Security and Privacy: As IoT devices become more common, keeping them secure and protecting user privacy will be crucial. Courses will likely dive deep into the latest practices for safeguarding data and ensuring your IoT systems are secure against potential threats.

Adapting to New Technologies: The IoT field is always evolving, with new technologies like 5G, blockchain, and advanced sensors emerging. Future learning will include these innovations, keeping you up-to-date and ready to tackle the newest challenges and opportunities in IoT.

7thSemester	Professional Course -III (PC) ETHICAL HACKING AND NETWORK DEFENSE	M23BCS704B

1. Prerequisites

S/L	Proficiency	Prerequisites
1.	Operating Systems	Familiarity with Windows, Linux, and macOS.
2.	Networking	Understanding of TCP/IP, subnetting, network masks, and common networking protocols.
3.	Cyber security Fundamentals	Basic understanding of information security principles and practices. Knowledge of common threats, vulnerabilities, and attack vectors.
4.	Programming Skills	Ability to write scripts to automate tasks and exploit vulnerabilities.

2. Competencies

S/L	Competency	KSA Description
1.	**Basics of Ethical Hacking Techniques**	**Knowledge:** ● Familiarity with reconnaissance, exploitation, and post-exploitation techniques. ● Awareness of cybersecurity laws, regulations, and ethical hacking guidelines. **Skills:** ● Proficiency in using tools like Nmap, Wireshark, Metasploit, and Burp Suite for ethical hacking. ● Ability to ensure compliance with legal standards and ethical practices. **Attitudes:** Integrity and a strong sense of ethical responsibility and adherence to legal guidelines.
2.	**Embedded Systems, Networking Fundamentals & Cryptography**	**Knowledge:** ● Familiarity with Windows, Linux, and macOS operating systems. ● Understanding of TCP/IP, DNS, DHCP, subnetting, and common networking protocols. ● Understanding of cryptographic principles such as public-key cryptography, cryptographic hashing, and digital signatures. **Skills:** ● Proficiency in using command-line interfaces, managing system processes, and configuring system settings. ● Ability to configure and troubleshoot network devices, analyze network traffic, and understand network topologies. ● Implement cryptographic algorithms like Secret Key Cryptography (SKC), Public Key Cryptography (PKC) & Hash Functions. **Attitudes:** ● Willingness to explore and experiment with different operating systems. ● Curiosity and a proactive approach to learning about network infrastructures.
3.	**Defensive Strategies**	**Knowledge:** Understanding of firewalls, intrusion detection/prevention systems (IDS/IPS), and endpoint security solutions. **Skills:** Ability to configure and manage security devices, monitor network traffic, and respond to security incidents. **Attitudes:** Proactive and defensive mindset towards protecting systems and networks.

3. Syllabus

ETHICAL HACKING AND NETWORK DEFENSE VII SEMESTER			
Course Code	**M23BCS704B**	CIE Marks	**50**
Number of Lecture Hours/Week(L: T: P: S)	**(3:0:0)**	SEE Marks	**50**
Total Number of Lecture Hours	**40 Hours**	Total Marks	**100**
Credits	**03**	Exam Hours	**03**

Course objectives: This course will enable students to:
- To understand the core concepts of Ethical Hacking
- To understand how security vulnerabilities are exploited
- To analyze the impact of security vulnerabilities in systems
- To understand popular Network Defense solutions deployed at large organizations
- To configure basic firewall and IDS solution

Module – 1
Introduction: Ethical Hacking Overview - Role of Security and Penetration Testers, Penetration-Testing Methodologies, Laws of the Land, Overview of TCP/IP, The Application Layer, The Transport Layer, The Internet Layer, IP Addressing – Textbook 1: Chapter 1 & 2
Module - 2
Network and Computer Attacks –Malware, Protecting Against Malware Attacks, Intruder Attacks , Addressing Physical Security - Textbook 1: Chapter 3 **Casing the Establishment:** What is foot printing, Internet Foot printing, Scanning, Enumeration, basic banner grabbing, Enumerating Common Network services. Textbook 2: Chapter
Module - 3
Desktop and Server OS Vulnerabilities: Windows OS Vulnerabilities, Tools for Identifying Vulnerabilities in Windows, Best Practices for Hardening Windows Systems, Linux OS Vulnerabilities Textbook 1: Chapter 8
Module-4
Embedded Operating Systems: Introduction to Embedded Operating Systems, Windows and Other Embedded Operating Systems, Vulnerabilities of Embedded OS. Textbook 1: Chapter 9
Module - 5
Network Protection Systems: Understanding Network Protection Systems, Understanding Firewalls, Understanding Intrusion Detection and Prevention Systems, Understanding Honeypots. Textbook 1: Chapter 13
Text Books: 1. Michael T. Simpson, Kent Backman, and James E. Corley, Hands-On Ethical Hacking and Network Defense, Course Technology, Delmar Cengage Learning, 2010. 2. Stuart McClure, Joel Scambray and Goerge Kurtz, Hacking Exposed 7: Network Security Secrets & Solutions, Tata Mc Graw Hill Publishers, 2010 **Reference Books:** 1. Stuart McClure, Joel Scambray and Goerge Kurtz, "Hacking Exposed Network Security Secrets & Solutions", 5th Edition, Tata Mc Graw Hill Publishers, 2010. 2. Black Hat Python: Python Programming for Hackers and Pentesters, Justin Seitz , 2014.

4. Syllabus Timeline

S/L	Syllabus Timeline	Description
1	Week 1-2: Fundamentals of Ethical hacking & Operating systems	Familiarity with reconnaissance, exploitation, and post-exploitation techniques. Awareness of cybersecurity laws, regulations, and ethical hacking guidelines. Familiarity with Windows, Linux, and macOS operating systems.
2	Week 3-4: Networking Primer	Understanding of TCP/IP, DNS, DHCP, subnetting, and common networking protocols. Understanding of cryptographic principles such as public-key cryptography, cryptographic hashing, and digital signatures.
3	Week 5-6: Techniques for Network Intrusion Detection System	Understanding of firewalls, intrusion detection/prevention systems (IDS/IPS), and endpoint security solutions.

5. Teaching-Learning Process Strategies

S/L	TLP Strategies:	Description
1	Lecture Method	Utilize various teaching methods within the lecture format to reinforce competencies.
2	Video/Animation	Incorporate visual aids like videos/animations to enhance understanding of concepts.
3	Collaborative Learning	Encourage collaborative learning for improved competency application.
4	Higher Order Thinking (HOTS) Questions:	Pose HOTS questions to stimulate critical thinking related to each competency.
5	Problem-Based Learning (PBL)	Implement PBL to enhance analytical skills and practical application of competencies

6	Multiple Representations	Introduce topics in various representations to reinforce competencies
7	Real-World Application	Discuss practical applications to connect theoretical concepts with real-world competencies.
8	Flipped Class Technique	Utilize a flipped class approach, providing materials before class to facilitate deeper understanding of competencies
9	Programming Assignments	Assign programming tasks to reinforce practical skills associated with competencies.

6. 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:

Components		Number	Weightage	Max. Marks	Min. Marks
(i)	Internal Assessment-Tests (A)	2	50%	25	10
(ii)	Assignments/Quiz/Activity (B)	2	50%	25	10
	Total Marks			**50**	**20**

Final CIE Marks = (A) + (B)

Average internal assessment shall be the average of the 2 test marks conducted.

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 as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. Question paper pattern will be ten questions. Each question is set for 20marks. The medium of the question paper shall be English unless otherwise it is mentioned.
2. There shall be 2 questions from each module, each of the two questions under a module (with a maximum of 3 sub questions), may have mix of topics under that module if necessary.
3. The students have to answer 5 full questions selecting one full question from each module.
4. Marks scored will be proportionally scaled down to 50 marks

7. Learning Objectives

S/L	Learning Objectives	Description
1	Understanding Ethical Hacking Fundamentals	Students will grasp the fundamental concepts of ethical hacking, including Life Cycle of Ethical Hacking, Types of Ethical Hacking, Fundamentals of Vulnerability Analysis and Penetration Testing.
2	Understanding Network Attack and Defense	Students will grasp the fundamental concepts of Network Attack and Defense techniques and can perform Vulnerability and Penetration testing on given Vulnerable system and generate report.
4	Collaboration and Communication Skills	Students will work collaboratively in teams on design projects, enhancing their ability to communicate effectively, share ideas, and solve problems collectively.
5	Ethical and Professional Responsibility	Students will understand the ethical and professional responsibilities associated with digital design, including respecting intellectual property rights, ensuring design reliability and security, and adhering to industry standards and best practices.

8. Course Outcomes (COs) and Mapping with POs/ PSOs

Course Outcomes (COs)

COs	Description
M23BCS704B.1	To understand how to find security vulnerabilities in given system.
M23BCS704B.2	To suggest the remediation steps for identified security bugs.
M23BCS704B.3	To perform VAPT task on given system and submit professional report.
M23BCS704B.4	To demonstrate knowledge of Embedded OS and vulnerabilities.
M23BCS704B.5	To demonstrate knowledge of IDS Systems and IDS signatures.

CO-PO-PSO Mapping

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
M23BCS704B.1	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**		
M23BCS704B.2	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**		
M23BCS704B.3	**-**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**		
M23BCS704B.4	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**		
M23BCS704B.5	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**		
M23BCS704B	**3**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**		

9. Assessment Plan

Continuous Internal Evaluation (CIE)

	CO1	CO2	CO3	CO4	CO5	**Total**
Module 1	**10**					**10**
Module 2		**10**				**10**
Module 3			**10**			**10**
Module 4				**10**		**10**
Module 5					**10**	**10**
Total	**10**	**10**	**10**	**10**	**10**	**50**

Semester End Examination (SEE)

	CO1	CO2	CO3	CO4	CO5	**Total**
Module 1	**20**					**20**
Module 2		**20**				**20**
Module 3			**20**			**20**
Module 4				**20**		**20**
Module 5					**20**	**20**
Total	**20**	**20**	**20**	**20**	**20**	**100**

Conditions for SEE Paper Setting:

Each module of SEE question paper should be allocated with questions for 20% of the total SEE marks

10. Future with this Subject

The **"Ethical Hacking and Network Defense"** course in the - semester of the B.E program lays a strong foundation for several future courses in the undergraduate program. The contributions of this subject extend across various areas, enhancing the students' understanding and skills in the field of cyber security. Here are some notable contributions:

- **Innovation and Research:** Working with the latest technologies and tools in cybersecurity. Engaging in research to develop new methods and tools for defending against cyber threats.
- **Continuous Learning:** Cybersecurity is a rapidly evolving field, requiring continuous learning and adaptation to new threats and technologies. Playing a crucial role in protecting sensitive data and maintaining the integrity of information systems.
- **Global Opportunities:** With the increasing number of cyber threats, there is a high demand for skilled cybersecurity professionals. Opportunities are available in various sectors including finance, healthcare, government, and technology.
- **Career Opportunities:**
  - Penetration Tester: Conducting authorized simulated attacks on computer systems to identify vulnerabilities.
  - Security Analyst: Monitoring and analyzing security systems to detect and respond to security incidents.
  - Security Consultant: Advising organizations on best practices for securing their networks and systems.
  - Incident Responder: Responding to and mitigating the impact of security breaches and incidents.

7th Semester	Professional Elective -II (PE) Data Engineering and MLOps	M23BCD704C

1. Prerequisites

S/L	Proficiency	Prerequisites
1	Mathematical Foundation	Basic understanding of statistics, probability, and linear algebra.
2	Programming Skills	Proficiency in Python and SQL; knowledge of Java or Scala is a plus.
3	Database Knowledge	Familiarity with relational databases (e.g., MySQL, PostgreSQL) and an introduction to NoSQL databases (e.g., MongoDB, Cassandra).
4	Basic Networking	Understanding of network protocols, APIs, and basic cloud computing concepts.
5	Machine Learning Knowledge	Understanding of machine learning algorithms, model evaluation, and basic ML libraries (e.g., Scikit-learn, TensorFlow, PyTorch).
6	Software Development	Experience with software development practices, version control, and scripting in Python.
7	DevOps Basics	Basic understanding of CI/CD pipelines, containerization (e.g., Docker), and familiarity with cloud platforms (AWS, Azure, GCP).
8	Data Engineering Skills	Basic knowledge of data pipelines, ETL processes, and data storage solutions.

2. Competencies

S/L	Competency	KSA Description
1	**Data Engineering**	**Knowledge:** **Data Modeling and Design:** Understanding of data modeling techniques, including relational and dimensional modeling, schema design, and normalization. **Database Systems:** In-depth knowledge of relational (SQL) and non-relational (NoSQL) databases, including their architecture, indexing, and query optimization. **ETL Processes:** Familiarity with ETL (Extract, Transform, Load) processes, data integration techniques, and tools like Apache NiFi, Talend, or Informatica. **Big Data Technologies:** Knowledge of big data frameworks such as Hadoop, Spark, and their ecosystems. **Data Warehousing:** Understanding of data warehousing concepts, including OLAP, data lakes, and cloud-based warehousing solutions like Amazon Redshift or Google BigQuery. **Skills:** **Programming:** Proficiency in programming languages such as Python, SQL, and familiarity with Java or Scala. **Data Pipeline Development:** Ability to design, build, and manage data pipelines using tools like Apache Kafka, Apache Airflow, or AWS Glue. **Database Management:** Skills in managing, tuning, and securing databases, including backup, recovery, and replication strategies. **Data Quality Management:** Ability to implement data quality checks, validation, and data cleansing processes. **Cloud Computing:** Skills in deploying and managing data infrastructure on cloud platforms (AWS, Azure, GCP). **Abilities:** **Problem-Solving:** Ability to troubleshoot complex data-related issues and optimize data processes for efficiency and scalability. **Project Management:** Ability to manage data engineering projects, including planning, execution, and collaboration with cross-functional teams. **Adaptability:** Ability to learn and adapt to new tools, technologies, and methodologies in the rapidly evolving field of data engineering. **Communication:** Strong ability to communicate technical concepts to non-technical stakeholders, and document processes clearly.
2	**MLOps**	**Knowledge:**

		Machine Learning Fundamentals: Understanding of ML algorithms, model training, evaluation, and tuning. **DevOps Principles:** Knowledge of DevOps methodologies, including continuous integration, continuous deployment (CI/CD), and infrastructure as code (IaC). **Containerization and Orchestration:** Understanding of containerization (e.g., Docker) and orchestration tools (e.g., Kubernetes) for deploying scalable ML models. **ML Lifecycle Management:** Knowledge of tools and frameworks for managing the ML lifecycle, such as MLflow, TFX, or Kubeflow. **Monitoring and Logging:** Understanding of monitoring and logging techniques to track model performance and detect drift in production. **Skills:** **Automation:** Skills in automating ML workflows, including data preprocessing, model training, and deployment pipelines. **Version Control:** Proficiency in using version control systems (e.g., Git) for managing code and model versions. **Cloud Services:** Skills in deploying and managing ML models on cloud platforms, utilizing services like AWS SageMaker, Google AI Platform, or Azure ML. **Collaboration:** Ability to work closely with data scientists, data engineers, and IT teams to integrate ML models into production environments. **Security:** Skills in securing ML models and data, including encryption, access control, and compliance with regulations. **Abilities:** **Critical Thinking:** Ability to evaluate the feasibility of ML models in production environments and assess their impact on business processes. **Efficiency:** Ability to optimize ML pipelines for speed, cost, and resource utilization. **Leadership:** Ability to lead MLOps initiatives, mentor team members, and drive best practices in ML model management. **Innovation:** Ability to explore and implement new technologies and methodologies to enhance the MLOps process.

