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MAHARAJA INSTITUTE OF TECHNOLOGY MYSORE

Autonomous Institution Affiliated to VTU

Competency Based Syllabus (CBS)

For

Computer Science & Engineering (AI)

(Under Outcome Based Education (OBE) and

Choice-Based Credit System (CBCS))

Offered from 5th to 6th Semesters of Study

in

Partial Fulfillment for the Award of Bachelor's Degree in

Computer Science & Engineering (AI)

2023 Scheme

Scheme Effective from the academic year 2023-24

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5th Semester	Professional Course (PC) Machine Learning	M23BCA501

1. Prerequisites

S/L	Proficiency	Prerequisites
1.	Basic Mathematics	• Foundation in linear algebra (vectors, matrices, linear transformations). • Good understanding of calculus (derivatives, integrals, optimization). • Familiarity with probability and statistics (probability distributions, hypothesis testing).
2.	Programming	• Proficiency in at least one programming language commonly used for machine learning (Python, R). • Experience with data structures and algorithms. • Basic understanding of software engineering principles (code organization, debugging).
3.	Working with Data using Pandas	• Loading data from files (CSV, etc.) • Dataframe manipulation (selecting columns, filtering rows, adding/removing data) • Handling missing values.

2. Competencies

S/L	Competency	KSA Description
1	Data Exploration and Preparation	• Knowledge: Understanding various data types, data quality issues, and data pre-processing techniques. • Skills: Ability to clean, transform, and prepare data for machine learning algorithms. • Attitudes: Appreciation for the importance of high-quality data.
2	Supervised Learning Algorithms	• Knowledge: Understanding the principles of supervised learning, including regression and classification algorithms (linear regression, logistic regression, decision trees, support vector machines). • Skills: Ability to apply, evaluate, and tune these algorithms. • Attitudes: Critical thinking in model selection and evaluation.
3	Unsupervised Learning and Dimensionality Reduction	• Knowledge: Understanding clustering and dimensionality reduction techniques (k-means, PCA). • Skills: Ability to apply these methods for data exploration and feature engineering. • Attitudes: Openness to exploring data patterns and reducing data complexity.
4	Model Evaluation and Selection	• Knowledge: Understanding metrics for evaluating model performance (accuracy, precision, recall, F1-score, ROC curves). • Skills: Ability to compare models, perform cross-validation, and select the best model for a given task. • Attitudes: Objectivity in model assessment.
5	Ethical Considerations in Machine Learning	• Knowledge: Awareness of ethical implications, bias in data, and fairness considerations. • Skills: Ability to identify and mitigate bias in machine learning models. • Attitudes: Responsibility and a commitment to ethical AI practices.

3. Syllabus

Machine Learning **SEMESTER – V**			
Course Code	**M23BCA501**	**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 Theory**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Course Objectives:

1. Introduce the fundamental concepts and principles of machine learning.
2. Provide hands-on experience with commonly used machine learning algorithms.
3. Develop skills in data pre-processing, feature engineering, model building, evaluation, and selection.
4. Foster critical thinking about the ethical implications of machine learning.
5. Prepare students to apply machine learning techniques to real-world problems.

Module -1 **(8 hours)**

Machine Learning and Data Essentials: Introduction to Machine Learning, Machine Learning Explained, Machine Learning in Relation to Other Fields, Types of Machine Learning, Challenges of Machine Learning, Machine Learning Process, Machine Learning Applications, What is Data?, Big Data Analytics and Types of Analytics, Big Data Analysis Framework.
Chapter 1 (All Sections), Chapter 2 (Sections 2.1, 2.2, 2.3)

Module -2 **(8 hours)**

Data Analysis and Learning Foundations: Descriptive Statistics, Univariate Data Analysis and Visualization, Bivariate Data and Multivariate Data, Essential Mathematics for Multivariate Data, Introduction to Learning and its Types.
Chapter 2 (Sections 2.4, 2.5, 2.6, 2.7, 2.8), Chapter 3 (Section 3.1)

Module -3 **(10 hours)**

Regression and Supervised Learning
Introduction to Computation Learning Theory, Design of a Learning System, Introduction to Concept Learning, Induction Biases, Modeling in Machine Learning, Learning Frameworks, Introduction to Regression, Introduction to Linearity, Correlation, and Causation, Introduction to Linear Regression, Validation of Regression Methods.
Chapter 3 (Sections 3.2, 3.3, 3.4, 3.5, 3.6, 3.7), Chapter 5 (Sections 5.1, 5.2, 5.3, 5.4)

Module -4 **(8 hours)**

Advanced Supervised Learning and Bayesian Principles: Multiple Linear Regression, Polynomial Regression, Logistic Regression, Ridge, Lasso, and Elastic Net Regression, Introduction to Decision Tree Learning Model, Decision Tree Induction Algorithms, Introduction to Probability-based Learning, Fundamentals of Bayes Theorem, Classification Using Bayes Model, Introduction to Ensemble Learning, Ensembling Techniques, Parallel Ensemble Models.
Chapter 5 (Sections 5.5, 5.6, 5.7, 5.8), Chapter 6 (Sections 6.1, 6.2), Chapter 8 (Sections 8.1, 8.2, 8.3), Chapter 12 (Sections 12.1, 12.2).

Module -5 **(6 hours)**

Unsupervised Learning, Reinforcement Learning, and Beyond: Introduction to Clustering Approaches, Proximity Measures, Hierarchical Clustering Algorithms, Partitional Clustering Algorithm, Overview of Reinforcement Learning, Scope of Reinforcement Learning, Reinforcement Learning As Machine Learning, Probabilistic Graphical Models, Artificial Neural Networks, Support Vector Machines, Genetic Algorithms, Deep Learning.
Chapter 13 (Sections 13.1, 13.2, 13.3, 13.4), Chapter 14 (Sections 14.1, 14.2, 14.3), Overview of Chapters 9, 10, 11, 15, 16.

TEXTBOOK:

1. S. Sridhar, M Vijayalakshmi "Machine Learning". Oxford, 2021.
2. Hands-On Machine Learning with Scikit-Learn, Keras & TensorFlow by Aurélien Géron, O'Reilly Media, 2019.

REFERENCE BOOKS:

1. Tom Michel, Machine Learning, McGrawHill Publication.
2. Introduction to Machine Learning, Fourth Edition By Ethem Alpaydin.

VIDEO LINKS:

1. Machine Learning Course by Andrew Ng (Stanford CS229): https://www.youtube.com/playlist?list=PLoROMvodv4rMiGQp3WXShtMGgzqpfVfbU

2. Blue1Brown - Essence of Linear Algebra & Calculus:
Linear Algebra:
https://www.youtube.com/playlist?list=PLZHQObOWTQDPD3MizzM2xVFitgF8hE_ab
Calculus: https://www.youtube.com/playlist?list=PLZHQObOWTQDMsr9K-rj53DwVRMYO3t5Yr
3. StatQuest with Josh Starmer (YouTube Channel): https://www.youtube.com/user/joshstarmer.

4. Syllabus Timeline

S/L	Syllabus Timeline	Description
1	Week 1-2:	Introduction to ML, Types of Learning, Applications, Data Types, Descriptive Statistics, Visualization (Modules 1 & 2, introductory portions).
2	Week 3-4:	Regression Analysis: Linear, Multiple Linear, Polynomial, Model Evaluation (Module 3).
3	Week 5-6:	Classification with Logistic Regression, Regularization, Bias-Variance Tradeoff (Module 3 & 4 - introductory part).
4	Week 7-8:	Decision Trees, Ensemble Methods (Bagging, Random Forests), Evaluating Classifiers (Module 4)
5	Week 9-10:	Unsupervised Learning: Clustering (k-means), Dimensionality Reduction (PCA), Applications (Module 5)
6	Week11-12:	Reinforcement Learning Fundamentals, Applications, Introduction to Advanced Topics: Probabilistic Graphical Models, Neural Networks, Support Vector Machines, Genetic Algorithms, Deep Learning (Module 5 & Overviews)

5. Teaching-Learning Process Strategies

S/L	TLP Strategies:	Description
1	Lecture Method	Deliver core concepts and foundational knowledge, interactive discussions.
2	Code Demonstrations	In-class coding examples using Python and relevant ML libraries (like scikit-learn) to illustrate algorithm implementation and data analysis techniques.
3	Project-Based Learning	Hands-on projects where students apply ML to datasets and solve real-world inspired problems.
4	Case Studies	Analyze real-world applications of machine learning to understand its impact and challenges.
5	Group Discussions	Facilitate critical thinking and encourage collaborative learning through discussions on ethical considerations, future trends, and current events in AI/ML.
6	Guest Lectures	Invite industry experts to provide insights into practical applications and career paths in Machine Learning.