3. Syllabus

Data Engineering and MLOps **SEMESTER – VI**			
Course Code	**M23BCD704C**	CIE Marks	**50**
Number of Lecture Hours/Week(L: T: P: S)	**(3:1:0)**	SEE Marks	**50**
Total Number of Lecture Hours	**42 hours Theory**	Total Marks	**100**
Credits	**03**	Exam Hours	**03**

Course Objectives:

- Understand foundational concepts of data engineering and MLOps, including data modeling and machine learning lifecycle.
- To study robust data pipelines and ML workflows using ETL processes and CI/CD practices with tools like Apache Airflow and Kubeflow.
- To be able to understand data quality management and security practices to ensure the integrity and compliance of data and ML models.
- Demonstrate proficiency in containerizing and orchestrating applications using Docker and Kubernetes.
- Apply data engineering and MLOps principles in real-world projects, collaborating with cross-functional teams.

Module -1

Data Engineering Described: What Is Data Engineering? , Data Engineering Defined , The Data Engineering Lifecycle , Evolution of the Data Engineer , Data Engineering and Data Science , Data Engineering Skills and Activities , Data Maturity and the Data Engineer , The Background and Skills of a Data Engineer , Business Responsibilities , Technical Responsibilities , The Continuum of Data Engineering Roles, from A to B , Data Engineers Inside an Organization , Internal-Facing Versus External-Facing Data Engineers , Data Engineers and Other Technical Roles , Data Engineers and Business Leadership . The Data Engineering Lifecycle, What Is the Data Engineering Lifecycle? , The Data Lifecycle Versus the Data Engineering Lifecycle , Generation:

Source Systems , iii Storage , Ingestion , Transformation , Serving Data , Major Undercurrents Across the Data Engineering Lifecycle , Security , Data Management ,DataOps , Data Architecture .
TEXT BOOK 1 :Chapter 1,2

Module -2

Designing Good Data Architecture, What Is Data Architecture? ,Enterprise Architecture Defined ,Data Architecture Defined , "Good" Data Architecture ,Principles of Good Data Architecture ,Major Architecture Concepts ,Domains and Services ,Distributed Systems, Scalability, and Designing for Failure ,Tight Versus Loose Coupling: Tiers, Monoliths, and Microservices ,User Access: Single Versus Multitenant 96
Event-Driven Architecture ,Brownfield Versus Greenfield Projects ,Examples and Types of Data Architecture ,Data Warehouse ,Data Lake ,Convergence, Next-Generation Data Lakes, and the Data Platform ,Modern Data Stack ,Lambda Architecture, Kappa Architecture ,The Dataflow Model and Unified Batch and Streaming ,Architecture for IoT ,Data Mesh ,Other Data Architecture Examples ,Who's Involved with Designing a Data Architecture?
TEXT BOOK 1 :Chapter 3

Module -3

Choosing Technologies Across the Data Engineering Lifecycle:Speed to Market ,Interoperability ,Cost Optimization and Business Value ,Total Cost of Ownership ,Total Opportunity Cost of Ownership ,FinOps
Today Versus the Future: Immutable Versus Transitory Technologies ,Our Advice ,Location ,On Premises , Cloud ,Hybrid Cloud ,Multicloud ,Decentralized: Blockchain and the Edge ,Our Advice ,Cloud Repatriation Arguments ,Build Versus Buy ,Open Source Software ,Proprietary Walled Gardens ,Our Advice ,Monolith Versus Modular ,Monolith ,Modularity ,The Distributed Monolith Pattern ,Our Advice ,Serverless Versus Servers ,Serverless ,Containers ,How to Evaluate Server Versus Serverless ,Our Advice ,Optimization, Performance, and the Benchmark Wars Big Data...for the 1990s ,Nonsensical Cost Comparisons ,Asymmetric Optimization ,Caveat Emptor ,Undercurrents and Their Impacts on Choosing Technologies ,Data Management ,DataOps ,Data Architecture ,Orchestration Example: Airflow ,Software Engineering .
TEXT BOOK 1 :Chapter 4

Module -4

MLOps Essentials: Introduction to MLOps, MLOps vs. DevOps, SDLC Basics, Waterfall vs AGILE vs DevOps vs MLOps, MLOps Phases, Versioning, Testing, Automation, Reproducibility, Deployment, Monitoring
TEXTBOOK 2(selected Topics)

Module -5

MLOPs Architecture, ML Pipeline MLOps Tools **Version Control System**: Git Essentials, Configuring Git Branching, Git Workflow, Repo, Git Commands, GitHub Action
TEXTBOOK 2(selected Topics)

TEXTBOOKS:

1. Joe Reis and Matt Housley—Fundamentals of Data Engineering, First Edition, O'Reilly 2022.
2. Mark Treveil and the Dataiku Team – Introducing MLOps, O'Reilly, 2020

REFERENCE BOOKS:

1. Paul Crickard, Data Engineering with Python, Packt Publishing, 2020
2. Emmanuel Raj, Engineering MLOps, Packt Publishing, 2021

VIDEO LINKS:

https://www.youtube.com/watch?v=PHsC_t0j1dU
https://www.youtube.com/watch?v=-dJPoLm_gtE

4.Syllabus Timeline

S/L	Syllabus Timeline	Description
1	Week 1-3: Data Engineering Described	Data Engineering Defined , The Data Engineering Lifecycle , Evolution of the Data Engineer , Data Engineering and Data Science , Data Engineering Skills and Activities Data Maturity and the Data Engineer , The Background and Skills of a Data Engineer , Business Responsibilities , Technical Responsibilities , The Continuum of Data Engineering Roles, from A to B , Data Engineers Inside an Organization , Internal-Facing Versus External-Facing Data Engineers , Data Engineers and Other Technical Roles , Data Engineers and Business Leadership .
2	Week 4-6: Designing Good Data Architecture	What Is Data Architecture? ,Enterprise Architecture ,Data Architecture Defined Good" Event-Driven Architecture ,Brownfield Versus Greenfield Projects ,Examples and Types of Data Architecture ,Data Warehouse ,Data Lake ,Convergence, Next-Generation Data Lakes, and the Data Platform ,Modern Data Stack ,Lambda Architecture, Kappa Architecture ,The Dataflow Model and Unified Batch and Streaming ,Architecture for IoT ,Data Mesh ,Other Data Architecture Examples
3	Week 8-11: Choosing Technologies Across the Data Engineering Lifecycle	Optimization and Business Value ,Total Cost of Ownership ,Total Opportunity Cost of Ownership ,FinOps Cloud ,Hybrid Cloud ,Multicloud ,Decentralized: Blockchain and the Edge ,Our Advice ,Cloud Repatriation Arguments ,Build Versus Buy ,Open Source Software ,Proprietary Walled Gardens ,Our Advice ,Monolith Versus Modular ,Monolith ,Modularity ,The Distributed Monolith Pattern ,Our Advice ,Serverless Versus Servers ,Serverless ,Containers ,How to Evaluate Server Versus Serverless ,Our Advice ,Optimization, Performance, and the Benchmark,Data Architecture ,Orchestration Example: Airflow ,Software Engineering
4	Week 7-8: MLOps Essentials	Introduction to MLOps, MLOps vs. DevOps, SDLC Basics, Waterfall vs AGILE vs DevOps vs MLOps, MLOps Phases, Versioning, Testing, Automation, Reproducibility, Deployment, Monitoring
5	Week 9-12: Architecture and VCS	MLOPs Architecture, ML Pipeline MLOps Tools **Version Control System**: Git Essentials, Configuring Git Branching, Git Workflow, Repo, Git Commands, GitHub Action

5.Teaching-Learning Process Strategies

S/L	TLP Strategies:	Description
1	Lecture Method	Utilize various teaching methods within the lecture format to reinforce competencies.
2	Video/Animation	Incorporate visual aids like videos/animations to enhance understanding
3	Collaborative Learning	Encourage collaborative learning for improved competency application.
4	Real-World Application	Discuss practical applications to connect theoretical concepts with real-world competencies.
5	Flipped Class Technique	Utilize a flipped class approach, providing materials before class to facilitate deeper understanding of competencies

6.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:

Components		Number	Weightage	Max. Marks	Min. Marks
(i)	Internal Assessment-Tests (A)	2	50%	25	10
(ii)	Assignments/Quiz/Activity (B)	2	50%	25	10
	Total Marks			**50**	**20**

Final CIE Marks = (A) + (B)

Average internal assessment shall be the average of the 2 test marks conducted.

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 as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. Question paper pattern will be ten questions. Each question is set for 20marks. The medium of the question paper shall be English unless otherwise it is mentioned.
2. There shall be 2 question from each module, each of the two questions under a module (with a maximum of 3 sub questions), may have mix of topics under that module if necessary.
3. The students have to answer 5 full questions selecting one full question from each module.
4. Marks scored will be proportionally scaled down to 50 marks

7.Learning Objectives

S/L	Learning Objectives	Description
1	Understand Data Engineering and MLOps Concepts	Develop a comprehensive understanding of core concepts in data engineering and MLOps, including data modeling, database management, ML lifecycle, and deployment.
2	Build and Automate Data Pipelines	Learn to design, build, and automate data pipelines and workflows, integrating ETL processes and CI/CD pipelines for efficient data movement and transformation.
3	Master Big Data and Cloud Technologies	Gain expertise in big data tools (e.g., Hadoop, Spark) and cloud platforms (e.g., AWS, Azure, GCP) for scalable data processing and model deployment.
4	Ensure Data Quality, Governance, and Security	Understand and implement strategies for data quality management, governance, and security, ensuring compliance and integrity in data handling and model management.
5	Apply Containerization and Orchestration	Develop skills in containerizing applications using Docker and orchestrating deployments with Kubernetes for scalable and reliable production environments.
6	Monitor and Manage ML Models in Production	Learn techniques for monitoring ML models in production, detecting drift, managing versions, and ensuring continuous performance and accuracy.
7	Collaborate on Real-World Projects	Apply theoretical knowledge to practical projects, working in cross-functional teams to design, deploy, and maintain data-driven solutions and ML models.

8.Course Outcomes (COs) and Mapping with POs/ PSOs

Course Outcomes (COs)

Cos	Description
M23BCS603D.1	**Apply core data engineering principles** to design and implement efficient data pipelines across various stages of the data lifecycle.
M23BCS603D.2	**Design effective data architectures** by applying principles of good data architecture to meet organizational needs and scalability requirements.
M23BCS603D.3	**Analyze optimal data architectures and technologies** by assessing cost, performance, and scalability to design efficient and effective systems.
M23BCS603D.4	**Analyze MLOps practices and tools** to evaluate their effectiveness compared to DevOps and assess pipeline management, versioning, and deployment strategies.

CO-PO-PSO Mapping

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
M23BCS603D.1	3	-	-	-	-	-	-	-	-	-	-	-	3	-
M23BCS603D.2	3		-	-	2	-	-	-	-	-	-	-	3	-
M23BCS603D.3	-	3	-	-	-	-	-	-	-	-	-	-	-	2
M23BCS603D.4	-	3	-	-	2	-	-	-	-	-	-	-	-	2
M23BCS603D	**3**	**3**	-	-	2	-	-	-	-	-	-	-	3	2

9.Assessment Plan

Continuous Internal Evaluation (CIE)

	CO1	CO2	CO3	CO4	Total
Module 1	**10**				**10**
Module 2		**10**			**10**
Module 3			**10**		**10**
Module 4				**10**	**10**
Module 5				**10**	**10**
Total	**10**	**10**	**10**	**20**	**50**

Semester End Examination (SEE)

	CO1	CO2	CO3	CO4	Total
Module 1	**20**				**20**
Module 2		**20**			**20**
Module 3			**20**		**20**
Module 4				**20**	**20**
Module 5				**20**	**20**
Total	**20**	**20**	**20**	**40**	**100**

10 Future with this Subject

- **Unified Data and Model Pipelines:** Integration of data engineering and MLOps will streamline end-to-end workflows, from data ingestion to model deployment and monitoring.
- **Enhanced Scalability:** Advances in both fields will support the scaling of data and AI solutions, enabling real-time processing of vast datasets and seamless model deployment.
- **Improved Automation:** Increased automation in data processing and machine learning operations will accelerate development cycles and reduce manual intervention.
- **Better Data Management:** Enhanced data engineering practices will ensure high-quality, accessible, and well-governed data, crucial for effective machine learning models.
- **Advanced Analytics Integration:** MLOps and data engineering will enable more sophisticated analytics and insights by seamlessly integrating data pipelines with machine learning models.
- **Optimized Performance and Efficiency:** Combined advancements will lead to more efficient and optimized data workflows and model performance, driving innovation and operational excellence.
- **Cross-Disciplinary Collaboration:** Greater collaboration between data engineers and MLOps professionals will foster a more cohesive approach to managing and deploying data-driven AI solutions.

7th Semester	Professional Elective-III (PE) USER INTERFACE DESIGN	M23BCS704D

1. Prerequisites

S/L	Proficiency	Prerequisites
1	Basic Computer Skills	Basic computer skills, such as saving files in multiple versions and formats.
2	Programming basic tools	Familiar with Programming tools like assemblers, compilers, linkers translate, flowchart, algorithms which can be used to form a program from a human write-able and readable source language into the bits and bytes that can be executed by a computer.
3	Programming Fundamentals	Familiar with general coding concepts like variables, basic data types, Conditional Statements, Looping, Functions, creation of source file, compilation process, program execution techniques.
4	Basic Object Orientation Concepts	Basic of four basic principles: encapsulation, inheritance, polymorphism, and abstraction. Where these four OOP principles can be used enable to create objects and collaborate to create powerful applications too.