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 20 marks. 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	Data Understanding and Preparation for Machine Learning	Comprehend data types, data quality issues, and learn data preprocessing techniques for effective machine learning.
2	Supervised Learning Concepts and Algorithms	Understand the principles of supervised learning, including regression and classification algorithms. Be able to apply, evaluate, and tune these algorithms for predictive modeling.
3	Unsupervised Learning Techniques	Grasp the concepts of clustering, dimensionality reduction, and their applications in data exploration and feature engineering. Be able to apply common methods like k-means and PCA.
4	Model Evaluation, Selection, and Performance Metrics	Learn various metrics for evaluating model performance and be able to compare and select the best model for a given task using techniques like cross-validation.
5	Ethical Implications and Applications of Machine Learning	Develop an understanding of the ethical implications of machine learning, including bias in data, fairness considerations, and responsible AI development practices.
6	Future Trends and Advanced Topics in Machine Learning	Gain awareness of current trends, emerging technologies, and advanced topics in machine learning to foster continuous learning and exploration in the field.

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

Course Outcomes (COs)

COs	Description
M23BCS501.1	Understand the fundamental concepts of machine learning, its types, applications, and the ethical implications of its use.
M23BCS501.2	Apply data preprocessing techniques and perform exploratory data analysis to prepare data for machine learning algorithms.
M23BCS501.3	Implement unsupervised learning techniques for clustering and dimensionality reduction.
M23BCS501.4	Build, evaluate, and compare supervised learning models for regression and classification tasks.
M23BCS501.5	Analyze and interpret the results of machine learning models and communicate findings effectively.

CO-PO-PSO Mapping

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
M23BCS501.1	2												3	
M23BCS501.2		3												3
M23BCS501.3			3		3									
M23BCS501.4				3	3									3
M23BCS501.5				3						3			3	
M23BCS501	**2**	**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:

1. Deep Learning Specialization: The knowledge gained here primes you to explore the fascinating world of deep learning (CNNs, RNNs, Transformers). Imagine designing algorithms for self-driving cars, medical image analysis, or even writing creative text—all made possible with deep learning and highly relevant to your future careers.
2. MLOps (Machine Learning Operations): Building ML models is just the start. MLOps focuses on deploying, managing, and scaling those models to real-world applications, a crucial skill for ML engineers and data scientists.
3. Explainable AI (XAI): As AI makes more decisions, understanding why becomes paramount. XAI techniques, which focus on interpreting model behavior, are essential for building trust and ensuring ethical AI development, especially in sensitive fields like healthcare and finance.
4. Edge Computing and IoT: The future is interconnected. By integrating ML with edge devices and the Internet of Things (IoT), you can create intelligent systems that react in real-time – from smart homes and factories to autonomous vehicles, creating massive career opportunities in the process.
5. Reinforcement Learning Applications: Imagine teaching robots to learn like humans. Reinforcement learning makes this possible and is poised to revolutionize fields like robotics, control systems, and personalized learning experiences.
6. Generative AI: This rapidly advancing field uses models like GANs and diffusion models to create stunningly realistic images, videos, and even music, blurring the lines between human and machine creativity and opening exciting career paths for those with the right ML skills.

Job Prospects:

Thriving in a High-Demand Field: ML expertise is highly sought after across industries. This course equips you with in-demand skills, paving the way for careers as Machine Learning Engineers, Data Scientists, AI Specialists, and more.

1. Solving Real-World Challenges: From optimizing manufacturing processes and developing intelligent systems to revolutionizing healthcare and transportation, ML skills are driving innovation. Your expertise will be invaluable in tackling these challenges.
2. Future-Proofing Your Career: ML is constantly evolving, and a strong foundation ensures you can adapt to new advancements. This course equips you with the tools and mindset to stay ahead of the curve and thrive in a dynamic job market.

5th Semester	Integrated Professional Course(IPC) Computer Network and Security	M23BCS502

1. Prerequisites

S/L	Proficiency	Prerequisites
1	Basic Computer Science Knowledge	Basic Computer Science Knowledge: Programming Skills: Familiarity with programming languages such as Python, C, or Java is essential for scripting and automation tasks. Operating Systems: Understanding of operating system concepts, including process management, memory management, and file systems. Data Structures and Algorithms: Knowledge of basic data structures (e.g., arrays, lists, trees) and algorithms (e.g., sorting, searching) is important for problem-solving and optimization.
2	Networking Fundamentals	OSI and TCP/IP Models: Understanding the OSI model and the TCP/IP stack, including the functions of different layers (physical, data link, network, transport, and application). IP Addressing and Sub-netting: Knowledge of IP address formats (IPv4 and IPv6), subnet masks, and how to perform sub-netting and address allocation. Network Protocols: Familiarity with key protocols such as HTTP, FTP, TCP, UDP, DNS, and DHCP. Routing and Switching: Understanding of how routers and switches operate, including basic routing algorithms and protocols like RIP, OSPF, and BGP.
3	Network Devices and Technologies	Network Devices: Knowledge of different network devices such as routers, switches, firewalls, and access points. Wireless Technologies: Understanding of wireless networking principles, including Wi-Fi standards and security measures.
4	Cyber-security Basics	Security Principles: Awareness of core security principles, including confidentiality, integrity, and availability. Common Threats and Attacks: Knowledge of common types of cyber -attacks, such as phishing, malware, ransom-ware, and denial-of-service (DoS) attacks. Cryptography: Basic understanding of cryptographic concepts like encryption, decryption, hashing, and digital signatures.
5	Network Security Fundamentals	Firewalls and Intrusion Detection Systems (IDS): Familiarity with how firewalls and IDS/IPS (Intrusion Prevention Systems) function and are configured. VPNs and Encryption: Understanding of Virtual Private Networks (VPNs) and encryption protocols used to secure network communications. Access Control: Knowledge of access control methods, including authentication, authorization, and accounting (AAA).
6	Hands-On Experience	Lab Practice: Practical experience with network configuration, management, and troubleshooting using tools like Cisco Packet Tracer or GNS3. Security Tools: Familiarity with security tools and techniques, such as network scanners (N-map), penetration testing tools (Metasploit), and security information and event management (SIEM) systems.

2. Competencies

S/L	Competency	KSA Description
1	**Application protocols**	**Knowledge:** Understand the basic functions of application protocols **Skills**: know the service provided by the DNS,HTTP,FTP **Attitudes:** Appreciation for the versatility of application protocols and distributed services.
2	**Transport layer**	**Knowledge:** Data volume, destination, and rate are all controlled by transport-layer protocols including TCP, UDP, DCCP, and SCTP. **Skills:** the transport layer receives the packets, sorts them, and looks for faults. Subsequently, Enable efficient network transmission, **Attitudes:** Provide the communication services directly to the application processes running on different hosts
3	**Network layers**	**Knowledge:** The main job of this layer is to maintain the quality of the data and pass and transmit it from its source to its destination. There are several important protocols that work in this layer. **Skills:** Selects the best path to transfer the data from source to its destination.

		Attitudes: The network layer performs packetization on the data. This makes it easier to transmit the data packets in the network.
4	**Security services and attacks**	**Knowledge:** Mechanisms used to provide confidentiality, identity authentication, integrity authentication, source authentication, and/or support the non-repudiation of information. **Skills:** A mechanism that is designed to detect, prevent, or recover from a security attack. Security Service: A service that enhances the security of data processing systems and information transfers **Attitudes:** The versatility of security guards across various sectors—from retail to construction, events, and VIP protection, offering specialized services that go beyond general surveillance.
5	**Cryptography**	**Knowledge:** There are two main types of cryptography used for digital data and secure messages today: symmetric cryptography and asymmetric cryptography. Hash functions, a third type, doesn't involve use of a key **Skills:** Basically to protect their privacy and keep their conversations and data confidential. Cryptography ensures confidentiality by encrypting sent messages using an algorithm with a key only known to the sender and recipient. **Attitudes:** By employing cryptographic techniques, data security applications help to protect various everyday transactions, ranging from file sharing within business networks to online apps used for banking or shopping.
6	**Cloud computing and its security**	**Knowledge:** Associated with cloud computing and determine the best security measures for protecting data with cloud security models. **Skills: 1)** Identify sensitive or regulated data. 2) Understand how sensitive data is being accessed and shared. 3) Discover shadow IT (unknown cloud use). **Attitudes:** Cloud computing gives your business more flexibility. You can quickly scale resources and storage up to meet business demands without having to invest in physical infrastructure.
7	**Transport level security**	**Knowledge:** Internet Engineering Task Force (IETF) standard protocol that provides authentication, privacy and data integrity between two communicating computer applications. **Skills:** Transport Security Layer (TLS) is the successor of the Secure Socket Layer (SSL); both are security protocols and are sometimes used interchangeably. **Attitudes:** TLS is usually implemented on top of **TCP** (Transmission Control Protocol) which further encrypts Application Layer protocols such as FTP, SMTP, and HTTP. However, it can be implemented on DCCP, UDP, and SCTP
8	**Web security**	**Knowledge:** Provides protection for web applications against attacks, including cross-site scripting, file inclusion, cross-site forgery, Structured Query Language (SQL) injection, and other threats. **Skills:** A web application firewall (WAF) protects web applications by monitoring and filtering internet traffic that flows between an application and the internet. In this way, a WAF works as a secure web gateway (SWG). **Attitudes:** Web scanning involves using an application to crawl a website in search for vulnerabilities that can leave it open to a bot, spyware, rootkit, Trojan horse, or distributed denial-of-service (DDoS) attack, It then systematically checks the entire site for potential weaknesses.
9	**IP security**	**Knowledge:** unique identifying number assigned to every device connected to the internet. **Skills:** To protect network data by setting up circuits using IPsec tunnelling in which all data being sent between the two endpoints is encrypted, as with a Virtual Private Network (VPN) connection. **Attitudes:** IP Security is a versatile and widely adopted security protocol used in various network scenarios, including site-to-site VPNs, remote access VPNs, and secure communication between network devices.

3. Syllabus

Computer Network and Security **SEMESTER – V**			
Course Code	**M23BCS502**	CIE Marks	**50**
Number of Lecture Hours/Week(L: T: P: S)	**(2:2:2:0)**	SEE Marks	**50**
Total Number of Lecture Hours	**40 hours Theory**	Total Marks	**100**
Credits	**04**	Exam Hours	**03**

Course Objectives:

1. To understand network application architectures and the many types of service protocols such as HTTP, SMTP, FTP, and DNS
2. Analyze how the transport layer responds to network and application requests with various services and functions such as TCP and UDP.
3. To analyze the network layer and how it is related to routing and securitbetween two data sets and its protocols, broadcast and multicast path.
4. Analyze security services and attacks by using data encryption and decryption techniques with the use of symmetric and asymmetric algorithms.
5. Apply and analyze the access control and network security like cloud security. Transport layer security, web security and IP security.

Module -1

Application Layer: Principles of Network Applications: Network Application Architectures, Processes Communicating, Transport Services Available to Applications, Transport Services Provided by the Internet, Application-Layer Protocols. The Web and HTTP: Overview of HTTP, Non-persistent and Persistent Connections, HTTP Message Format, User-Server Interaction: Cookies, Web Caching, The Conditional GET, File Transfer: FTP Commands & Replies, Electronic Mail in the Internet: SMTP, Comparison with HTTP, Mail Message Format, Mail Access Protocols, DNS; The Internet's Directory Service: Services Provided by DNS, Overview of How DNS Works, DNS Records and Messages, Peer-to-Peer Applications: P2P File Distribution, Distributed Hash Tables.**Textbook 1: chapter 2.1 to 2.6**

Module -2

Transport Layer :
Introduction and Transport-Layer Services: Relationship Between Transport and Network Layers, Overview of the Transport Layer in the Internet, Multiplexing and De-multiplexing: Connectionless Transport: UDP,UDP Segment Structure, UDP Checksum, Principles of Reliable Data Transfer: Building a Reliable Data Transfer Protocol, Pipelined Reliable Data Transfer Protocols, Go-Back-N, Selective repeat, Connection-Oriented Transport TCP: The TCP Connection, TCP Segment Structure, Round-Trip Time Estimation and Timeout, Reliable Data Transfer, Flow Control, TCP Connection Management.
Textbook 1: Chapter 3.1 to 3.5

Module -3

The Network layer:
What's Inside a Router? Input Processing, Switching, Output Processing, Where Does Queuing Occur? Routing control plane, IPv6,A Brief foray into IP Security, Routing Algorithms: The Link-State (LS) Routing Algorithm, The Distance-Vector (DV) Routing Algorithm, Hierarchical Routing, Routing in the Internet, Intra-AS Routing in the Internet: RIP, Intra-AS Routing in the Internet: OSPF, Inter/AS Routing: BGP, Broadcast Routing Algorithms and Multicast.
Textbook1: Ch 4: 4.3-4.7

Module -4

Computer Security Concepts: The OSI Security Architecture, Security Attacks, Security Services.
Symmetric Ciphers: Symmetric Cipher Model, Substitution Techniques, Transposition Techniques.
Cryptosystem::Block Cipher and the Data Encryption Standard: The Data Encryption Standard, **Advanced Encryption Standard (AES)**: Finite Field Arithmetic ,AES Structure, **Public-Key Cryptography and RSA**: Principles of Public-Key Cryptosystems, The RSA Algorithm, Diffie-Hellman Key Exchange
Textbook 2: Ch 1.1 to 1.4, Ch 2.1 to 2.3, Ch 3.2, Ch 5.1 to 5.2,Ch 9.1 to 9.2,10.1

Module -5

Network access control and cloud security: IEEE 802.1X Port-Based Network Access Control ,Cloud Computing**,** Cloud Security Risks and Countermeasures, **Transport level security:** Web Security Considerations, Secure Sockets Layer, Transport Layer Security, **IP Security :**IP Security Overview
Textbook 2: Ch 16.4 to 16.5,Ch 17.1 to 17.3,Ch 20.1

PRACTICAL COMPONENT

1.	Implement Three nodes point – to – point network with duplex links between them for different

	topologies. 1Set the queue size, vary the bandwidth, and find the number of packets dropped for various iterations
2.	Implement simple ESS and with transmitting nodes in wire-less LAN by simulation and determine the throughput with respect to transmission of packets.
3.	Using TCP/IP sockets, write a client – server program to make the client send the file name and to make the server send back the contents of the requested file if present and implement the above program using as message queues or FIFOs as IPC channels
4.	Write a program on datagram socket for client/server to display the messages on Client side, typed at the server side.
5.	Implement transmission of ping messages/trace route over a network topology consisting of 6 nodes and find the number of packets dropped due to congestion in the network.
6.	Write a program to find the shortest path between vertices using bellman-ford algorithm.
7.	Write a program for simple RSA algorithm to encrypt and decrypt the data
8.	Implement and study the performance of GSM on NS2/NS3 (Using MAC layer) or equivalent environment.

TEXTBOOKS:

1. James F Kurose and Keith W Ross, Computer Networking, A Top-Down Approach, Sixth edition, Pearson,2017 .
2. Cryptography and Network Security: Principles and Practice, William Stallings, Pearson , Sixth Edition .(http://www.pearsonhighered.com/stallings/)

REFERENCE TEXTBOOK:

1. Computer-Networks- Andrew S.Tanenbaum and David J.Wetherall, Pearson Education, 5thEdition. (www.pearsonhighered.com/tanenbaum
2. Nader F Mir, Computer and Communication Networks, 2nd Edition, Pearson, 2014.

4. Syllabus Timeline

S/L	Syllabus Timeline	Description
1	Week 1-3: Application layer	**Competency:** Understand the basic functions of application protocols **Knowledge:** understand the various functions of application protocols process and service. **Skills**: know the service provided by the DNS,HTTP,FTP
2	Week 4-6: Transport layer	**Competency:** Understand the concept of transport layer and its segments and services **Knowledge:** Data volume, destination, and rate are all controlled by transport-layer protocols including TCP, UDP, DCCP, and SCTP. **Skills**: the transport layer receives the packets, sorts them, and looks for faults. Subsequently, Enable efficient network transmission.
3	Week 7-8: Network layer	**Competency:** Understand the concept of The network layer performs packetization on the data. This makes it easier to transmit the data packets in the network **Knowledge:** The main job of this layer is to maintain the quality of the data and pass and transmit it from its source to its destination. There are several important protocols that work in this layer. **Skills:** Selects the best path to transfer the data from source to its destination Knowledge.
4	Week 9-10: Computer security concepts and Cryptosystem	**Competency**: Understand the concept of security attacks and services and analyse the cryptanalysis and various security attacks **Knowledge:** Mechanisms used to provide confidentiality, identity authentication, integrity authentication, source authentication, and/or support the non-repudiation of information. **Skills**: A mechanism that is designed to detect, prevent, or recover from a security attack. Security Service: A service that enhances the security of data processing systems and information transfers
5	Week 11-12:	**Competency:** Analyses the network access control and various security

	Network access control and security concepts	concepts **Knowledge:** Unique identifying number assigned to every device connected to the internet. **Skills**: To protect network data by setting up circuits using IPsec tunnelling in which all data being sent between the two endpoints is encrypted, as with a Virtual Private Network (VPN) connection

5. Teaching-Learning Process Strategies

S/L	TLP Strategies:	Description
1	Lecture Method	Utilize various teaching methods within the lecture format to network layers and security.
2	Video/Animation	Incorporate visual aids like videos/animations to enhance understanding of network components and protocols.
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	Real-World Application	Discuss practical applications to connect theoretical concepts with real-world competencies.
6	Flipped Class Techniqu	Utilize a flipped class approach, providing materials before class to facilitate deeper understanding of competencies
7	Laboratory Learning	Utilize the facilities available in the laboratories to understand the process of network layers and protocols.