2. Competencies

S/L	Competency	KSA Description
1.	Understanding basic User Interface Design	**Knowledge:** Importance of User Interface Design for any application. Understanding of the basics of User Interface Design. **Skills:** Ability to know the basic principles of Interface Design for the Users. **Attitudes:** Appreciation to understand the importance of Interface Design and implement the same with respect to user's perspective.
2.	Design Process: Requirement Analysis	**Knowledge:** Understanding of the need of requirement analysis before any design is to be made. Principles of Requirement Analysis and techniques. **Skills:** Steps to understand with proper guidelines to collect the requirements for the design. **Attitudes:** Appreciation for the procedure to gather the appropriate requirements for the design.
3.	Design Process: Business Function & Screen Design	**Knowledge:** Understanding the basic business functions with respect to user interface design. Importance of Screen Design. **Skills:** Defining appropriate Business Protocols and strategies. Designing of Screen Elements to produce Good Screen Design. **Attitudes:** Valuing the importance of Business Strategies and Screen Design which is appropriate for different types of Users.
4.	Design Process: Menus	**Knowledge:** Understanding the importance of Menus and its items for user interaction. **Skills:** Applying Guidelines of Menu Design and its Items to create proper structure of menu usage. **Attitudes:** Creativeness to design the menu and its items for effective usage.
5.	Design Process: Window	**Knowledge:** Understanding of issues and structures of windows and its types **Skills:** Constructing window structure to suit the best design for the elements of the screen for user interaction.

		Attitudes: Appreciation for the way types of windows can be designed and used with good design.
6.	Design Process: Controls	**Knowledge:** Understanding the characteristics and importance of Screen Controls. **Skills:** Designing and analyzing the appropriate Screen Controls. **Attitudes:** Recognizing the significance of screen controls.
7.	Design Process: Tests	**Knowledge:** Understanding the importance of Testing. **Skills:** Designing and analyzingelements of the screen through testing. **Attitudes:** Valuing the importance of Testing and Re-Testing

3. Syllabus

USER INTERFACE DESIGN SEMESTER – VII			
Course Code	**M23BCS704D**	CIE Marks	**50**
Number of Lecture Hours/Week(L: T: P: S)	**(3:0:0:0)**	SEE Marks	**50**
Total Number of Lecture Hours	**40 Hours**	Total Marks	**100**
Credits	**03**	Exam Hours	**03**

Course Objectives:
1.To study the concept of menus, windows, interfaces
2. To study about business functions
3. To study the characteristics and components of windows andthe various controls for the windows.
4. To study about various problems in windows design with color, text, graphics andstudy the testing methods

Module -1

Overview Introduction to User Interface,Defining the User Interface, The Importance of Good Design, A Brief History of the Human-Computer Interface, The Concept of Direct Manipulation, Graphical Systems: Advantages and Disadvantages, Characteristics of the Graphical User Interface, Characteristics of a Web Interface, General Principles of User Interface Design.
Textbook 1: Selected Topics from Part-1

Module -2

Introduction to The User InterfaceDesign Process, Obstacles and Pitfalls in the Development Path, Designing for People: The Five Commandments, Usability, Important Human Characteristics in Design,Human Considerations in Design, Human Interaction speeds.
Textbook 1: Selected Topics from Part-2 Step-1

Module -3

Introduction to Understand theBusiness Function, Business Definition and Requirements Analysis,Determining Basic Business Functions, Basic business functions, Design standards.Understand the Principlesof Good Screen Design, Human Considerations in Screen Design.
Textbook 1: Selected Topics from Part-2 and Step-3

Module -4

Introduction to Develop System Menusand Navigation Schemes, Structures of Menus, Functions of Menus,Contentsof Menus, Formatting of Menus, Phrasing the Menu, Selecting Menu Choices, Navigating Menus, Kinds of Graphical Menus.
Textbook 1: Selected Topics from Part-2 Step-4

Module -5

Introduction to Select the Proper Kindsof Windows, Window Characteristics, Components of window, Window presentation styles, Types of Windows, Characteristics of Device Based Controls. Introduction to Choose the Proper ScreenBased Controls,Operable Controls, Windows Tests-prototypes, kinds of tests.
Textbook 1: Selected Topics from Part-2 Step-5, Step-6, Step-7 & Step-14

TEXTBOOKS:
1.Wilbert O. Galitz, "The Essential Guide to User Interface Design", John Wiley &Sons, Second Edition 2002
2. Ben Sheiderman, "Design the User Interface", Pearson Education, 1998.
REFERENCE BOOKS:
1.Alan Cooper, "The Essential of User Interface Design", Wiley- Dream TechLtd.,2002.

4. Syllabus Timeline

S/L	Syllabus Timeline	Description
1	Week 1-3: Introduction to User Interface	Understanding the importance of User Interface design and Defining the User Interface, get to know the history of the Human-Computer Interface with Direct Manipulation and indirect manipulation along with the Characteristics of a Web Interface.
2	Week 4-6: Requirement Analysis for Design Process	Understanding the initial step of User Interface Design Process by knowing the Obstacles and Pitfalls in the Development Path and how People should be involved in the Designing process.
3	Week 7-8: Business Functions in Design Process	Understand the Business Function and Business Definition with Design standards with the importance of Good Screen Design by considering Human interaction in the process.
4	Week 9-10: Menus in Design Process	To Understand about Menus with its Structures, Functions, Contents, Formatting, Phrasing, Selection of Menu Items and Navigationof Menus with its Kinds.
5	Week 11-12: Windows, Controls and Test in Design Process	Selection of Proper Kinds of Windows by knowing the Window Characteristics with its Components and the styles to present it, Device Controls which can be used with Proper Screen Based Controls and Finally how Windows Tests-prototypes can be conducted knowing the kinds of tests.

5.Teaching-Learning Process Strategies

S/L	TLP Strategies:	Description
1	Lecture Method	Utilize various teaching methods within the lecture format to reinforce competencies.
2	Image/Video/Animation	Incorporate visual aids like image/videos/animations to enhance understanding of programming constructs.
3	Collaborative Learning	Encourage collaborative learning for improved competency application.
4	Higher Order Thinking (HOTS) Questions:	Pose HOTS questions to stimulate critical thinking related to each competency.
5	Group-Based Learning (GBL)	Implement GBL to enhance analytical skills and Design Skills
6	Real-World Application	Discuss practical applications to connect theoretical concepts with real-world competencies.
8	Flipped Class Technique	Utilize a flipped class approach, providing materials before class to facilitate deeper understanding of competencies

6.Assessment Details (both CIE and SEE)

Continuous Internal Evaluation:

This section of regulations is applicable to all theory-based courses. The minimum CIE marks requirement is 40% of maximum marks in each component.

CIE Split up

Components		Number	Weightage	Max. Marks	Min. Marks
(i)	Internal Assessment-Tests (A)	2	50%	25	10
(ii)	Assignments/Quiz/Activity (B)	2	50%	25	10
	TotalMarks			**50**	**20**

FinalCIE Marks = (A) + (B)

Average internal assessment shall be the average of the 2 test marks conducted.

Semester End Examination:

1. Question paper pattern will be ten questions. Each question is set for 20marks. The medium of the question paper shall be English unless otherwise it is mentioned.
2. There shall be 2 questions from each module, each of the two questions under a module (with a maximum of 3 sub questions), may have mix of topics under that module if necessary.
3. The students have to answer 5 full questions selecting one full question from each module.

4. Marks scored will be proportionally scaled down to 50 marks.

7. Learning Objectives

S/L	Learning Objectives	Description
1	Understanding and applying the basic User Interface Design	Students will grasp the fundamental concepts of User Interface Design by applying the basic elements of the design.
2	Applying the System Requirements during Design Process	Students will apply strategies for requirement analysis as part of the design process.
3	Analyse the Business Function & Screen Layouts	Students will become analyse the Business functions with respect to User Interface Design and uses the appropriate Screen Design.
4	Implement the appropriate Menus	Students will implement various types of Menus and its usage while designing the screen elements.
5	Examine the Design Process with Window, Controls and Tests	Students will examineWindow and its element design with proper device controllables. Later the design test and retest process applications.

8. Course Outcomes (COs) and Mapping with POs/ PSOs

Course Outcomes (COs)

Cos	Description
M23BCS704D.1	Understand and apply the fundamental characteristics of computer interface, graphics interface and web interface
M23BCS704D.2	Apply the various components of user interface design during the design process
M23BCS704D.3	Analyse the various characteristics of user interface components during the design process.
M23BCS704D.4	Implement the appropriate design strategies for good interface design.
M23BCS704D.5	Design the prototypes of user interface and examine with testing process.

CO-PO-PSO Mapping

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
M23BCS704D.1	3	-	-	-	-	-	-	-	-	-	-	-	3	-
M23BCS704D.2	3	-	-	-	-	-	-	-	-	-	-	-	3	-
M23BCS704D.3	-	3	-	-	-	-	-	-	-	-	-	-	3	-
M23BCS704D.4	-	-	3	-	-	-	-	-	-	-	-	-	3	3
M23BCS704D.5	-	-	-	3	-	-	-	-	-	-	-	-	3	3
M23BCS704D	**3**	**3**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**3**

9. Assessment Plan

Continuous Internal Evaluation (CIE)

	CO1	CO2	CO3	CO4	CO5	Total
Module 1	**10**					**10**
Module 2		**10**				**10**
Module 3			**10**			**10**
Module 4				**10**		**10**
Module 5					**10**	**10**
Total	**10**	**10**	**10**	**10**	**10**	**50**

Semester End Examination (SEE)

	CO1	CO2	CO3	CO4	CO5	Total
Module 1	**20**					**20**
Module 2		**20**				**20**
Module 3			**20**			**20**
Module 4				**20**		**20**
Module 5					**20**	**20**
Total	**20**	**20**	**20**	**20**	**20**	**100**

10. Future with this Subject:

- Advanced UserInterface Design Courses: The knowledge gained in this course, covering principles of Design and Human Interaction Can is used to have more advanced complete design courses.
- User-Centric Design: Companies are prioritizing user-centric design to differentiate themselves in a competitive market, leading to increased demand for UI/UX professionals.
- Mobile and Web Applications: The proliferation of mobile devices and web applications has created a need for well-designed interfaces that provide seamless experiences across various platforms.
- Emerging Technologies: As emerging technologies like AI, AR/VR, and voice interfaces become more prevalent, UI/UX designers will be needed to create intuitive and engaging experiences.
- Accessibility and Inclusive Design: There is a growing focus on designing products that are accessible to all users, including those with disabilities, opening up opportunities for UI/UX professionals with expertise in inclusive design.
- Continuous Iteration and Improvement: The iterative nature of UI/UX design means that there will always be a need for designers to collect user feedback, analyze data, and make improvements to existing products.
- Project Work and Research: The hands-on experience gained through design process and its fundamentals can be utilized to design front-end of project work.
- Industry Applications: The course provides some fundamentals and guidelines which can be used in real-time project works.

7th semester	Professional Elective-IV (PE) Quantum Computing	M23BCS705A

1. Prerequisites

S/L	Proficiency	Prerequisites
1	Linear Algebra	Essential for understanding quantum states, gates, and transformations. Proficiency in vector spaces, matrices, eigenvalues, eigenvectors, and tensor products.
2	Probability Theory	Necessary for understanding quantum measurements and probability amplitudes. Proficiency in basic probability concepts is required.
3	Complex Numbers	Fundamental for quantum state representation. Proficiency in complex arithmetic and complex plane visualization.
4	Algorithms	Required for understanding classical algorithms before quantum ones. Proficiency in designing and analyzing classical algorithms.
5	Programming	Essential for implementing quantum algorithms. Proficiency in Python and familiarity with quantum programming frameworks like Qiskit.

2. Competencies

S/L	Competency	KSA Description
1	Quantum Computing Concepts	**Knowledge:** Understand and articulate the fundamental principles of quantum mechanics, such as superposition, entanglement, and quantum interference, and how they apply to quantum computing. **Skills:** Demonstrate proficiency in designing, simulating, and optimizing quantum algorithms using quantum programming languages. **Attitudes:** Adopt amindset for applying quantum computing techniques to real-world challenges in areas like cryptographyand artificial intelligence.
2	Problem-solving Skills	**Knowledge:** Understand the potential of quantum computing to solve complex problems faster than classical computers, including problems related to cryptography, optimization, and data analysis. **Skills:** Demonstrate the ability to design and implement quantum algorithms that address specific problems, utilizing quantum principles like superposition and entanglement to optimize solutions. **Attitudes:** Adopt a creative and critical approach to problem-solving, exploring innovative quantum computing solutions to real-world challenges in fields such as machine learning, logistic
3	Critical Thinking	**Knowledge:** Understand the theoretical foundations of quantum computing and its limitations, including the challenges of noise, decoherence, and error correction in quantum systems. **Skills:** Demonstrate the ability to critically analyze and evaluate quantum algorithms and quantum hardware, identifying potential issues and improvements for more efficient solutions. **Attitudes:** Cultivate a mindset of curiosity and skepticism, continuously questioning assumptions and exploring innovative approaches to overcome challenges in the development of quantum te
4	Mathematical Foundations	**Knowledge:** Understand the mathematical principles underlying quantum computing, including linear algebra, complex numbers, probability theory, and quantum state representation. **Skills:** Demonstrate the ability to apply mathematical tools to model quantum systems, analyze quantum algorithms, and solve problems related to qubits,

		quantum gates, and entanglement. **Attitudes:** Adopt a detail-oriented approach to problem-solving, valuing precision and accuracy in mathematical modeling to ensure the correct application of quantum computing concepts.
5	Classical Computing Fundamentals	**Knowledge:** Understand the core principles of classical computing, including algorithms, data structures, and computational complexity, and how they contrast with quantum computing concepts. **Skills:** Demonstrate the ability to apply classical computing knowledge to identify the limits of classical systems and determine when quantum computing provides a potential advantage. **Attitudes:** Adopt an interdisciplinary mindset, recognizing the complementary roles of classical and quantum computing in solving complex problems and driving technological advancements.