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:

1. 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.
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. The question paper may include at least one question from the laboratory component.
5. Marks scored will be proportionally scaled down to 50 marks.

7. Learning Objectives

S/L	Learning Objectives	Description
1	Application layer	Students should understand the fundamental principles, components, and functions of network layers, such as protocol mechanisms, processes, and file transformation through client-server interaction.
2	Transport layers	Learning how processes are created, scheduled, transmitted, and all layers are interrelated to each other and learning each mechanism of transport layer.
3	Network layers	Learn about the network layer and how it relates to routing and security between two data sets, as well as its protocols, broadcast and multicast paths, including the Routing Algorithm, the Distance-Vector (DV) Routing Algorithm, and hierarchical routing.
4	Security attacks services and Cryptosystem	Understand security services and attacks that use data encryption and decryption techniques based on symmetric and asymmetric algorithms.
5	Network access control and Various security concepts	Analyse access control and network security, including cloud security. Transport layer security, online security, and IP security issues covered include the OSI Security Architecture, symmetric and asymmetric algorithms, and other network access and security concepts.

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

Course Outcomes (COs)

COs	Description
M23BCS502.1	Understand and apply application layer, architecture and protocols.
M23BCS502.2	Analyse the transport layer services and UDP and TCP protocols.
M23BCS502.3	Develop the routers, IP and Routing Algorithms in network layer.
M23BCS502.4	Understand and evaluate the various security attacks, services, symmetric and asymmetric ciphers and standards.
M23BCS502.5	Design and develop the network access control and various security management.

CO-PO-PSO Mapping

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
M23BCS502.1	3	-	-	3	-	3	-	-	-	3	-	-	3	-
M23BCS502.2	-	3	-	3	-	3	-	-	-	3	-	-	-	3
M23BCS502.3	-	-	3	3	-	3	-	-	-	3	3	-	3	-
M23BCS502.4	-	-	-	3	-	3	-	-	-	3	3	-	-	3
M23BCS502.5	-	-	3	3	-	3	-	-	-	3	3	-	3	3
M23BCS502	**3**	**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:

- **Application layer**: Application layer protocols are the messaging protocols that these IoT devices used to transport data. Without application layer protocols, Internet of Things devices would have no means by which to share data and information either from device-to-device or from device-to-server.
- **Transport layer:** Some of the transport layer devices are, Gateways: In computer networking, a gateway is a component that is part of two networks, which use different protocols. The gateway is a protocol converter which will translate one protocol into the other. The transport layer provides a total end-to-end solution for reliable communications. TCP/IP relies on the transport layer to effectively control communications between two hosts. When an IP communication session must begin or end, the transport layer is used to build this connection
- **Network layer**: The scope of networking courses is very high and promising. The courses offered in the networking domain are the most in-demand and leading. Networking jobs are increasing, and so is the demand for Network Engineers. Dwell in the networking jobs in India and boost your career in the IT industry and emerging technologies shaping the future of networking:
- **5G Networks:** 5G technology is the most delinquent generation of mobile communication networks, providing faster speeds and enhanced dependability compared to earlier generations.
- **Computer Security Concepts and Crypto-system:** The future of cyber security is closely connected to quantum computing because quantum computers could change how we protect and use data. Right now, most of the ways we keep information safe in cyber security rely on the fact that some math problems are really hard for regular computers to solve.
- **Network access control and various security concepts**: Future NAC solutions will focus on improving user experience by implementing seamless authentication mechanisms, frictionless onboarding processes, and user-friendly interfaces for policy management and self-service capabilities. The NAC can also provide endpoint security protection such as antivirus software, firewall, and vulnerability assessment with security enforcement policies and system authentication methods.

5th Semester	Professional Course (PC) DATA SCIENCE	M23BCA503

1. Prerequisites

S/L	Proficiency	Prerequisites
1	**Programming Fundamentals**	Students should have a solid understanding of programming concepts, particularly in Python, as it is widely used in data science for data manipulation, analysis, and machine learning. Knowledge of data structures (e.g., lists, dictionaries) and control structures (e.g., loops, conditionals) is essential.
2	**Basic Mathematics**	A strong foundation in mathematics, especially in linear algebra, calculus, and discrete mathematics. Understanding matrices, vectors, derivatives, and basic algebraic operations will be crucial for grasping machine learning algorithms and concepts like PCA and SVD.
3	**Introduction to Statistics**	Students should be familiar with basic statistical concepts such as mean, median, variance, probability distributions, and hypothesis testing. This knowledge is vital for understanding statistical inference, model fitting, and the core principles of data science.
4	**Fundamentals of Probability**	Knowledge of probability theory, including conditional probability, Bayes' theorem, and probability distributions, is essential. This will help students understand the statistical underpinnings of many data science algorithms, such as Naive Bayes

2. Competencies

S/L	Competency	KSA Description
1	**Introduction to Data Science**	**Knowledge:** Understanding the definition, scope, and significance of Data Science. Awareness of the current landscape, including Big Data, datafication, and the skills required in Data Science. **Skills:** Ability to articulate the role and impact of Data Science in various industries. Skill in identifying the different components of the Data Science workflow. **Attitudes:** Curiosity about the evolving field of Data Science and its applications. Appreciation for the interdisciplinary nature of Data Science, integrating statistics, mathematics, and domain knowledge.
2	**Exploratory Data Analysis and the Data Science Process**	**Knowledge:** Familiarity with the tools and techniques for Exploratory Data Analysis (EDA), including plots, graphs, and summary statistics. Understanding the philosophy of EDA and its role in the Data Science process. **Skills:** Proficiency in performing EDA to discover patterns, trends, and insights from data. Ability to apply simple machine learning algorithms to real-world case studies. **Attitudes:** A detail-oriented mindset, emphasizing careful examination and interpretation of data. An inquisitive attitude towards data exploration, always seeking to uncover deeper insights.
3	**Beams One More Machine Learning Algorithm and**	**Knowledge:** Understanding of Naive Bayes and its application in filtering spam. Awareness of why some algorithms (e.g., Linear Regression, k-NN) may not be suitable for certain tasks like spam filtering.

	Usage in Applications	**Skills:** Ability to choose appropriate machine learning algorithms for specific tasks, such as spam filtering. Proficiency in data wrangling, including extracting, cleaning, and transforming data from various sources. **Attitudes:** Critical thinking in evaluating the suitability of different algorithms for various applications.
4	**Feature Generation and Feature Selection**	**Knowledge:** Understanding the concepts and importance of feature generation and selection in machine learning. Knowledge of various feature selection algorithms, including Filters, Wrappers, Decision Trees, and Random Forests. **Skills:** Proficiency in brainstorming and generating relevant features from raw data, using domain knowledge and creative approaches. Ability to apply feature selection algorithms to improve model performance and interpretability. **Attitudes:** Creativity and imagination in the feature generation process, seeing possibilities in data that may not be immediately obvious.
5	**Recommendation Systems and Mining Social-Network Graphs**	**Knowledge:** Understanding the components of a recommendation engine, including algorithmic ingredients like collaborative filtering and content-based filtering. Knowledge of dimensionality reduction techniques such as Singular Value Decomposition (SVD) and Principal Component Analysis (PCA). **Skills:** Ability to design and develop a recommendation system using appropriate algorithms and dimensionality reduction techniques. **Attitudes:** Innovation in building user-facing data products that are intuitive and useful. A collaborative mindset, recognizing the interconnectedness of social networks and the value of understanding social structures.

3. Syllabus

DATA SCIENCE SEMESTER – V			
Course Code	**M23BCA503**	CIE Marks	**50**
Number of Lecture Hours/Week(L: T: P: S)	**(4:0:0:0)**	SEE Marks	**50**
Total Number of Lecture Hours	**40 hours Theory**	Total Marks	**100**
Credits	**04**	Exam Hours	**03**

Course Objectives:

1. Introduce fundamental concepts and techniques in data science.
2. Equip students with practical skills for data analysis, visualization, and machine learning.
3. Foster an understanding of real-world applications of data science, such as in recommendation systems and predictive modelling.
4. Prepare students for advanced study or careers in data science and related fields.

Module -1

Introduction to Data Science

Introduction: What is Data Science? Big Data and Data Science hype – and getting past the hype, Why now? Datafication, Current landscape of perspectives, Skill sets needed.

Statistical Inference: Populations and samples, Statistical modelling, probability distributions, fitting a model.

Module -2

Exploratory Data Analysis and the Data Science Process Basic tools (plots, graphs and summary statistics) of EDA, Philosophy of EDA, The Data Science Process, Case Study: Real Direct (online real estate firm). Three Basic Machine Learning Algorithms: Linear Regression, k-Nearest Neighbours (k- NN), k-means.
Module -3
One More Machine Learning Algorithm and Usage in Applications - Motivating application: Filtering Spam - Why Linear Regression and k-NN are poor choices for Filtering Spam - Naive Bayes and why it works for Filtering Spam - Data Wrangling: APIs and other tools for scrapping the Web.
Module -4
Feature Generation and Feature Selection (Extracting Meaning From Data) - Motivating application: user (customer) retention - Feature Generation (brainstorming, role of domain expertise, and place for imagination) - Feature Selection algorithms – Filters; Wrappers; Decision Trees; Random Forests.
Module -5
Recommendation Systems: Building a User-Facing Data Product - Algorithmic ingredients of a Recommendation Engine - Dimensionality Reduction - Singular Value Decomposition - Principal Component Analysis - Exercise: build your own recommendation system **Mining Social-Network Graphs** - Social networks as graphs - Clustering of graphs - Direct discovery of communities in graphs - Partitioning of graphs - Neighbourhood properties in graphs.
TEXTBOOKS: 1. Cathy O'Neil and Rachel Schutt. Doing Data Science, Straight Talk From The Frontline. O'Reilly. 2014. 2. Data Science for Business: What you need to know about data mining and data-analytic thinking by Foster Provost and Tom Fawcett, O'Reilly Media, 2013. **REFERENCE BOOKS:** 1. Jure Leskovek, Anand Rajaraman and Jeffrey Ullman. Mining of Massive Datasets. v2.1, Cambridge University Press. 2014. (free online). 2. Kevin P. Murphy. Machine Learning: A Probabilistic Perspective. ISBN 0262018020. 2013. 3. Python for Data Analysis by Wes McKinney, O'Reilly Media, 2017.

4. Syllabus Timeline

S/L	Syllabus Timeline	Description
1	Week 1-3:	**Introduction:** What is Data Science? Big Data and Data Science hype – and getting past the hype, Why now? Datafication, Current landscape of perspectives, Skill sets needed. **Statistical Inference:** Populations and samples, Statistical modelling, probability distributions, fitting a model.
2	Week 4-6:	**Exploratory Data Analysis and the Data Science Process** Basic tools (plots, graphs and summary statistics) of EDA, Philosophy of EDA, The Data Science Process, Case Study: Real Direct (online real estate firm). Three Basic Machine Learning Algorithms: Linear Regression, k-Nearest Neighbours (k- NN), k-means.
3	Week 8-11:	**One More Machine Learning Algorithm and Usage in Applications** - Motivating application: Filtering Spam - Why Linear Regression and k-NN are poor choices for Filtering Spam - Naive Bayes and why it works for Filtering Spam - Data Wrangling: APIs and other tools for scrapping the Web.
4	Week 7-8:	**Feature Generation and Feature Selection (Extracting Meaning From Data)** - Motivating application: user (customer) retention - Feature Generation (brainstorming, role of domain expertise, and place for imagination) - Feature Selection algorithms – Filters; Wrappers; Decision Trees; Random Forests.
5	Week 9-12:	**Recommendation Systems:** Building a User-Facing Data Product - Algorithmic ingredients of a Recommendation Engine - Dimensionality Reduction - Singular Value Decomposition - Principal Component Analysis -

		Exercise: build your own recommendation system **Mining Social-Network Graphs** - Social networks as graphs - Clustering of graphs - Direct discovery of communities in graphs - Partitioning of graphs - Neighbourhood properties in graphs.

5. Teaching-Learning Process Strategies

S/L	TLP Strategies:	Description
1	Lectures and Interactive Discussions	Provide clear, concise explanations of key concepts, theories, and algorithms in each module. Use visual aids, such as slides and diagrams, to enhance understanding.
2	Case Studies and Real-World Applications	Incorporate visual aids like videos/animations to enhance understanding of concepts. Incorporate case studies like the Real Direct example in Week 4 to demonstrate the application of data science concepts in real-world scenarios. This helps students see the relevance of what they are learning.
3	Collaborative Learning	Encourage collaborative learning for improved competency application.
4	Hands-On Labs and Practical Sessions	Include coding exercises where students implement algorithms and techniques discussed in lectures.
5	Project-Based Learning	Organize students into small groups to discuss complex topics, such as the ethical implications of data science

6. Assessment Details (both CIE and SEE)

Continuous Internal Evaluation:

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

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.

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 20 marks. 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	Master Core Concepts	Develop a strong foundation in the fundamental principles of Data Science, including Big Data, statistical inference, and necessary skills for data-driven problem-solving.
2	Apply Data Analysis	Learn to use various tools and methods for exploratory data analysis, feature

	Techniques	generation, and machine learning to extract meaningful insights from data.
3	Evaluate Machine Learning Models	Understand the advantages and limitations of different machine learning algorithms and feature selection methods in real-world applications.
4	Develop Data Wrangling Skills:	Acquire the ability to collect, clean, and prepare data using modern tools and techniques, ensuring data quality for analysis.
5	Build Recommendation Systems:	Gain hands-on experience in designing and implementing recommendation engines and other advanced data-driven products.
6	Explore Social Network Analysis	Study the structure and dynamics of social networks, including community detection and graph-based analysis techniques.

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

Course Outcomes (COs)

COs	Description
M23BCA503.1	**Understand** the fundamental principles of Data Science and **evaluate** the significance of Big Data and datafication on contemporary business and technology landscapes.
M23BCA503.2	**Apply** statistical modeling techniques to analyze data, including understanding and fitting probability distributions, and **evaluate** their effectiveness in solving data-driven problems.
M23BCA503.3	**Analyze** data using Exploratory Data Analysis (EDA) tools such as plots, graphs, and summary statistics, and **utilize** these tools to derive meaningful insights and guide further analysis.
M23BCA503.4	**Evaluate** the implementation and performance of basic machine learning algorithms, including Linear Regression, k-Nearest Neighbours (k-NN), k-means, and Naive Bayes, by assessing their effectiveness and limitations in various real-world scenarios.
M23BCA503.5	**Create** and **optimize** predictive models by generating relevant features, constructing recommendation systems, and **mining** social network graphs, to develop effective user-facing data products and solutions.

CO-PO-PSO Mapping

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
M23BCA503.1	3	-	-	-	-	-	-	-	-	-	-	-	3	3
M23BCA503.2	-	3	-	-	-	-	-	-	-	-	-	-	3	3
M23BCA503.3	-	-	3	3	-	-	-	-	-	-	-	-	3	3
M23BCA503.4	-	-	3	3	-	-	-	-	-	-	-	-	3	3
M23BCA503.5	**-**	**-**		-	3	-	-	-	3	-	-	-	3	3
M23BCA503	**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:

- **Deep Learning Innovations:** Expect further advancements in deep learning techniques, including more sophisticated neural networks and transfer learning methods that improve model performance and generalization.
- **AI Integration:** Data Science will increasingly integrate with artificial intelligence (AI) to develop advanced predictive models, autonomous systems, and intelligent data-driven solutions.
- **Enhanced Data Storage and Processing:** The growth of big data technologies and cloud computing will facilitate the storage, processing, and analysis of vast amounts of data. This will enable more complex analyses and real-time data processing.
- **Scalable Solutions:** Cloud platforms will offer scalable solutions for data science projects, making it easier for organizations to handle and analyze large datasets.
- **Stronger Data Privacy Regulations:** With growing concerns about data privacy, there will be a greater emphasis on ethical data collection, handling, and usage. Regulations and best practices will evolve to protect user privacy and ensure responsible data use.
- **Bias Mitigation:** Data scientists will focus on developing methods to detect and mitigate bias in data and algorithms, ensuring fair and equitable outcomes.

5th Semester	Professional Course Laboratory(PCL) Machine Learning Laboratory	M23BCAL504

1. Prerequisites

S/L	Proficiency	Prerequisites
1.	Foundational Programming in Python.	• Understanding data types (integers, floats, strings, lists, dictionaries) • Control flow (loops, conditional statements) • Functions, Basic file handling.
2.	Working with Data using Pandas	• Loading data from files (CSV, etc.) • Dataframe manipulation (selecting columns, filtering rows, adding/removing data) • Handling missing values.
3.	Data Visualization Basics	• Creating plots using Matplotlib or Seaborn (histograms, scatter plots, bar charts, etc.) • Customizing plots (labels, titles, legends).
4.	Core Mathematical Concepts	• Basic linear algebra (vectors, matrices, linear equations - at a conceptual level) • Basic probability and statistics (mean, variance, probability distributions, conditional probability).
5.	Introduction to Machine Learning Concepts.	• Understanding of the machine learning process (training data, testing data, model building, evaluation) • Familiarity with the types of machine learning (supervised, unsupervised).