3. Syllabus

Quantum Computing **SEMESTER – VII**			
Course Code	**M23BCS705A**	CIE Marks	**50**
Number of Lecture Hours/Week(L: T: P: S)	**(3:0:0:0)**	SEE Marks	**50**
Total Number of Lecture Hours	**40 Hours**	Total Marks	**100**
Credits	**03**	Exam Hours	**03**

Course objectives: This course will enable students to:

1. Understanding of the basic principles of Quantum Computing and Information.
2. Understand the Quantum Operations and Quantum Gates.
3. Understand the basic features of Quantum Coding and Algorithms.
4. Understand the Quantum Computational Complexity and Error Correction.

Module -1

Foundation: Overview – Church-Turing Thesis – The circuit model of computation – reversible computation – quantum physics – quantum physics and computation – Dirac notation and Hilbert Spaces – dual vectors – operators – the spectral theorem – functions of operators – tensor products – Schmidt decomposition theorem.
Textbook 1- Chapter 1(1.1,1.2,1.3,1.5,1.6,1.7) Chapter 2 (2.1,2.2,2.3,2.4,2.5,2.6,2.7)

Module -2

Qubits and Quantum Model of Computation Management: State of a quantum system – time evolution of a closed system – composite systems – measurement – mixed states and general quantum operations – quantum circuit model – quantum gates – universal sets of quantum gates – unitary transformations – quantum circuits.
Textbook 1-Chapter 3(3.1,3.2,3.3,3.4,3.5) Chapter 4(4.1,4.2,4.3,4.4,4.5)

Module -3

Quantum Algorithms - 1: Superdense coding – quantum teleportation – applications of teleportation – probabilistic versus quantum algorithms – phase kick-back – the Deutsch algorithm – the Deutsch - Jozsa algorithm – Simons algorithm – Quantum phase estimation and quantum Fourier Transform – eigenvalue estimation.
Textbook 1-Chapter 5(5.1,5.2,5.3) Chapter 6(6.1,6.2,6.3,6.4,6.5) Chapter 7(7.1,7.2)

Module -4

Quantum Algorithms - 2: Order-finding problem – eigenvalue estimation approach to order finding – Shor's algorithm for order finding – finding discrete logarithms – hidden subgroups – Grover's quantum search algorithm – amplitude amplification – quantum amplitude estimation – quantum counting – searching without knowing the success probability.
Textbook 1-Chapter 7(7.3.1,7.3.3,7.3.4,7.4,7.5) Chapter 8(8.1-8.4)

Module -5

Quantum Computational Complexity and Error Correction: Computational complexity – black-box model – lower bounds for searching – general black-box lower bounds – polynomial method – block sensitivity – adversary methods – classical error correction – classical three-bit code – fault tolerance – quantum error correction – three- and nine-qubit quantum codes – fault-tolerant quantum computation.
Textbook 1-Chapter 9(9.1-9.7) Chapter 10(10.1-10.6)

Text Books:

1. Phillip Kaye, R. Laflamme, and M. Mosca, "An Introduction to Quantum Computing",Oxford University Press, 2007.
2. V. Sahni, "Quantum Computing", Tata McGraw-Hill Publishing Company, 2007.

Reference Books:

1.Quantum Computing and Quantum Information, Michael A. Nielsen & Isaac L. Chuang, 10th Anniversary edition, Cambridge University Press, 2010.

3. Quantum Computing by Parag Lala, McGraw-Hill, Indian Edition, Reprint 2020.

Web links and Video Lectures (e-Resources):

https://nptel.ac.in/courses/106106232
https://archive.nptel.ac.in/courses/115/101/115101092/
https://www.ibm.com/quantum

4. Syllabus Timeline

S/L	Syllabus Timeline	Description
1	Week 1-2	Overview Church-Turing Thesis The circuit model of computation Reversible computation Quantum physics Quantum physics and computation
2	Week 3-4	Dirac notation and Hilbert Spaces Dual vectors Operators The spectral theorem Functions of operators
3	Week 5-6	Tensor products Schmidt decomposition theorem State of a quantum system Time evolution of a closed system Composite systems Measurement Mixed states and general quantum operations
4	Week 7-8:	Quantum circuit model Quantum gates Universal sets of quantum gates Unitary transformations Quantum circuits Superdense coding Quantum teleportation Applications of teleportation
5	Week 9-10	Probabilistic versus quantum algorithms Phase kick-back The Deutsch algorithm The Deutsch - Jozsa algorithm Simons algorithm Quantum phase estimation and quantum Fourier Transform Eigenvalue estimation
6	Week 11-12	Order-finding problem Eigenvalue estimation approach to order finding Shor's algorithm for order finding Finding discrete logarithms Hidden subgroups Grover's quantum search algorithm Amplitude amplification Quantum amplitude estimation Quantum counting

		Searching without knowing the success probability.
7	Week 13-14:	Computational complexity Black-box model Lower bounds for searching General black-box lower bounds Polynomial method Block sensitivity Adversary methods
8	Week 15-16:	Classical error correction Classical three-bit code Fault tolerance Quantum error correction Three- and nine-qubit quantum codes Fault-tolerant quantum computation.

5. Teaching-Learning Process Strategies

S/L	TLP Strategies:	Description
1	Lecture Method	Utilize various teaching methods within the lecture format to reinforce competencies.
2	Video/Animation	Incorporate visual aids like videos/animations to enhance understanding of the concepts.
3	Collaborative Learning	Encourage collaborative learning for improved competency application.
4	Higher Order Thinking (HOTS) Questions:	Pose HOTS questions to stimulate critical thinking related to each competency.
5	Problem-Based Learning (PBL)	Implement PBL to enhance analytical skills and practical application of competencies
6	Multiple Representations	Introduce topics in various representations to reinforce competencies
7	Real-World Application	Discuss practical applications to connect theoretical concepts with real-world competencies.
8	Flipped Class Technique	Utilize a flipped class approach, providing materials before class to facilitate deeper understanding of competencies
9	Programming Assignments	Assign programming tasks to reinforce practical skills associated with competencies.

6 .Assessment Details (both CIE and SEE)

Continuous Internal Evaluation:

This section of regulations is applicable to all theory-based courses. The minimum CIE marks requirement is 40% of maximum marks in each component.

CIE Split up

Components		Number	Weightage	Max. Marks	Min. Marks
(i)	Internal Assessment-Tests (A)	2	50%	25	10
(ii)	Assignments/Quiz/Activity (B)	2	50%	25	10
	TotalMarks			**50**	**20**

FinalCIE Marks =(A) + (B)

Average internal assessment shall be the average of the 2 test marks conducted.

Semester End Examination:

1.Question paper pattern will be ten questions. Each question is set for 20marks. The medium of the question paper shall be English unless otherwise it is mentioned.

2.There shall be 2 questions from each module, each of the two questions under a module (with a maximum of 3 sub questions), may have mix of topics under that module if necessary.

3.The students have to answer 5 full questions selecting one full question from each module.

4.Marks scored will be proportionally scaled down to 50 marks.

7. Learning Objectives

S/L	Learning Objectives	Description
1	**Understand Quantum Mechanics Fundamentals**	Gain a foundational understanding of quantum mechanics principles, including superposition, entanglement, and quantum states.
2	**Develop Proficiency in Quantum Algorithms**	Learning and implement key quantum algorithms, such as Shor's and Grover's algorithms, understanding their significance and applications.
3	**Apply Mathematical Concepts to Quantum Computing**	Use linear algebra, complex numbers, and probability theory to model and analyze quantum systems and processes.
4	**Design and Simulate Quantum Circuits**	Develop the ability to design quantum circuits and simulate them using quantum programming tools like Qiskit.
5	**Explore Quantum Information Theory**	Understand the concepts of quantum information, quantum entropy, and quantum error correction, and their applications in quantum communication.

8. Course Outcomes (Cos) and Mapping with Pos/ PSOs

Course Outcomes (Cos)

CO'S	Description
M23BCS705A.1	Analyze the fundamental concepts and principles of quantum computing
M23BCS705A.2	Analyze the Qubits and Quantum Model of Computation Management
M23BCS705A.3	Evaluate and understand various Quantum Algorithms
M23BCS705A.4	Analyze and understand various Quantum Algorithms
M23BCS705A.5	Examine the various concepts of Quantum Computational Complexity and Error Correction

CO-PO-PSO Mapping

Cos/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO110	PO111	PO112	PSO1	PSO2
M23BCS705A.1	3	2	-	-	3	-	-	-	-	-	-	3	3	
M23BCS705A.2	3	3	3	-	-	-	-	-	-	-	-		3	
M23BCS705A.3	-	3		2	-	-	-	-	-	-	-	3		
M23BCS705A.4	-	3	-	2	-	-	-	-	-	-	-	3		
M23BCS705A.5	-	-	3	-	-	-	-	-	-	-	-	-	3	
M23BCS705A	3	3	3	2								3	3	

9. Assessment Plan

Continuous Internal Evaluation (CIE)

	CO1	CO2	CO3	CO4	CO5	**Total**
Module 1	**10**					
Module 2		**10**				
Module 3			**10**			
Module 4				**10**		
Module 5					**10**	
Total	**10**	**10**	**10**	**10**	**10**	**50**

Semester End Examination (SEE)

	CO1	CO2	CO3	CO4	CO5	**Total**
Module 1	**20**					
Module 2		**20**				
Module 3			**20**			
Module 4				**20**		
Module 5					**20**	
Total	**20**	**20**	**20**	**20**	**20**	**100**

Conditions for SEE Paper Setting:

Each module of SEE question paper should be allocated with questions for 20% of the total SEE marks.

10. Future with this Subject

- The future with Quantum Computing is likely to involve several key trends and developments:
- Revolutionizing Cryptography: Quantum computers could break traditional cryptographic schemes, like RSA, by efficiently factoring large numbers. This will lead to the development of quantum-resistant encryption methods, securing data in a post-quantum world.
- Advancements in Drug Discovery and Material Science: Quantum computing could simulate molecular interactions at an unprecedented scale, enabling the discovery of new drugs and materials with properties tailored for specific purposes, potentially revolutionizing healthcare and materials engineering.
- Optimization and Problem-Solving: Quantum algorithms can solve complex optimization problems exponentially faster than classical algorithms. This could impact logistics, finance, manufacturing, and any field that relies on solving large-scale optimization problems.
- Artificial Intelligence and Machine Learning:Quantum computing could enhance machine learning algorithms, enabling faster training and more accurate models. This could lead to breakthroughs in AI applications, such as natural language processing, image recognition, and autonomous systems.
- Accelerating Scientific Research: Quantum computers can simulate quantum systems, aiding in the understanding of fundamental physics and chemistry. This could lead to new discoveries in quantum mechanics, particle physics, and other scientific fields, pushing the boundaries of our knowledge.
- Economic and Industrial Transformation: Quantum computing has the potential to create new industries, jobs, and economic growth. Companies and countries that invest in quantum technologies could gain a significant competitive advantage, leading to shifts in global economic power.

7th Semester	Professional Elective–IV (PE) Cryptography	M23BCS705B

1. Prerequisites

S/L	Proficiency	Prerequisites
1.	Mathematics	**Number Theory:** Understanding concepts like prime numbers, modular arithmetic, and Euler's theorem is crucial for many cryptographic algorithms. **Abstract Algebra:** Familiarity with groups, rings, and fields is important, especially for grasping encryption methods like RSA and elliptic curve cryptography. **Probability and Statistics:** Useful for analyzing the security of cryptographic systems and understanding concepts like randomness and entropy.
2.	Computer Science Fundamentals	**Algorithms and Data Structures:** Knowing how to efficiently implement and analyze algorithms is essential, as many cryptographic techniques involve complex computations and data manipulations. **Complexity Theory:** Understanding the computational complexity of algorithms helps in assessing their practicality and security.
3.	Discrete Mathematics	**Combinatorics:** Useful for understanding permutations, combinations, and other counting principles. **Graph Theory:** Relevant for certain cryptographic protocols and network security.
4.	Programming Skills	**Scripting and Coding**: Proficiency in programming languages (like Python, C++, or Java) is important for implementing and testing cryptographic algorithms and protocols.
5.	Understanding of Security Concepts	**Basic Security Principles:** Knowledge of concepts like confidentiality, integrity, and authentication is fundamental for designing and evaluating cryptographic systems. **Network Security:** Familiarity with protocols such as SSL/TLS and concepts like public key infrastructure (PKI) can be beneficial.

2. Competencies

S/L	Competency	KSA Description
1.	Number Theory	Understand prime numbers, modular arithmetic, and Euler's theorem. Apply concepts of greatest common divisor (GCD) and modular inverses.
2.	Cryptographic Algorithms and Techniques	Implement and understand block ciphers (e.g., AES) and stream ciphers.
3.	Protocols and Standards	Understand key exchange protocols, authentication protocols, and secure messaging. Implement and analyze protocols such as SSL/TLS, IPsec, and PKI.
4.	Implementation and Secure Coding	Code cryptographic algorithms and protocols in languages such as Python, C++, or Java. Ensure correct implementation and avoid common programming mistakes.
5.	Security Analysis and Evaluation	Analyze the security of cryptographic algorithms using formal methods and proofs. Evaluate potential attack vectors and cryptographic weaknesses.
6.	Legal and Ethical Considerations	Understand legal regulations related to cryptography, including data protection laws and export controls.