2. Competencies

S/L	Competency	KSA Description
1	Data Fluency and Exploration	**Knowledge:** • Understanding of various data types (numerical, categorical, text) and their characteristics. • Awareness of data quality issues and common data cleaning techniques. • Familiarity with key descriptive statistics and visualization methods. **Skills:** • Ability to load, clean, transforms, and visualizes data using Python libraries like Pandas and Matplotlib/Seaborn. • Skill in identifying patterns, trends, and potential relationships within datasets. **Attitudes:** • Appreciation for the importance of data quality and its impact on ML model performance. • Curiosity and a data-driven mindset when approaching problems.
2	Supervised Learning Techniques	**Knowledge:** • Understanding of supervised learning principles, including regression and classification. • Familiarity with common algorithms: Linear Regression, Logistic Regression, Decision Trees, Random Forests. • Knowledge of model evaluation metrics (e.g., MSE, accuracy, precision, recall, F1-score). **Skills:** • Ability to build, train, and evaluate supervised learning models using scikit-learn or similar libraries. • Skill in tuning hyper parameters to optimize model performance. • Ability to interpret model results and communicate findings effectively. • **Attitudes:** • Critical thinking when selecting and evaluating models, considering bias-variance trade-offs.

3	Unsupervised Learning Techniques	**Knowledge:** • Understanding of clustering and dimensionality reduction techniques. • Familiarity with algorithms like k-Means Clustering and Principal Component Analysis (PCA). **Skills:** • Ability to apply clustering to discover patterns and group similar data points. • Skill in using dimensionality reduction to visualize high-dimensional data and improve model efficiency**.** **Attitudes:** • Openness to exploring data without predefined labels. • Understanding the value of uncovering hidden structures and relationships within data.
4	Reinforcement Learning Foundations	**Knowledge:** • Basic understanding of reinforcement learning concepts (agents, environments, rewards, policies). • Introduction to Q-learning or other fundamental RL algorithms. **Skills:** • Ability to implement a simple Q-learning agent in a simulated environment. **Attitudes:** • Interest in the potential of learning through trial and error.

3. Syllabus

Machine Learning Laboratory **SEMESTER – V**			
Course Code	**M23BCAL504**	CIE Marks	**50**
Number of Lecture Hours/Week(L: T: P: S)	**0:0:2:0**	SEE Marks	**50**
Total Number of Lecture Hours	**24 Hours Practical**	Total Marks	**100**
Credits	**01**	Exam Hours	**03**

Course Objectives:

1. Master fundamental machine learning concepts and algorithms across various paradigms (supervised, unsupervised, reinforcement).
2. Develop proficiency in implementing and evaluating ML models using Python and relevant libraries.
3. Cultivate a data-driven approach to problem-solving through exploration, visualization, and insight generation.
4. Critically evaluate ML model performance, considering factors beyond accuracy and selecting appropriate models for diverse tasks.
5. Promote a spirit of exploration, independent learning, and continuous growth in the ever-evolving field of machine learning.

1: Data Exploration and Visualization

Aim: Familiarize with basic data loading, cleaning, and visualization techniques.

Question: Analyze a dataset of your choice (e.g., Iris dataset, Titanic dataset) to identify patterns and relationships between variables.

Dataset:

Iris: https://www.kaggle.com/datasets/uciml/iris

Titanic: https://www.kaggle.com/c/titanic.

2: Data pre-processing Pipeline

Aim: Build a data pre-processing pipeline to handle missing values, categorical data, and feature scaling.

Question: Prepare a dataset for a machine learning task. Implement techniques like imputation, one-hot encoding, and standardization/normalization.

Dataset: Use the same dataset from Program 1 or a different one with similar characteristics.

3: Implementing k-Nearest Neighbors

Aim: Understand and implement the k-NN algorithm for classification.

Question: Build a k-NN classifier to predict the species of iris flowers based on sepal and petal measurements. Experiment with different values of 'k'**.**

Dataset: Iris dataset.

4: Linear Regression for Prediction

Aim: Apply linear regression to predict a continuous target variable.
Question: Build a linear regression model to predict housing prices based on features like area, number of bedrooms, and location.
Dataset:
Boston Housing: https://www.kaggle.com/datasets/vikrishnan/boston-house-prices
California Housing**:** https://scikit-learn.org/stable/datasets/real_world.html#california-housing-dataset.

5: Logistic Regression for Classification
Aim: Use logistic regression for binary or multi-class classification.
Question: Build a logistic regression model to predict whether a customer will click on an ad based on demographics and browsing history.
Dataset: You can simulate this type of dataset or find related advertising datasets on Kaggle.

6: Comparing Regression Models
Aim: Compare the performance of different regression models on a given dataset.
Question: Evaluate and compare linear regression, polynomial regression, and Ridge/Lasso regression for a prediction task of your choice.
Dataset: Use a dataset suitable for regression, potentially from previous programs.

7: Decision Tree Classification
Aim: Visualize and interpret decision tree models.
Question: Build a decision tree classifier to predict customer churn based on service usage patterns and account information. Visualize the tree and analyze feature importance.
Dataset: You can simulate a churn dataset or search for "telecom churn" datasets.

8: Ensemble Methods - Random Forest
Aim: Apply the Random Forest algorithm and evaluate its performance.
Question: Build a Random Forest classifier for a classification task. Tune hyperparameters (e.g., number of trees) to optimize performance.
Dataset: Choose a dataset suitable for classification, possibly from a previous program.

9: Naive Bayes for Text Classification
Aim: Implement the Naive Bayes algorithm for text data.
Question: Build a spam email classifier using the Naive Bayes algorithm.
Dataset: Spambase: https://archive.ics.uci.edu/ml/datasets/Spambase
Other text datasets: https://www.kaggle.com/datasets?tags=text

10: Customer Segmentation with K-Means Clustering
Aim: Apply clustering to group similar data points.
Question: Segment customers based on their purchasing behavior (e.g., RFM: Recency, Frequency, Monetary value) using k-means clustering. Visualize the clusters.
Dataset: Simulate a customer purchase dataset or use a retail dataset with transaction history.

11: Dimensionality Reduction with PCA
Aim: Reduce data dimensionality while preserving important information**.**
Question: Apply PCA to a dataset with a high number of features (e.g., images, text) and visualize the data in a lower-dimensional space.
Dataset:
MNIST Handwritten Digits (image): http://yann.lecun.com/exdb/mnist/
20 Newsgroups (text): https://scikit-learn.org/stable/datasets/real_world.html#the-20-newsgroups-text-dataset

12: Introduction to Q-Learning
Aim: Implement a basic reinforcement learning algorithm.
Question: Use Q-learning to train an agent to navigate a simple grid-world environment and find an optimal path to a goal.
Dataset: No external dataset is needed. You'll create a grid environment within your code (e.g., using Python lists).

TEXTBOOK:
Prescribed Textbooks:

1. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow" by Aurélien Géron (3rd Edition)
2. Python Machine Learning by Sebastian Raschka and Vahid Mirjalili

REFERENCE BOOKS:

1. Tom Michel, Machine Learning, McGrawHill Publication.
2. Introduction to Machine Learning, Fourth Edition By Ethem Alpaydin.

VIDEO LINKS:

1. Machine Learning Course by Andrew Ng (Stanford CS229): https://www.youtube.com/playlist?list=PLoROMvodv4rMiGQp3WXShtMGgzqpfVfbU.

2. Data School: https://www.youtube.com/user/dataschool

4. Syllabus Timeline

S/L	Syllabus Timeline	Description
1	**Week-1** Data Exploration and Visualization	Lecture: Introduction to Machine Learning, Types of Learning, Applications, Python for ML Lab: Program 1 - Data Exploration and Visualization
2	**Week-2** Data Preprocessing	Lecture: Data Preprocessing Techniques (handling missing values, encoding categorical data, feature scaling) Lab: Program 2 - Data Preprocessing Pipeline
3	**Week 3** k-Nearest Neighbours	Lecture: Distance Metrics, k-NN Algorithm, Model Evaluation (accuracy, confusion matrix) Lab: Program 3 - Implementing k-Nearest Neighbors
4	**Week 4** Linear Regression	Lecture: Linear Regression Fundamentals, Cost Functions, Gradient Descent (Conceptual), Simple Linear Regression Lab: Program 4 - Linear Regression for Prediction
5	**Week 5** Multiple Linear Regression & Logistic Regression	Lecture: Multiple Linear Regression, Assumptions of Linear Regression, Feature Selection, Introduction to Classification Lab: Program 5 - Logistic Regression for Classification.
6	**Week 6** Model Evaluation & Comparison (Regression)	Lecture: Overfitting and Underfitting, Bias-Variance Trade-off, Regularization (Ridge, Lasso) Lab: Program 6 - Comparing Regression Models.
7	**Week 7:** Decision Trees	Lecture: Decision Tree Learning, Entropy, Information Gain, Visualizing Decision Trees Lab: Program 7 - Decision Tree Classification
8	**Week 8:** Ensemble Methods	Lecture: Ensemble Learning Concepts (Bagging, Boosting), Random Forests Lab: Program 8 - Ensemble Methods - Random Forest.
9	**Week 9:** Naive Bayes & Text Preprocessing	Lecture: Bayes' Theorem, Naive Bayes Classifier, Text Preprocessing Techniques (Tokenization, Stop Words). Lab: Program 9 - Naive Bayes for Text Classification.
10	**Week 10:** Unsupervised Learning: Clustering	Lecture: Introduction to Unsupervised Learning, Clustering Algorithms, k-Means Clustering Lab: Program 10 - Customer Segmentation with k-Means Clustering.
11	**Week 11:** Dimensionality Reduction	Lecture: Curse of Dimensionality, Feature Extraction, Principal Component Analysis (PCA) Lab: Program 11 - Dimensionality Reduction with PCA
12	**Week 12:** Introduction to Reinforcement Learning	Lecture: Fundamentals of Reinforcement Learning, Q-Learning Lab: Program 12 - Introduction to Q-Learning.

5. Teaching-Learning Process Strategies

S/L	TLP Strategies:	Description
1	Theory-Practice Bridge	Begin each lab with a brief recap of relevant ML concepts from lectures. Prompt students to connect theoretical understanding with the lab's practical implementation.
2	Scaffolding to Independence	Start with partially completed code templates (scaffolding) for early programs. Gradually reduce scaffolding as labs progress, leading students to write more code independently.
3	Collaborative Learning	Integrate pair programming, group discussions, and peer code reviews. Encourage students to help each other debug, analyze, and explore

		alternative approaches.
4	Interactive Visualizations	Utilize tools like Jupyter Notebooks to encourage interactive data and model exploration. Guide students to create insightful visualizations that deepen their understanding.
5	Real-World Projects	Group several labs into a larger project using a real-world dataset. This provides context, boosts motivation, and mirrors industry workflows.

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**

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

7. Learning Objectives

S/L	Learning Objectives	Description
1	Master fundamental ML concepts and algorithms across paradigms.	This objective sets a strong foundation, ensuring students understand not just how to code, but why algorithms work, covering supervised, unsupervised, and reinforcement learning.
2	Develop proficiency in implementing and evaluating ML models using Python	This focuses on the essential practical skills: coding, using libraries, and assessing model performance. Python is a wise choice given its popularity in the ML community.
3	Cultivate a data-driven approach	This highlights the importance of data exploration, visualization, and insight generation, which are essential for real-world problem-solving. It's not just about building models blindly.
4	Critically evaluate ML model performance.	This promotes a deeper understanding of model selection and evaluation. It moves beyond simple accuracy metrics to consider factors like bias-variance trade-off, interpretability, and suitability for specific tasks.
5	Promote a spirit of exploration	This is crucial in the rapidly evolving field of ML. It encourages students to be lifelong learners, adapt to new technologies, and approach ML with curiosity and a desire for continuous improvement.

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

Course Outcomes (COs)

COs	Description
M23BCAL504.1	Prepare data for machine learning by effectively applying preprocessing, feature engineering, and exploratory analysis techniques to diverse datasets.
M23BCAL504.2	Implement a range of machine learning algorithms by successfully building and training supervised and unsupervised learning models in Python, including k-NN, regression, decision trees, random forests, k-means, and PCA.
M23BCAL504.3	Analyze machine learning results by interpreting model outputs, identifying patterns and insights in data, and effectively communicating findings through visualizations

	and reports.
M23BCAL504.4	Evaluate and select appropriate machine learning models by critically comparing their performance using relevant metrics and considering factors beyond simple accuracy to justify choices for specific tasks.
M23BCAL504.5	Design a basic reinforcement learning agent by developing a Q-learning agent to solve a simple problem in a simulated environment.

CO-PO-PSO Mapping

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
M23BCAL504.1	3				3								3	
M23BCAL504.2		3			3									3
M23BCAL504.3		3		3						3			3	3
M23BCAL504.4	3	3		3									3	
M23BCAL504.5			3											3
M23BCAL504	**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:

1. **Capstone Projects and Research:** The ML skills gained in this course can prove invaluable for final year projects. Students can leverage this knowledge to optimize robotic systems, analyze sensor data for predictive maintenance, or develop intelligent control algorithms — all empowered by the solid foundation built in this course.
2. **Advanced Engineering Electives:** Many higher-level electives, such as "Robotics," "Computer Vision," "Data Science," or "Artificial Intelligence," rely heavily on ML concepts. Students who have mastered the fundamentals through this course will be well-prepared to excel in these advanced subjects.
3. **Data-Driven Decision Making:** Regardless of their specialization, the ability to extract meaningful insights from data is an essential skill for any engineer. This course equips students to make informed, data-driven decisions, analyze trends, and approach complex engineering problems with a data-centric perspective.

Job Prospects:

1. **High Demand, High Reward:** ML expertise is highly sought after across industries, making it one of the most in-demand skillsets in today's job market. Graduates with a strong foundation in ML will have a competitive edge in securing rewarding and impactful roles.
2. **Career Versatility:** ML skills are transferable to a wide range of industries and job titles. Potential career paths include Machine Learning Engineer, Data Scientist, AI Specialist, Robotics Engineer, or any position requiring data analysis, predictive modeling, and intelligent system development.

5th Semester	Professional Elective-I (PE) Knowledge Representation and Reasoning	M23BCA505A

1. Prerequisites

S/L	Proficiency	Prerequisites
1	**Mathematics**	• **Logic:** Understanding of propositional logic, predicate logic, and formal proof systems is crucial, as these are the basis for representing and reasoning about knowledge. • **Set Theory:** Basics of sets, relations, functions, and operations on these structures. • **Discrete Mathematics:** Knowledge of graphs, combinatorics, and algorithms can be beneficial.
2	**Computer Science**	• **Algorithms and Data Structures:** Familiarity with fundamental algorithms (e.g., search, sorting) and data structures (e.g., trees, graphs) is important for implementing and manipulating knowledge representations. • **Programming:** Proficiency in at least one programming language (e.g., Python, Java) for practical implementation.
3	**Artificial Intelligence**	• **Search Algorithms:** Understanding of different search techniques, such as depth-first search, breadth-first search, and heuristic search. • **Machine Learning:** Basic knowledge of machine learning can help in understanding how KRR integrates with learning systems.
4	**Linguistics**	• **Semantics and Syntax:** Understanding the structure and meaning of language helps in developing systems that can process natural language and represent knowledge.
5	**Cognitive Science**	• **Human Cognition:** Knowledge of how humans perceive, categorize, and reason about the world can inspire and inform knowledge representation techniques.
6	**Databases**	• **Database Theory:** Concepts like entity-relationship models, normalization, and query languages (e.g., SQL) are useful for understanding how knowledge can be stored and retrieved.

2. Competencies

S/L	Competency	KSA Description
1	**Theoretical knowledge**	**Knowledge:** • Understanding of syntax, semantics, truth tables, logical connectives, and logical equivalences. • Familiarity with quantifiers, predicates, logical formulas, and inference rules • Knowledge of modal logics (e.g., necessity and possibility), fuzzy logic, and other non-standard logics. **Skills:** • Skill in constructing formal proofs and reasoning about logical consistency and completeness. **Attitudes:** • A strong desire to explore and understand complex theoretical concepts in KRR and their implications. • Willingness to explore new theoretical approaches and integrate diverse perspectives in KRR.
2	**Technical skills**	**Knowledge:** • Familiarity with programming languages relevant to KRR, such as Python, Java, Prolog, and R. • Understanding of software engineering principles and practices for building and maintaining KRR systems. **Skills:** • Ability to write, debug, and optimize code that implements KRR algorithms and processes. This includes using libraries and APIs related to KRR. • Skill in implementing and adapting algorithms for reasoning, search, and knowledge manipulation.