3. Syllabus

Cryptography (M23BCS705B) SEMESTER – VII			
Course Code	**M23BCS705B**	CIE Marks	**50**
Number of Lecture Hours/Week(L: T: P: S)	**(3:0:0)**	SEE Marks	**50**
Total Number of Lecture Hours	**40 hours Theory**	Total Marks	**100**
Credits	**03**	Exam Hours	**03**

Course objectives: This course will enable students to:

- Define cryptography and its principles
- Explain Cryptography algorithms
- Illustrate Public and Private key cryptography
- Explain Key management, distribution and certification

- Explain authentication protocols
- Tell about IPSec

Module -1

Classical Encryption Techniques Symmetric Cipher Model, Cryptography, Cryptanalysis and Brute-Force Attack, Substitution Techniques, Caesar Cipher, Monoalphabetic Cipher, Playfair Cipher, Hill Cipher, Polyalphabetic Cipher, One Time Pad. Block Ciphers and the data encryption standard: Traditional block Cipher structure, stream Ciphers and block Ciphers, Motivation for the feistel Cipher structure, the feistel Cipher, The data encryption standard, DES encryption, DES decryption, A DES example, results, the avalanche effect, the strength of DES, the use of 56-Bit Keys, the nature of the DES algorithm, timing attacks, Block cipher design principles, number of rounds, design of function F, key schedule algorithm Textbook 1: Ch. 2.1,2.2, Ch. 3 RBT: L1, L2

Module -2

Public-Key Cryptography and RSA: Principles of public-key cryptosystems. Public-key cryptosystems. Applications for public-key cryptosystems, requirements for public-key cryptosystems. public-key cryptanalysis. The RSA algorithm, desription of the algorithm, computational aspects, the security of RSA. Other Public-Key Cryptosystems: Diffie-hellman key exchange, The algorithm, key exchange protocols, man in the middle attack,Elgamal Cryptographic systems Textbook 1: Ch. 9, Ch. 10.1,10.2 RBT: L1, L2

Module -3

Elliptic curve arithmetic, abelian groups, elliptic curves over real numbers, elliptic curves over Zp, elliptic curves overGF(2m), Elliptic curve cryptography, Analog of Diffie-hellman key exchange, Elliptic curve encryption/ decryption, security of Elliptic curve cryptography, Pseudorandom number generation based on an asymmetric cipher, PRNG based on RSA. Key Management and Distribution: Symmetric key distribution using Symmetric encryption, A key distribution scenario, Hierarchical key control, session key lifetime, a transparent key control scheme, Decentralized key control, controlling key usage, Symmetric key distribution using asymmetric encryption, simple secret key distribution, secret key distribution with confidentiality and authentication, A hybrid scheme, distribution of public keys, public announcement of public keys, publicly available directory,public key authority, public keys certificates. Textbook 1: Ch. 10.3-10.5, Ch.14.1 to 14.3 RBT: L1, L2

Module -4

X-509 certificates. Certificates, X-509 version 3, public key infrastructure .User Authentication: Remote user Authentication principles, Mutual Authentication, one wayAuthentication, remote user Authentication using Symmetric encryption, Mutual Authentication, one way Authentication, Kerberos, Motivation , Kerberos version 4, Kerberos version 5, Remote user Authentication using Asymmetric encryption, Mutual Authentication, one way Authentication. Electronic Mail Security: Pretty good privacy, notation, operational; description, S/MIME, RFC5322, Multipurpose internet mail extensions, S/MIME functionality, S/MIME messages, S/MIME certificate processing, enhanced security services, Domain keys identified mail, internet mail architecture, E-Mail threats, DKIM strategy, DKIM functional flow. Textbook 1: Ch. 14.4, Ch. 15.1 to 15.4, Ch.19 RBT: L1, L2

Module -5

IP Security: IP Security overview, applications of IPsec, benefits of IPsec, Routing applications, IPsec documents, IPsec services, transport and tunnel modes, IP Security policy, Security associations, Security associations database, Security policy database, IP traffic processing, Encapsulating Security payload, ESP format, encryption and authentication algorithms, Padding, Anti replay service Transport and tunnel modes, combining security associations, authentication plus confidentiality, basic combinations of security associations, internet key exchange, key determinations protocol, header and payload formats, cryptographic suits. Textbook 1: Ch. 20.1 to 20.3 RBT: L1, L2

Text Books:

1. William Stallings: Cryptography and Network Security, Pearson 6th edition.
2. Cryptography and Network Security Behrouz A. Forouzan, De Anza College

Reference Books:

1.V K Pachghare: Cryptography and Information Security, PHI 2nd Edition

Web links and Video Lectures (e-Resources):

https://nptel.ac.in/courses/106105214
https://www.youtube.com/playlist?list=PLBlnK6fEyqRiVhbXDGLXDk_OQAeuVcp2O

4. Syllabus Timeline

S/L	Syllabus Timeline	Description
1	Week1: Introduction to Cryptography	·**Topics:** • History and importance of cryptography • Basic concepts: confidentiality, integrity, authentication • Overview of cryptographic systems and their applications ·**Activities:** • Lecture on the history and evolution of cryptography • Introduction to basic cryptographic terminology
2	Week2: Mathematical Foundations	·**Topics:** • Number theory basics: primes, modular arithmetic • Introduction to algorithms: Euclidean algorithm, modular inverses ·**Activities:** • Lecture on number theory and its relevance to cryptography • Problem sets on modular arithmetic and number theory
3	Week3: Abstract Algebra	· T**opics:** • Groups, rings, and fields • Applications to cryptographic algorithms ·**Activities:** • Lecture on abstract algebra concepts • Exercises on group theory and their application in cryptograph
4	Week4: Symmetric Key Cryptography	·**Topics:** • Block ciphers: DES, AES • Modes of operation: ECB, CBC, CTR • Padding schemes and their importance ·**Activities:** • Lecture on symmetric encryption algorithms • Hands-on lab: Implementing and testing AES • Reading: "Understanding Cryptography" (Chapters on AES and DES)
5	Week 5: Stream Ciphers and Their Applications	·**Topics:** • Stream ciphers: RC4, Salsa20 • Comparison with block ciphers ·**Activities:** • Lecture on stream ciphers and their use cases • Coding exercise: Implementing a stream cipher
6	Week 6: Hash Functions	·**Topics:** • Properties and uses of hash functions • Cryptographic hash functions: MD5, SHA-1, SHA-2, SHA-3 • HMAC and its applications **Activities:** • Lecture on hash functions and their importance in cryptography • Hands-on lab: Implementing and analyzing hash functions

5. Teaching-Learning Process Strategies

S/L	TLP Strategies:	Description
1	Lecture Method	Utilize various teaching methods within the lecture format to reinforce competencies.
2	Video/Animation	Incorporate visual aids like videos/animations to enhance understanding of concepts.
3	Collaborative Learning	Encourage collaborative learning for improved competency application.
4	Higher Order Thinking (HOTS) Questions:	Pose HOTS questions to stimulate critical thinking related to each competency.
5	Problem-Based Learning (PBL)	Implement PBL to enhance analytical skills and practical application of competencies
6	Multiple Representations	Introduce topics in various representations to reinforce competencies

7	Real-World Application	Discuss practical applications to connect theoretical concepts with real-world competencies.
8	Flipped Class Technique	Utilize a flipped class approach, providing materials before class to facilitate deeper understanding of competencies
9	Programming Assignments	Assign programming tasks to reinforce practical skills associated with competencies.

6 .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:

Components		Number	Weightage	Max. Marks	Min. Marks
(i)	Internal Assessment-Tests (A)	2	50%	25	10
(ii)	Assignments/Quiz/Activity (B)	2	50%	25	10
	Total Marks			**50**	**20**

Final CIE Marks = (A) + (B)

Average internal assessment shall be the average of the 2 test marks conducted.

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 as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. Question paper pattern will be ten questions. Each question is set for 20marks. The medium of the question paper shall be English unless otherwise it is mentioned.
2. There shall be 2 questions from each module, each of the two questions under a module (with a maximum of 3 sub questions), may have mix of topics under that module if necessary.
3. The students have to answer 5 full questions selecting one full question from each module.
4. Marks scored will be proportionally scaled down to 50 marks

7. Learning Objectives

S/L	Learning Objectives	Description
1	**Fundamental Principles**	Understand the basic principles of cryptography, including confidentiality, integrity, authenticity, and non-repudiation. Learn the difference between symmetric and asymmetric encryption and their use cases.
2	**Cryptographic Algorithms**	Study various cryptographic algorithms and protocols, such as DES, AES, RSA, and ECC.Learn how to implement and analyze these algorithms in practical scenarios.
3	**Key Management**	Understand key generation, distribution, and storage techniques. Learn the principles of key exchange protocols, such as Diffie-Hellman.
4	**Cryptographic Protocols**	Gain knowledge about cryptographic protocols, including SSL/TLS, IPsec, and others. Understand how these protocols secure communications over networks.
5	**Hash Functions**	Study hash functions like MD5, SHA-1, and SHA-256. Learn how hash functions contribute to data integrity and digital signatures.

8. Course Outcomes (Cos) and Mapping with Pos/ PSOs

Course Outcomes (Cos)

Cos	Description
M23BCS705B.1	Understand cryptography basics, algorithms and mathematical background for cryptography.
M23BCS705B.2	Analyze the important cryptographic algorithms.
M23BCS705B .3	Apply Cryptographic algorithms for Encryption and KeyExchange in real time projects.
M23BCS705B.4	Apply the various Authentication schemes to simulate different applications
M23BCS705B.5	Realize the security threats caused by malware, design Firewall based solutions and access control techniques to solve societal security problems.

CO-PO-PSO Mapping

Cos/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
M23BCS705B.1	2	2	-	-	-	-	-	-	-	-	-	2	2	2
M23BCS705B.2	2	2	-	-	-	-	-	-	-	-	-	-	-	-
M23BCS705B .3	2	3	-	-	-	-	-	-	-	-	-	-	-	-
M23BCS705B.4	3	2	2	-	-	-	-	-	-	-	-	-	-	-
M23BCS705B.5	-	2	2	3	3	-	-	-	-	-	-	-	-	-
M23BCS705B	2.25	2.2	2	3	3	-	-	-	-	-	-	-	2	2

9. Assessment Plan

Continuous Internal Evaluation (CIE)

	CO1	CO2	CO3	CO4	CO5	Total
Module 1	10					10
Module 2		10				10
Module 3			10			10
Module 4				10		10
Module 5					10	10
Total	10	10	10	10	10	50

Semester End Examination (SEE)

	CO1	CO2	CO3	CO4	CO5	Total
Module 1	20					20
Module 2		20				20
Module 3			20			20
Module 4				20		20
Module 5					20	20
Total	20	20	20	20	20	100

10. Future with this Subject

1. Post-Quantum Cryptography:

Challenge: Quantum computers have the potential to break many of the cryptographic algorithms currently in use, such as RSA and ECC.

2. Advances in Cryptographic Algorithms:

Enhancements: Cryptographic algorithms will continue to evolve to address new security threats and improve efficiency.

Example: The development of lightweight cryptographic algorithms for resource-constrained environments like IoT devices.

3. Blockchain and Cryptocurrencies:

Expansion: Cryptography will remain central to blockchain technologies, ensuring secure transactions, smart contracts, and decentralized applications (DApps).

Innovation: Advances in blockchain technology and cryptographic techniques will drive the development of new financial systems, governance models, and digital identities.

7thSemester	Professional Elective-IV(PE) BUSINESS INTELLIGENCE AND ANALYTICS	M23BCD705C

1. Prerequisites

S/L	Proficiency	Prerequisites
1	Basic Statistics:	Understanding of fundamental statistical concepts such as mean, median, mode, variance, standard deviation, correlation, and regression.
2	Probability:	Familiarity with basic probability theory, including probability distributions and probability rules.
3	Introductory Programming:	Knowledge of at least one programming language, such as Python or R, which are commonly used in data analysis and BI..
4	Introduction to Business Concepts:	Basic understanding of business processes, organizational structures, and key performance indicators (KPIs).
5	Information Systems:	Familiarity with the role of information systems in organizations, including data management systems, enterprise resource planning (ERP), and customer relationship management (CRM) systems.

2. Competencies

S/L	Competency	KSA Description
1	Data Management	**Knowledge:** Knowledge of how to structure and store data efficiently to ensure its integrity and accessibility. **Skills:** The ability to analyze complex datasets, identify trends and patterns. **Attitudes:** This involves understanding the strategic context of data analysis and using insights to influence business strategy.
2	Business Intelligence Concepts	**Knowledge:** Familiarity with the fundamental concepts of BI, such as data visualization, reporting, decision support systems, and key performance indicators (KPIs). **Skills:** Skill in developing script for analysis. **Attitudes:** Ability to Analyze business data efficiently.
3	Statistical and Analytical Techniques	**Knowledge:** Understanding how to apply these techniques to real-world business problems. **Skills:** The ability to approach business problems analytically, develop hypotheses, and use data to test and validate these hypotheses. **Attitudes:** The ability to quickly adapt to new tools, technologies, and methodologies in the rapidly evolving field of BI and Analytics.
4	Decision Support System	**Knowledge:** Knowledge of ANN, Decision support system. **Skills:** Skill on applying ANN knowledge and Decision support system. **Attitudes:** Ability to apply export system.

3. Syllabus

BUSINESS INTELLIGENCE AND ANALYTICS SEMESTER – VII			
Course Code	**M23BCD705C**	CIE Marks	**50**
Number of Lecture Hours/Week(L: T: P: S)	**(3:0:0:0)**	SEE Marks	**50**
Total Number of Lecture Hours	**40 Hours**	Total Marks	**100**
Credits	**03**	Exam Hours	**03**

Course Objectives:

1. Explain the Business Intelligence, Analytics and Decision Support system
2. List the technologies for Decision making, Automated decision systems
3. Explain sentiment analysis techniques
4. Illustrate Multi-criteria Decision making systems, predictive modelling techniques

Module -1

An Overview of Business Intelligence, Analytics, and Decision Support: Information Systems Support for Decision Making, An Early Framework for Computerized Decision Support, TheConcept of Decision Support Systems, A Framework for Business Intelligence, Business Analytics Overview, Brief Introduction to Big Data Analytics.

Module -2

Decision Making: Introduction and Definitions, Phases of the Decision, Making Process, The Intelligence Phase, Design Phase, Choice Phase, Implementation Phase, Decision Support Systems Capabilities, Decision Support Systems Classification, Decision Support Systems Components.
Module -3
Neural Networks and Sentiment Analysis: Basic Concepts of Neural Networks, Developing Neural Network-Based Systems, Illuminating the Black Box of ANN with Sensitivity, Support Vector Machines, A Process Based Approach to the Use of SVM, Nearest Neighbour Method for Prediction, Sentiment Analysis Overview, Sentiment Analysis Applications, Sentiment Analysis Process,, Sentiment Analysis, Speech Analytics.
Module -4
Model-Based Decision Making: Decision Support Systems modeling, Structure of mathematical models for decision support, Certainty, Uncertainty, and Risk, Decision modeling with spreadsheets, Mathematical programming optimization, Decision Analysis with Decision Tables and Decision Trees, Multi-Criteria Decision Making With Pairwise Comparisons.
Module -5
Automated Decision Systems and Expert Systems: Automated Decision Systems, The Artificial Intelligence field, Basic concepts of Expert Systems, Applications of Expert Systems, Structure of Expert Systems, Knowledge Engineering, Development of Expert Systems.
Suggested Learning Resources: **Text Books:** 1. Ramesh Sharda, DursunDelen, EfraimTurban, J.E.Aronson,Ting-Peng Liang, David King, "Business Intelligence and Analytics: System for Decision Support", 10th Edition, Pearson Global Edition, 2013 2. Data Analytics: The Ultimate Beginner's Guide to Data Analytics Paperback – 12 November 2017by Edward Mize. **REFERENCE BOOKS:** 1. Kumar U. D: Business Analytics – The Science of Data – Driven Decision Making, Wiley. 2. Bowles M. : Machine Learning in Python – Essential Techniques for Predictive Analysis, Wiley.

4. Syllabus Timeline

S/L	Syllabus Timeline	Description
1	Week 1-3: An Overview of Business Intelligence, Analytics, and Decision Support	Introduction to concepts of Business Intelligence. Review of theory and concepts.. Basics data analytics and decision support system.
2	Week 4-6: Decision Making	Introduction to decision system. Phases of decision making system. Process of decision making system.
3	Week 8-11: Neural Networks and Sentiment Analysis	Introduction to Neural Networks and Sentiment Analysis.
4	Week 7-8: Model-Based Decision Making	Introduction to the structure of decision making system. Different decision making models.
5	Week 9-12: Automated Decision Systems and Expert Systems	Introduction to Automated decision system. Basics of expert system. Structure and applications of expert system.

5. Teaching-Learning Process Strategies

S/L	TLP Strategies:	Description
1	Lecture Method	Utilize various teaching methods within the lecture format to reinforce competencies.
2	Simulation	Use software simulations to mimic real-world business scenarios.
3	Group Projects and Collaborative Learning	Promote teamwork through group projects that require students to collaborate on analysis and decision-making.
4	Problem based Learning	Present students with real-world business problems to solve using BI tools.
5	Case Study based	Analyze case studies of companies that have successfully implemented BI and

	approach	Analytics.
6	Labs and Workshops	Provide regular lab sessions where students can practice using BI tools like Tableau, Power BI, or SQL.

6. Assessment Details (both CIE and SEE)

Continuous Internal Evaluation:

The minimum CIE marks requirement is 40% of maximum marks in each component.

CIE Split up

Components		Number	Weightage	Max. Marks	Min. Marks
(i)	Internal Assessment-Tests (A)	2	50%	25	10
(ii)	Assignments/Quiz/Activity (B)	2	50%	25	10
	TotalMarks			**50**	**20**

FinalCIE Marks = (A) + (B)

Average internal assessment shall be the average of the 2 test marks conducted.

Semester End Examination:

- Question paper pattern will be ten questions. Each question is set for 20marks. The medium of the question paper shall be English unless otherwise it is mentioned.
- There shall be 2 questions from each module, each of the two questions under a module (with a maximum of 3 sub questions), may have mix of topics under that module if necessary.
- The students have to answer 5 full questions selecting one full question from each module.
- Marks scored will be proportionally scaled down to 50 marks

7. Learning Objectives

S/L	Learning Objectives	Description
1	Understanding Business Intelligence Concepts	Describe the role of BI in supporting strategic and operational decision-making in organizations.
2	Data Management and Preparation	Perform data extraction, transformation, and loading (ETL) processes to prepare data for analysis.
3	Analytical Skills Development	Apply statistical methods and data analysis techniques to interpret data and derive actionable insights.
4	Data Visualization and Reporting	Design and develop effective data visualizations that communicate insights clearly and concisely to stakeholders.
5	Real-World Application	Implement a comprehensive BI project that involves data collection, analysis, visualization, and reporting in response to a real-world business challenge.

8. Course Outcomes (COs) and Mapping with POs/ PSOs

Course Outcomes (COs)

Cos	Description
M23BCD705C.1	Able to analyze Business Intelligence, Analytics and Decision support.
M23BCD705C.2	Analyze and apply technologies for decision making.
M23BCD705C.3	Apply predictive modelling techniques
M23BCD705C.4	Apply sentiment analysis techniques
M23BCD705C.5	Develop NN model for analysis.

CO-PO-PSO Mapping

COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
M23BCD705C.1	-	3	-	-	-	-	-	-	-	-	-	-	-	-
M23BCD705C.2	3	-	-	-	-	-	-	-	-	-	-	-	-	-
M23BCD705C.3	3	-	-	-	-	-	-	-	-	-	-	-	-	-
M23BCD705C.4	3	-	-	-	-	-	-	-	-	-	-	-	-	-
M23BCD705C.5	-	-	3	-	-	-	-	-	-	-	-	-	-	-
M23BCD705C	**3**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**3**

9. Assessment Plan

Continuous Internal Evaluation (CIE)

	CO1	CO2	CO3	CO4	CO5	Total
Module 1	**10**					**10**
Module 2		**10**				**10**
Module 3			**10**			**10**
Module 4				**10**		**10**
Module 5					**10**	**10**
Total	**10**	**10**	**10**	**10**	**10**	**50**

Semester End Examination (SEE)

	CO1	CO2	CO3	CO4	CO5	Total
Module 1	**20**					**20**
Module 2		**20**				**20**
Module 3			**20**			**20**
Module 4				**20**		**20**
Module 5					**20**	**20**
Total	**20**	**20**	**20**	**20**	**20**	**100**

10. Future with this Subject:

- **AI-Powered Analytics**: The integration of artificial intelligence (AI) and machine learning (ML) into BI will become more prevalent, leading to the development of more sophisticated predictive and prescriptive analytics.
- **Natural Language Processing (NLP):** NLP will allow users to interact with BI tools using conversational language, making data analysis more accessible to non-technical users.
- **IoT and Big Data**: The convergence of BI with IoT and Big Data will lead to new opportunities for analytics.
- **Lifelong Learning**: The rapid evolution of tools and technologies in BI and Analytics will require professionals to engage in lifelong learning.

7th Semester	Professional Elective –IV (PE) Augmented Reality and Virtual reality	M23BIS705D

1.Prerequisites

S/L	Proficiency	Prerequisites
1	**Hardware Requirements**	For VR: You'll need a VR headset (like Oculus Quest, HTC Vive, or PlayStation VR) and possibly additional peripherals like motion controllers. High-performance computers or consoles may also be required to run VR applications smoothly. For AR: AR experiences can be accessed through smartphones and tablets, which need to have good processing power and sensors (camera, gyroscope, accelerometer). For advanced AR experiences, specialized AR glasses or headsets might be needed.
2	**Software and Development Tools**:	Both AR and VR development require software tools for creating and managing content. Common tools include Unity or Unreal Engine for creating interactive 3D environments, as well as AR-specific tools like ARKit (for iOS) or ARCore (for Android) for developing AR applications.
3	**Understanding of 3D Modeling and Animation**	Creating immersive AR and VR experiences often involves 3D modeling and animation. Proficiency with 3D modeling software (like Blender, 3ds Max, or Maya) is crucial for designing and animating virtual objects and environments.
4	**Programming Skills**	Developing AR and VR applications usually requires programming knowledge. Familiarity with languages like C# (commonly used in Unity) or C++ (often used in Unreal Engine) is important for scripting interactions, game mechanics, and other functionalities within AR/VR environments.
5	**User Experience (UX) Design Knowledge**:	Designing for AR and VR involves unique considerations for user experience. Understanding how users interact with 3D spaces, how to create intuitive controls, and how to ensure comfort and accessibility (to prevent issues like motion sickness) are all critical for creating effective and engaging AR/VR experiences.

2.Competencies

S/L	Competency	KSA Description
1	3D Modeling and Animation	Students are able to create and animate 3D assets that are optimized for AR/VR environments.
2	Programming and Scripting	Students will understand the use of AR/VR SDKs and APIs (e.g., Unity, Unreal Engine, ARKit, ARCore).
3	User Experience (UX) Design	Students learn Ability to analyze user behavior and feedback to improve the AR/VR experience.
4	Hardware and Sensor Integration	Students learn to address and resolve hardware and sensor integration challenges.
5	Computer Vision	Students learn to enhance the AR experience by integrating sophisticated computer vision capabilities.
6	Project Management and Collaboration	Ability to lead projects from conception through completion, ensuring timelines and goals are met.

3.Syllabus

Augmented Reality and Virtual reality **SEMESTER – VII**			
Course Code	**M23BIS705D**	CIE Marks	**50**
Number of Lecture Hours/Week(L: T: P: S)	**(3:0:0)**	SEE Marks	**50**
Total Number of Lecture Hours	**40 hours Theory**	Total Marks	**100**
Credits	**03**	Exam Hours	**03**

Course objectives: This course will enable students to:
Basic Understanding of Augmented Reality and Virtual Reality
Develop Proficiency in AR/VR Development Tools
Design and Implement Interactive Experiences
Analyze and Evaluate AR/VR Technologies and Trends

Module -1

Defining Virtual and Augmented Reality: Introducing Virtual Reality and Augmented Reality. Looking at Some Other Types of Virtual and Augmented Reality. Mixed reality. Augmented virtuality. Extended reality.
Exploring the Current State of Virtual Reality: Looking at the Available Form Factors. Focusing on Features. Room-scale versus stationary experience. Inside-out tracking. Haptic feedback. Audio. Considering Controllers.
Exploring the Current State of Augmented Reality: Mobile devices. AR Headsets, AR Glasses. Considering Controllers. Touch. Gaze. Keyboard and mouse. Voice. Hand tracking.
Textbook1-Chapter 1, 2,3

Module -2

Consuming Content in Virtual Reality- Exploring Consumer-Grade Virtual Reality. High-end devices. Mid-tier devices. Low-end devices. Identifying Near-Future Hardware. HTC Vive Pro. HTC Vive Focus Lenovo Mirage Solo.
Consuming Content in Augmented Reality- Exploring Consumer-Grade Augmented Reality. Microsoft HoloLens. Meta 2. Magic Leap. Identifying Near-Future Hardware. Heads-up displays. AR devices. Comparing Current and Future Options.
Textbook1-Chapter 4, 5

Module -3

Evaluating Project: Choosing Virtual Reality- Strengths And Weaknesses. Choosing Augmented Reality-Strengths And Weaknesses.
Creating Content for Virtual And Augmented Reality: Assessing Design Software. Traditional design tools-VR/AR-based design tools. Capturing Real Life. Video-capture options. Still-image capture options. Audio options. Virtual reality desktop headsets. Virtual reality mobile headsets. Augmented reality headsets. Mobile augmented reality.
Textbook1-Chapter 6, 9

Module -4

Exploring Virtual Reality Use Cases- Art- Tilt Brush. Google Arts & Culture V. Education- Google Expeditions V. Apollo 11. VR. Entertainment-Intel True. Healthcare- Virtual operating room. Psychological therapy. Gaming- Rec Room. VR arcade.
Exploring Augmented Reality Use Cases- Art- Facebook Building. Education- Google Expeditions. Industry and Commerce-Worklink. Entertainment- Kinetic Sandbox.
Textbook1-Chapter 10,11

Module -5

The Future of VR and AR: Assessing the Future of Virtual Reality: Anticipating the Near-Future Changes. Evaluating the market. Looking at upcoming hardware and software. Considering Virtual Reality's "Killer App".
Assessing the Future of Augmented Reality: Analyzing Near Future Changes. Evaluating the market. Considering AR's "Killer App".
Textbook1-Chapter 12,13

Text Books:
1. Virtual & Augmented Reality for Dummies by Paul Mealy.
Reference Books:
1. Coiffet, P., Burdea, G. C., (2003), "Virtual Reality Technology," Wiley-IEEE Press.
2. Schmalstieg, D., Höllerer, T., (2016), "Augmented Reality: Principles & Practice," Pearson,

Web links and Video Lectures (e-Resources):
https://arvr.google.com/

https://www.goshort.nl
https://www.8thwall.com/

4.Syllabus Timeline

S/L	Syllabus Timeline	Description
1	Week 1-2: Introduction to Augmented and Virtual Reality	**Knowledge**: Understanding of 3D modeling techniques, textures, and animations. **Skills**: Ability to create and animate 3D assets that are optimized for AR/VR environments.
2	Week 3-4: Consuming Content In Virtual And Augmented Reality	**Knowledge**: develop skills in breaking down problems and designing efficient solutions. **Skills:** Ability to create and animate 3D assets that are optimized for AR/VR environments.
3	Week 5-6: Creating Content In Virtual And Augmented Reality	**Knowledge**: Understanding of computer vision techniques used in AR, such as object recognition and image tracking. **Skills**: kill in using computer vision libraries and frameworks (e.g., OpenCV).
4	Week 7-8: Virtual And Augmented Reality In The World	**Knowledge:** how operating systems manage memory resources efficiently to support multiple processes. **Skills:** Skill in creating wireframes, prototypes, and conducting usability testing for AR/VR applications
5	Week 9-10: The Future of VR and AR: Assessing the	**Knowledge**: Familiarity with the collaborative aspects of AR/VR development, including team dynamics and communication. **Skills**: Skill in coordinating with multidisciplinary teams, including designers, developers, and stakeholders.
6	Week 11-12: Integration and Practical Applications	Apply learned concepts and competencies to real-world scenarios. Hands-on practice with AR and VR.

5.Teaching-Learning Process Strategies

S/L	TLP Strategies:	Description
1	Lecture Method	Utilize various teaching methods within the lecture format to reinforce competencies.
2	Video/Animation	Incorporate visual aids like videos/animations to enhance understanding of Verilog concepts.
3	Collaborative Learning	Encourage collaborative learning for improved competency application.
4	Higher Order Thinking (HOTS) Questions:	Pose HOTS questions to stimulate critical thinking related to each competency.
5	Problem-Based Learning (PBL)	Implement PBL to enhance analytical skills and practical application of competencies
6	Multiple Representations	Introduce topics in various representations to reinforce competencies
7	Real-World Application	Discuss practical applications to connect theoretical concepts with real-world competencies.
8	Flipped Class Technique	Utilize a flipped class approach, providing materials before class to facilitate deeper understanding of competencies
9	Programming Assignments	Assign programming tasks to reinforce practical skills associated with competencies.

6 .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:

Components		Number	Weightage	Max. Marks	Min. Marks
(i)	Internal Assessment-Tests (A)	2	50%	25	10
(ii)	Assignments/Quiz/Activity (B)	2	50%	25	10
	Total Marks			**50**	**20**

Final CIE Marks = (A) + (B)
Average internal assessment shall be the average of the 2 test marks conducted.

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 as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

- Question paper pattern will be ten questions. Each question is set for 20marks. The medium of the question paper shall be English unless otherwise it is mentioned.
- There shall be 2 question from each module, each of the two questions under a module (with a maximum of 3 sub questions), may have mix of topics under that module if necessary.
- The students have to answer 5 full questions selecting one full question from each module.
- Marks scored will be proportionally scaled down to 50 marks

7. Learning Objectives

S/L	Learning Objectives	Description
1	**Understand AR/VR Fundamentals**	Students Learn the core concepts and technologies behind AR and VR.
2	**Develop AR/VR Content**	Acquire skills in creating and programming interactive 3D content for AR/VR.
3	**Design Immersive UX**	Master user experience principles specific to AR/VR environments.
4	**Optimize AR/VR Systems**	Implement and fine-tune AR/VR applications for performance and usability
5	**Explore Trends and Applications**	Stay updated on the latest AR/VR advancements and industry applications.

8.Course Outcomes (Cos) and Mapping with Pos/ PSOs
Course Outcomes (Cos)

Cos	Description
M23BIS705D.1	Analyse the fundamental concepts and principles of AR and VR.
M23BIS705D.2	Design and develop AR/VR projects, demonstrating the ability to create immersive and interactive experiences using appropriate development tools and technologies.
M23BIS705D.3	Apply key principles of AR and VR, including spatial awareness, user interaction, and real-time rendering, to create functional and engaging applications.
M23BIS705D.4	Analyze the performance of AR/VR applications, optimizing aspects such as graphics rendering, user interaction, and system efficiency to ensure high-quality user experiences.
M23BIS705D.5	Evaluate and critique different AR/VR technologies and platforms, understanding their features, capabilities, and limitations, and making informed decisions about their use in various contexts.

CO-PO-PSO Mapping

Cos/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
M23BIS705D.1	3	-	-	-		-	-	-	-	-	-	3	3	
M23BIS705D.2	-	-	3	2	3	-	-	-	-	-	-	3	3	
M23BIS705D.3	-	-	3	2	3	-	-	-	-	-	-	3		3
M23BIS705D.4	3	-	3	2	3	-	-	-	-	-	-	3	3	
M23BIS705D.5	-	-	3	-		-	-	-	-	-	-	-	3	
M23BIS705D	3		3	2	3							3	3	3

9.Assessment Plan

Continuous Internal Evaluation (CIE)

	CO1	CO2	CO3	CO4	CO5	**Total**
Module 1	**10**					**10**
Module 2		**10**				**10**
Module 3			**10**			**10**
Module 4				**10**		**10**
Module 5					**10**	**10**
Total	**10**	**10**	**10**	**10**	**10**	**50**

Semester End Examination (SEE)

	CO1	CO2	CO3	CO4	CO5	**Total**
Module 1	**20**					**20**
Module 2		**20**				**20**
Module 3			**20**			**20**
Module 4				**20**		**20**
Module 5					**20**	**20**
Total	**20**	**20**	**20**	**20**	**20**	**100**

Conditions for SEE Paper Setting:

Each module of SEE question paper should be allocated with questions for 20% of the total SEE marks.

10.Future with this Subject

The future with Augmented and Virtual Reality is likely to involve several key trends and developments:

1. **Enhanced Immersive Experiences**: Future AR and VR systems will offer even more immersive experiences with advancements in hardware and software, including higher resolution displays, more accurate motion tracking, and improved sensory feedback. Innovations like haptic feedback suits and advanced spatial audio will further enhance the sense of presence and immersion.
2. **Integration with Artificial Intelligence (AI)**: AR and VR will increasingly integrate with AI to create more intelligent and responsive environments. AI could enhance real-time object recognition, personalize user experiences, and enable dynamic content generation, making interactions more intuitive and context-aware.
3. **Broader Applications across Industries**: The application of AR and VR will expand significantly across various industries. For example, AR might revolutionize fields like healthcare with surgical visualization tools or remote diagnostics, while VR could transform education through virtual classrooms and hands-on simulations.
4. **Advancements in Wearable Technology**: Future developments will lead to more compact, comfortable, and less intrusive AR/VR wearables. This could include lightweight AR glasses with enhanced functionalities or VR headsets with improved ergonomics and wireless capabilities, making them more accessible and practical for daily use.
5. **Social and Collaborative Virtual Spaces**: AR and VR will increasingly facilitate social interactions and collaboration in virtual spaces. Enhanced social VR platforms could allow for more natural and engaging virtual meetings, social gatherings, and collaborative work environments, bridging geographical gaps and fostering global connectivity.

7th Semester	Professional Core Course laboratory (PCL) Neural Network and Deep Learning Lab	M23BISL706

1. **Prerequisites**

S/L	Proficiency	Prerequisites
01	**Hardware Requirements**	**Computers/Workstations**: Adequate number of computers with varying specifications to test software on different configurations. **Servers**: For testing server-based applications, load balancing, and stress testing. **Network Infrastructure**: Routers, switches, and cabling for connecting computers and servers. **Mobile Devices**: For testing mobile applications, you'll need a range of smartphones and tablets.
02	**Software Requirements**	**Operating Systems**: Different OS versions for compatibility testing (e.g., Windows, Linux, macOS). **Browsers**: Various web browsers for cross-browser testing (e.g., Chrome, Firefox, Edge, Safari). **Testing Tools**: **Automated Testing Tools**: Selenium, QTP, etc. **Performance Testing Tools**: JMeter, LoadRunner, etc. **Bug Tracking Tools**: Jira, Bugzilla, etc. **Version Control Systems**: Git, SVN, etc
03	**Network Configuration**	**Local Area Network (LAN)**: To connect the devices within the lab. **Internet Connectivity**: For accessing online resources, updates, and cloud-based services. **Firewall and Security**: Proper configurations to protect the lab network.
04	**Human Resources**	**Testers/Engineers**: Skilled professionals who perform the testing. **Developers**: To fix any issues identified during testing. **System Administrators**: To manage and maintain hardware and software.
05	**Environment Setup**	**Test Environment**: A controlled setup that mimics the production environment as closely as possible. **Backup and Recovery**: Procedures and tools to ensure data integrity and recovery in case of failure.

2. **Competencies**

S/L	Competency	KSA Description
1	**Technical Skills**	**Knowledge:** Proficiency in using automated testing tools (e.g., Selenium, QTP) and performance testing tools (e.g., JMeter, LoadRunner). **Skills:** Ability to write and understand code in languages relevant to the application under test (e.g., Java, Python, C#). **Attitudes:** Competence in querying and managing databases (e.g., SQL, NoSQL) for data-driven testing.
2	**Testing Methodologies**	**Knowledge:** Expertise in performing manual testing, including exploratory, regression, and user acceptance testing. **Skills:** Skills in assessing system performance, load, stress, and scalability. **Attitudes:** Ability to design, implement, and maintain automated test scripts

3	**Test Planning and Design**	**Knowledge:** Developing comprehensive test strategies and plans that align with project requirements and goals. **Skills:** Ability to create detailed and effective test cases and scenarios. **Attitudes:** Identifying and managing risks associated with the testing process and product quality.
4	**Problem-Solving and Analytical Skills**	**Knowledge:** Proficiency in identifying, documenting, and communicating defects effectively. **Skills:** Skills in analyzing issues to determine their root causes and potential solutions. **Attitudes:** Ability to interpret test results and metrics to make informed decisions.
5	**Knowledge of Development Life Cycle**	**Knowledge:** Understanding of Software Development Life Cycle (SDLC) and Agile frameworks (e.g., Scrum, Kanban). **Skills:** Familiarity with Continuous Integration and Continuous Deployment (CI/CD) processes and tools.

3. Syllabus

Neural Network and Deep Learning Lab SEMESTER – VII			
Course Code	**M23BISL706**	CIE Marks	**50**
Number of Lecture Hours/Week(L: T: P: S)	**0:0:2:0**	SEE Marks	**50**
Total Number of Lecture Hours	**22-26 hours of lab sessions**	Total Marks	**100**
Credits	**01**	Exam Hours	**03**

Course objectives: This course will enable students to:

- Understand the basic in deep learning and neural network.
- Understand the basic of associative memory and unsupervised learning network.
- Apply CNN network of deep neural network.
- Analyze the key computations underlying deep neural network, then use them to build and train deep neural network for various tasks.

Programs	
1	Implementation of simple vector addition in Tensor Flow
2	Implementation a regressive model in Keras.
3	Implementation of Perceptron Networks in Tensor Flow/ Keras environment.
4	Implementation of Feed forward network in Tensor Flow/ Keras environment.
5	Implementation of image classifier in CNN network Tensor Flow/ Keras environment.
6	Improve the deep learning model by fine tuning hyper parameters.
7	Implement a Transfer Learning concept in image classification.
8	Using a pre trained model on Keras for Transfer Learning.
9	Perform Sentimental Analysis using RNN.
10	Implement object detection using CNN.
11	Recommendation system from sales data using deep learning.
12	Train a deep learning model to classify a given image using pre trained model.

4. Syllabus Timeline

S/L	Syllabus Timeline	Description
1	Week 1-2:	Introduction, Program1
2	Week 3-4:	Program2, 3.
3	Week 5-6:	Program4,5
4	Week 7-8:	Program 6,7
5	Week 9-10:	Program.8,9
6	Week 11-12:	Program 10-12

5. Teaching-Learning Process Strategies

S/L	TLP Strategies:	Description
1	Interactive Lectures	Use interactive lectures to introduce new concepts. Incorporate questions and discussions to engage students.
2	Coding Sessions	Demonstrate the implementation of different Testing live, showing step-by-step coding and debugging.
3	Lab Exercises	Design lab exercises that require students to implement and manipulate Testing process.
4	Coding Assignments	Assign regular coding tasks that reinforce lecture material and provide practical experience.
5	Group Projects	Encourage students to work in groups for larger projects, fostering teamwork and collaborative problem-solving.
6	Code Documentation	Practice writing clear and comprehensive documentation for all coding assignments and projects.
7	Programming Assignments	Assign programming tasks and mini projects to reinforce practical skills associated with competencies.

6. Assessment Details (both CIE and SEE)

Marks distribution for Program based Practical Course for CIE

Sl. No.	Description	% of Marks	In Marks
1	Observation, write-up, algorithm/program/execution	80% of the maximum	80
2	Viva-Voce	20% of the maximum	20
Total		100%	100

Marks scored by the student for 100 are scaled down to 50 marks.

SEE for practical Course (Irrespective of Experiment or program based):

Marks distribution for Experiment based Practical Course for Final CIE

SL. No.	Description	% of Marks	Marks
1	Write-up, Procedure	20%	20
2	Conduction and result	60%	60
3	Viva-Voce	20%	20
Total		**100%**	**100**

- SEE marks for practical course shall be 50 marks
- See for practical course is evaluated for 100 marks and scored marks shall be scaled down to 50 marks.
- Change of experiment/program is allowed only once and 20% marks allotted to the procedure/write-up part to be made zero.
- Duration of SEE shall be 3 hours.

7. Course Outcomes (COs) and Mapping with POs/ PSOs

Course Outcomes (COs)

COs	Description
M23BISL706.1	Understand the basic in deep learning and neural network.
M23BISL706.2	Understand the basic of associative memory and unsupervised learning network.
M23BISL706.3	Apply CNN network of deep neural network.
M23BISL706.4	Analyze the key computations underlying deep neural network.

CO-PO-PSO Mapping

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
M23BISL706.1	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	2	-
M23BISL706.2	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	-	2
M23BISL706.3	**-**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	-	3
M23BISL706.4	**-**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**-**	-	-
M23BISL706.	**2**	**2.5**	**2**	**2**					**2**				**2**	**2.5**

8.Learning Objectives

S/L	Learning Objectives	Description
1	**Fundamental Concepts**	**Understand Neural Network Basics** **Objective**: Explain the architecture of neural networks, including neurons, layers (input, hidden, output), activation functions, and how data flows through the network. **Outcome**: Students will be able to describe the basic components and structure of neural networks and their functions. **Grasp the Principles of Deep Learning** **Objective**: Define deep learning and differentiate it from traditional machine learning approaches, focusing on the use of deep neural networks with multiple layers. **Outcome**: Students will understand what constitutes deep learning and its advantages over shallow neural networks.
2	**Mathematical Foundations**	**Apply Linear Algebra in Neural Networks** **Objective**: Use linear algebra concepts such as matrices, vectors, and operations to explain neural network computations. **Outcome**: Students will be able to perform matrix operations required for neural network training and understand their implications. **Utilize Calculus for Optimization** **Objective**: Apply calculus concepts, including differentiation and gradients, to understand how neural networks are optimized during training. **Outcome**: Students will be proficient in computing gradients and using them to optimize neural network parameters. **Implement Probability and Statistics** **Objective**: Use probability and statistical concepts to understand loss functions, regularization techniques, and model evaluation metrics. **Outcome**: Students will be able to apply statistical methods to evaluate and improve neural network performance.
3	**Neural Network Design and Training**	**Build and Train Neural Networks** **Objective**: Develop and train basic neural network models using popular frameworks such as TensorFlow, Keras, or PyTorch. **Outcome**: Students will be able to implement and train neural network models for various tasks, including classification and regression. **Apply Regularization Techniques** **Objective**: Implement regularization methods like dropout, L1/L2 regularization, and batch normalization to improve model generalization. **Outcome**: Students will be able to apply these techniques to prevent overfitting and enhance model performance.
4	**Practical Applications and Deployment**	**Implement Neural Networks for Real-World Problems** **Objective**: Apply neural network models to solve real-world problems in domains such as image recognition, speech processing, and recommendation systems. **Outcome**: Students will be able to design and deploy neural network solutions for practical applications. **Deploy and Maintain Models** **Objective**: Understand the process of deploying neural networks into production environments and maintaining their performance over time. **Outcome**: Students will be able to deploy models and address challenges related to scalability, integration, and real-time processing.
5	**Advanced Architectures and Techniques**	**Understand and Implement Convolutional Neural Networks (CNNs)** **Objective**: Explain the architecture and application of CNNs for image and video processing tasks. **Outcome**: Students will be able to build and deploy CNNs for tasks like image classification and object detection. **Explore Recurrent Neural Networks (RNNs) and LSTMs** **Objective**: Describe the structure and use cases of RNNs and Long Short-Term Memory (LSTM) networks for sequence modeling.

		Outcome: Students will be able to apply RNNs and LSTMs to problems involving sequential data, such as time series forecasting and natural language processing. **Utilize Transformer Models** **Objective**: Understand the architecture and applications of transformer models and attention mechanisms in tasks such as language translation and text generation. **Outcome**: Students will be able to work with transformer models and apply them to advanced natural language processing tasks.

9.Assessment Plan

Continuous Internal Evaluation (CIE)

	CO1	CO2	CO3	CO4	CO5	**Total**
Program 1-6	10	10	10	10	10	50
Total	10	10	10	10	10	**50**

Semester End Examination (SEE)

	CO1	CO2	CO3	CO4	CO5	**Total**
Program 1-10	20	20	20	20	20	100
Total	20	20	20	20	20	**100**

10.Future with this Subject

The future of deep learning and neural networks is incredibly promising, with the potential to revolutionize numerous industries and scientific fields. Here are some key areas where these technologies are expected to have a significant impact:

1. Healthcare and Medicine

Personalized Medicine: Deep learning can analyze genetic information and medical records to create personalized treatment plans, improving patient outcomes.

Drug Discovery: Neural networks can accelerate drug discovery by predicting how different compounds interact with biological systems, significantly reducing the time and cost associated with bringing new drugs to market.

Medical Imaging: Advanced neural networks will enhance diagnostic accuracy by analyzing medical images, such as X-rays and MRIs, with greater precision than human experts.

2. Autonomous Systems

Self-Driving Vehicles: Deep learning is central to the development of autonomous vehicles, enabling them to navigate complex environments, recognize objects, and make real-time decisions.

Robotics: Neural networks will allow robots to perform complex tasks with greater autonomy and adaptability, from manufacturing and logistics to household chores.

3. Natural Language Processing and AI

Advanced Conversational Agents: The development of more sophisticated natural language processing models will lead to AI that can understand and generate human language more effectively, enhancing communication between humans and machines.

Language Translation: Neural networks will continue to improve the accuracy and fluency of real-time language translation, breaking down communication barriers worldwide.

4. Finance and Economics

Algorithmic Trading: Deep learning models can analyze vast amounts of financial data to predict market trends and execute trades more efficiently, potentially leading to higher returns.

Fraud Detection: Neural networks will enhance the ability to detect fraudulent transactions in real-time, reducing financial crimes and improving security.

5. Climate Science and Environmental Monitoring

Climate Prediction: Deep learning models can analyze climate data to make more accurate predictions about future climate conditions, aiding in the fight against climate change.

Environmental Monitoring: Neural networks will improve the monitoring of ecosystems, helping to track changes in biodiversity, deforestation, and pollution

7thSemester	Project Work (PW) MAJOR PROJECT PHASE-II	M23BCD707

1. Prerequisites

S/L	Proficiency	Prerequisites
1	Project Planning and Management	Basic understanding of project management principles, acquired from earlier project work and theoretical courses.
2	Experimental Design and Analysis	Knowledge of experimental techniques and data analysis from core and elective courses.
3	Technical Documentation	Competence in technical writing and report drafting.
4	Application of Theoretical Knowledge	Strong foundation in the relevant engineering principles.
5	Team Collaboration	Experience in group projects and collaborative learning environments.

2. Competencies

S/L	Competency	KSA Description
1	Project Execution	**Knowledge:** Understanding of project planning, scheduling, and resource management. **Skill:** Ability to carry out practical work systematically and efficiently. **Attitude:** Proactive and solution-oriented approach to problem-solving.
2	Data Analysis	**Knowledge:** Advanced knowledge of data analysis techniques. **Skill:** Proficiency in interpreting and analyzing experimental data. **Attitude:** Analytical mindset with a focus on accuracy.
3	Technical Communication	**Knowledge:** Mastery of technical documentation standards. **Skill:** Ability to draft comprehensive project reports. **Attitude:** Precision and clarity in communication.
4	Presentation Skills	**Knowledge:** Understanding of audience engagement techniques. **Skill:** Ability to deliver clear and impactful presentations. **Attitude:** Confidence and professionalism in public speaking.
5	Collaboration	**Knowledge:** Awareness of effective teamwork strategies. **Skill:** Ability to work collaboratively in multidisciplinary teams. **Attitude:** Respect and openness to diverse perspectives.

3. Project Timeline

S/L	Timeline	Description
1	Week 1-2	Review of problem statement and project plan; setting milestones.
2	Week 3-4	Experimental setup and initial trials.
3	Week 5-6	Data collection and analysis; troubleshooting.
4	Week 7-8	Progress review and mid-term evaluation.
5	Week 9-10	Refinement of experiments and final data analysis.
6	Week 11-12	Drafting the final report.
7	Week 13-14	Presentation preparation and practice.
8	Week 15	Final project presentation and submission of the report.

4. Course Objectives

- To execute the project work based on the defined problem statement.
- To develop skills in practical application, experimentation, and analysis.
- To enhance project management, report writing, and presentation skills.

1. Assessment Details (both CIE and SEE)

CIE procedure for Project Work Phase-II:

(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 Phase-II: 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.

6. Learning Objectives

S/L	Learning Objectives	Description
1	To execute the project plan effectively.	Students will apply their theoretical knowledge to practical tasks, managing the project from start to finish.
2	To analyze data and refine project outcomes.	Students will enhance their skills in data interpretation and problem-solving.
3	To document and present the project work comprehensively.	Students will develop a final report and presentation that reflects their project work accurately.

7. Course Outcomes (COs) and Mapping with POs/ PSOs

Course Outcomes (COs)

COs	Description
M23BCD707.1	Successfully execute the project plan and achieve the defined objectives.
M23BCD707.2	Analyze and interpret experimental data to derive meaningful conclusions.
M23BCD707.3	Demonstrate the ability to apply engineering and management principles effectively within a team, managing project timelines, resources, and deliverables to achieve project goals.
M23BCD707.4	Prepare and present a comprehensive project report.

CO-PO-PSO Mapping

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
M23BCD707.1			3		3				3		3		3	3
M23BCD707.2	3	3		3		3					3		3	3
M23BCD707.3			3				3						3	3
M23BCD707.4								3		3	3	3	3	3
M23BCD707	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**

8. Future with this Subject

This phase solidifies the student's ability to independently execute complex engineering projects. The experience gained here is directly transferable to their future academic endeavors, and professional roles in engineering.

8th Semester	Seminar (SR) TECHNICAL SEMINAR	M23BCD803

1. Prerequisites

S/L	Proficiency	Prerequisites
1	Research and Information Gathering	Familiarity with academic research and access to digital libraries or databases.
2	Content Organization and Report Writing	Basic knowledge of report writing, including the use of Microsoft Word, equation editors, and drawing tools.
3	Technical Presentation Skills	Experience with PowerPoint or other presentation software, as well as fundamental public speaking skills.
4	Critical Thinking and Discussion	Experience in group discussions and the ability to analyze and critique technical content.
5	Originality and Integrity in Work	Understanding the importance of originality in academic work.

2. Competencies

S/L	Competency	KSA Description
1	Effective Research and Literature Review	**Knowledge:** Familiarity with technical literature, research databases, and citation practices. **Skill:** Ability to conduct a thorough literature review and identify key sources of information. **Attitude:** Curiosity and a proactive approach to learning.
2	Report Writing and Documentation	**Knowledge:** Understanding of technical writing formats, structure, and referencing. **Skill:** Proficiency in using word processors, equation editors, and drawing tools to create clear and concise reports. **Attitude:** Attention to detail and commitment to producing high-quality, original work.
3	Presentation and Communication	**Knowledge:** Understanding of effective communication techniques and presentation design. **Skill:** Ability to deliver clear, engaging presentations using visual aids. **Attitude:** Confidence and professionalism in public speaking.
4	Critical Engagement and Discussion	**Knowledge:** Familiarity with group discussion dynamics and debate techniques. **Skill:** Ability to engage with peers, ask relevant questions, and respond thoughtfully to feedback. **Attitude:** Openness to different viewpoints and willingness to engage in constructive criticism.
5	Ethical Standards and Academic Integrity	**Knowledge:** Understanding of the principles of academic honesty and the consequences of plagiarism. **Skill:** Ability to produce original work and properly cite all sources. **Attitude:** Integrity and responsibility in academic work.

3. Syllabus Timeline

S/L	Timeline	Description
1	**Week 1-2:** Topic Selection and Literature Review	Students will select a seminar topic relevant to their specialization and conduct a literature review to gather information.
2	**Week 3-4:** Content Organization and Report Drafting	Organize the gathered information into a coherent structure and begin drafting the seminar report.
3	**Week 5:** Report Writing and Formatting	Focus on refining the report, ensuring proper formatting, citation, and use of tools like equation editors and drawing tools.
4	**Week 6:** Presentation Preparation	Prepare the PowerPoint slides and practice the oral presentation, focusing on clarity and engagement.
5	**Week 7:** Seminar Presentation and Discussion	Deliver the seminar presentation, engage in a Q&A session, and participate in group discussions.
6	**Week 8:** Report Submission and Final Evaluation	Submit the final report and undergo a comprehensive evaluation by the faculty committee.

4. Assessment Details

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 Technical Seminar shall be based on the evaluation of the report, presentation skill, and question and answer session in the ratio of 50:25:25.

5. Learning Objectives

S/L	Learning Objectives	Description
1	Conduct In-Depth Research on a Technical Topic	Students will learn to independently research a technical topic, gather and analyse information, and synthesize it into a coherent understanding.
2	Develop and Deliver a Technical Presentation	Students will gain experience in creating and delivering professional technical presentation, enhancing their communication skills.
3	Engage in Technical Discussions and Debates	Students will enhance their critical thinking and discussion skills by engaging with peers in technical debates.
4	Prepare a Detailed Technical Report	Students will learn to write a detailed, well-organized technical report, ensuring proper citation and originality.

6. Course Outcomes (COs) and Mapping with POs/ PSOs

Course Outcomes (COs)

COs	Description
M23BCD803.1	Conduct comprehensive research and organize technical content for a seminar presentation.
M23BCD803.2	Prepare and deliver a clear and engaging technical presentation using appropriate tools and techniques.
M23BCD803.3	Engage in technical discussions, respond to queries, and participate in group debates effectively.
M23BCD803.4	Produce a well-structured, original technical report with proper citations and references.

CO-PO-PSO Mapping

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
M23BCD803.1	**3**	-	-	-	-	-	-	-	-	-	-	-	**3**	**3**
M23BCD803.2	-	**3**	-	-	-	-	-	-	-	-	-	-	**3**	**3**
M23BCD803.3	-	-	**3**	-	-	-	-	-	-	-	-	-	**3**	**3**
M23BCD803.4	-	-	-	**3**	-	-	-	-	-	-	-	-	**3**	**3**
M23BCD803	**3**	**3**	**3**	**3**	-	-	-	-	-	-	-	-	**3**	**3**

8th Semester	Internship (IS) INTERNSHIP	M23BCD804

1. Prerequisites

S/L	Proficiency	Prerequisites
1	Understanding of fundamental concepts in the chosen field of study.	Successful completion of core courses related to the field of study.
2	Ability to analyze and solve complex problems using discipline-specific methodologies.	Analytical and problem-solving skills gained through prior coursework and lab work.
3	Capability to conduct independent research or work effectively within an industrial setup.	Experience with project-based learning or relevant coursework that involved team collaboration.
4	Communication and technical writing for the preparation of reports and presentations.	Courses in communication skills and technical writing.
5	Understanding of ethical, social, and environmental responsibilities in professional practices.	Knowledge of professional ethics and sustainable practices.

1. Competencies

S/L	Competency	KSA Description
1	Research Methodology	**Knowledge:** Understanding of current research trends and methodologies in the chosen field. **Skill:** Ability to design and conduct experiments or studies, analyze data, and draw conclusions. **Attitude:** Curiosity and commitment to scientific inquiry and continuous learning.
2	Practical Application	**Knowledge:** Familiarity with industry standards and practical applications of theoretical concepts. **Skill:** Ability to apply theoretical knowledge to solve real-world problems in an industrial or rural context. **Attitude:** Adaptability and willingness to learn from real-world experiences.
3	Presentation and Communication	**Knowledge:** Understanding of effective communication techniques and presentation design. **Skill:** Ability to deliver clear, engaging presentations using visual aids. **Attitude:** Confidence and professionalism in public speaking.
4	Communication and Presentation	**Knowledge:** Techniques for effective communication, both written and oral. **Skill:** Ability to prepare and present technical reports and presentations. **Attitude:** Confidence in public speaking and openness to feedback.
5	Teamwork and Collaboration	**Knowledge**: Principles of team dynamics and collaborative working. **Skill**: Ability to work effectively as part of a team, contributing to shared goals. **Attitude**: Cooperative mindset and respect for diverse perspectives.
6	Professionalism and Ethics	**Knowledge**: Understanding of professional ethics and legal responsibilities. **Skill**: Ability to make ethical decisions and demonstrate professional behavior in all activities. **Attitude**: Integrity and responsibility in professional conduct.

2. Assessment Details

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/Mentor. The CIE marks awarded for the Internship shall be based on the evaluation of the report, presentation skill, and question and answer session in the ratio of 50:25:25.

3. Learning Objectives

S/L	Learning Objectives	Description
1	Understand and Apply Research Methodologies or Industry Practices	Students will gain an understanding of current research methodologies in their chosen field or industry practices in the professional setting. They will learn how to apply these methodologies or practices to real-world problems, fostering their ability to conduct independent research or contribute effectively in an industrial environment.
2	Develop Problem-Solving Skills in Real-World Contexts	Students will enhance their problem-solving abilities by working on practical issues encountered in research, industry, or rural settings. They will learn to analyze complex problems, develop viable solutions, and implement them effectively.
3	Improve Communication and Technical Writing Skills	Students will refine their communication skills, both in writing and orally. They will learn how to prepare clear and concise technical reports and deliver presentations that effectively communicate their findings and ideas to diverse audiences.
4	Foster Teamwork and Collaborative Skills	Through collaborative projects, students will develop their ability to work effectively in teams. They will learn how to contribute to group efforts, manage interpersonal dynamics, and achieve shared goals in a professional environment.
5	Cultivate Professionalism and Ethical Responsibility	Students will understand the importance of professionalism and ethical behavior in their work. They will learn to make responsible decisions that consider the broader social, environmental, and ethical implications of their actions.

5. Course Outcomes (COs) and Mapping with POs/ PSOs

Course Outcomes (COs)

COs	Description
M23BCD804.1	Demonstrate the ability to apply research methodologies or industry practices to solve complex problems in a real-world context.
M23BCD804.2	Develop and implement effective solutions to technical challenges encountered during the internship, showcasing problem-solving skills.
M23BCD804.3	Communicate technical information clearly and effectively through well-structured reports and presentations.
M23BCD804.4	Demonstrate knowledge and understanding of engineering and management principles, applying them in a team to manage projects in multidisciplinary environments.

CO-PO-PSO Mapping

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
M23BCD804.1	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**3**
M23BCD804.2	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**		**3**
M23BCD804.3	**-**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**3**
M23BCD804.4	**-**	**-**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**3**
M23BCD804	**3**	**3**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**3**