		Attitudes: • A proactive approach to analyzing and solving technical problems related to KRR systems and algorithms. • Precision in implementing algorithms and handling data to ensure the accuracy and reliability of KRR systems.
3	**Practical application**	**Knowledge:** • Understanding how to translate theoretical KRR models into solutions for real-world problems across various domains (e.g., healthcare, finance, and robotics). • Familiarity with practical use cases where KRR techniques can be applied, such as expert systems, semantic search engines, and decision support systems. **Skills:** • Ability to develop and deploy KRR systems that address practical needs and requirements. This includes configuring KRR frameworks and developing custom solutions. • Skill in creating prototypes to test and refine KRR solutions before full-scale implementation. **Attitudes:** • A focus on delivering practical, effective solutions to real-world problems using KRR techniques. • A commitment to designing KRR systems with the end user in mind, ensuring that solutions are intuitive and meet user needs.
4	**Research and Development**	**Knowledge:** • In-depth knowledge of the latest advancements in KRR, including emerging models, reasoning algorithms, and representation frameworks. • Familiarity with current research papers, journals, and conferences in KRR to stay updated on cutting-edge developments. **skills:** • Ability to perform comprehensive literature reviews to identify gaps in existing research and inform the development of new KRR techniques. • Skill in formulating research questions and hypotheses related to KRR challenges and opportunities. **Attitudes:** • A strong desire to explore new ideas, methods, and technologies in KRR. • Openness to experimenting with unconventional approaches and thinking creatively to address complex KRR challenges.
5	**Communication and Collaboration**	**Knowledge:** • Familiarity with the specific terms and concepts used in KRR to ensure clear and accurate communication. • Knowledge of how KRR is applied in different domains to facilitate relevant and context-aware discussions. **Skills:** • Ability to write clear, concise, and well-organized technical documentation, research papers, and reports on KRR topics. • Proficiency in preparing and delivering presentations that effectively communicate complex KRR concepts to both technical and non-technical audiences. • Ability to explain KRR concepts and systems clearly in meetings, discussions, and interviews. **Attitudes:** • A willingness to consider and incorporate diverse perspectives and approaches in KRR projects. • Flexibility in adjusting communication and collaboration strategies based on the needs of different audiences and project requirements.
6	**Ethics and Impact**	**Knowledge:** • Understanding of ethical guidelines and frameworks relevant to AI and KRR, such as fairness, accountability, and transparency • Knowledge of data privacy laws and regulations, such as GDPR and

		CCPA, and how they apply to the collection, storage, and use of data in KRR systems. **Skills:** • Ability to evaluate the ethical implications of KRR systems and decisions, including conducting ethical impact assessments and risk analyses. • Skills in identifying and addressing biases in KRR systems through techniques such as fairness audits and algorithmic transparency. **Attitudes:** • A strong commitment to upholding ethical principles and ensuring that KRR systems are developed and used in a responsible manner. • Awareness of the broader societal impacts of KRR systems and a commitment to mitigating potential negative effects.

3. Syllabus

SEMESTER – V **Knowledge Representation and Reasoning**			
Course Code	**M23BCA505A**	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 Theory**	Total Marks	**100**
Credits	**03**	Exam Hours	**03**

Course Objectives:

1. To, learn and Understanding Fundamental Concepts of KRR
2. To Apply Reasoning Methods
3. To Implement KRR Systems
4. To Evaluate and Analysing KRR Systems
5. Enhancing Communication and Collaboration
6. Conducting Research and Development

Module -1

Introduction to KRR modelling

The Key Concepts: Knowledge, Representation, and Reasoning; Why Knowledge Representation and Reasoning- Knowledge-Based Systems Why Knowledge Representation? Why Reasoning? ; The Role of Logic

Module -2

Introduction to First order logic

The Syntax; The Semantics- Interpretations ,Denotation ,Satisfaction and Models ;The Pragmatics -Logical Consequence, Why We Care ;Explicit and Implicit Belief -An Example ,Knowledge-Based Systems

Expressing Knowledge

Knowledge Engineering; Vocabulary ; Basic Facts; Complex Facts; Terminological Facts; Entailments; Abstract Individuals;

Module -3

Resolution

The Propositional Case- Resolution Derivations, An Entailment Procedure; Handling Variables and Quantifiers- First-Order Resolution, Answer Extraction, Skolemization, Equality; Dealing with Computational Intractability -First-Order Case ,The Herbrand Theorem ,The Propositional Case, The Implications, SAT Solvers, Most General Unifiers

Module -4

Reasoning with Horn Clauses

Horn Clauses- Resolution Derivations with Horn Clauses; SLD Resolution-Goal Trees; Computing SLD Derivations-Backward Chaining, The First-Order Case.

Procedural Control of Reasoning Facts and Rules , Rule Formation and Search Strategy ,Algorithm Design Specifying Goal Order ,Committing to Proof Methods, Controlling Backtracking .,Negation as Failure ,Dynamic Databases -The PLANNER Approach

Module -5

Rules in Production Systems

Production Systems: Basic Operation ,Working Memory , Production Rules , A Second Example
Conflict Resolution , Making Production Systems More Efficient , Applications and Advantages,
Some Significant Production Rule Systems

TEXTBOOKS:

1. Knowledge representation and reasoning, Ronald J. Brachman c 2004 by Elsevier.
2. Reasoning about Actions and Plans by Michael G. Schoppers, MIT Press, 2003

REFERENCE BOOKS:

1. Knowledge representation and reasoning and the design of intelligent agent by Michel Gelfond,Yulia Kahl,Cambridge university press, 2014.

VIDEO LINKS:

1. https://nptel.ac.in/courses/106106140

4. Syllabus Timeline

S/L	Syllabus Timeline	Description
1	Week 1-2: **Introduction to KKR modelling**	• Introduction to KKR modeling Knowledge, Representation, and Reasoning ,Why Knowledge Representation and Reasoning- • Knowledge-Based Systems Why Knowledge Representation? Why Reasoning? Role of Logic
2	Week 3-5: **Introduction to First order logic**	• Introduction to First order logic-The Syntax; The Semantics; The Pragmatics Explicit and Implicit Belief -An Example ,Knowledge-Based Systems; • Expressing Knowledge -Knowledge Engineering; Vocabulary ; • Basic Facts; Complex Facts; Terminological Facts; Entailments; Abstract Individuals;
3	Week 6-7: **Resolution**	• The Propositional Case, Handling Variables and Quantifiers; Dealing with Computational Intractability – • First-Order Case ,The Herbrand Theorem ,The Propositional Case, The Implications, SAT Solvers, Most General Unifiers
4	Week 8-10 **Reasoning with Horn Clauses**	• Horn Clauses- Resolution Derivations with Horn Clauses; SLD Resolution-Goal Trees; Computing SLD Derivations-Backward Chaining, The First-Order Case. • Procedural Control of Reasoning- Facts and Rules , Rule Formation and Search Strategy ,Algorithm Design Specifying Goal Order ,Committing to Proof Methods, • Controlling Backtracking, Negation as Failure, Dynamic Databases.
5	Week 11-13: **Rules in Production Systems**	• Rules in Production Systems- Production Systems: Basic Operation ,Working Memory , Production Rules , • A Second Example ,Conflict Resolution , Making Production Systems More Efficient , Applications and Advantages, , • Some Significant Production Rule Systems.

4. 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	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	Laboratory Learning	Utilize the facilities available in the laboratories to understand the behavior of the materials by performing few experiments.

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

7. Learning Objectives

S/L	Learning Objectives	Description
1	**Understanding Fundamental Concepts**	• Define and explain the core concepts and terminology used in KRR, including knowledge representation, reasoning, inference, and ontology. • Describe various knowledge representation models, such as semantic networks, frames, ontology's, and rules, and their applications. • Explain the principles of logic, including propositional logic, predicate logic, and modal logic, and their role in knowledge representation.
2	**Mastering Representation Techniques**	• Identify and apply different knowledge representation techniques, including logical formalisms, semantic networks, and frame-based representations. • Develop and use ontologies to represent domain-specific knowledge, including defining classes, properties, and relationships using ontology languages like OWL. • Implement rule-based systems to encode and reason about knowledge using rule engines or logic programming languages like Prolog.
3	**Applying Reasoning Methods**	• Explain various reasoning methods, including deductive, inductive, and abductive reasoning, and their applications in problem-solving. • Apply reasoning techniques to solve problems, including the use of inference rules and algorithms to derive new knowledge from existing information. • Utilize non-monotonic reasoning approaches, such as default logic and circumscription, to handle incomplete or evolving information.
4	**Implementing KRR Systems**	• Develop KRR systems and applications by integrating knowledge representation models with reasoning engines and other AI components. • Use programming languages and tools (e.g., Python, Prolog, Protégé) to build and test KRR systems, including writing and debugging code.
5	**Evaluating and Analyzing KRR Systems**	• Evaluate the effectiveness and efficiency of KRR systems using appropriate metrics, such as precision, recall, and computational complexity. • Analyze and interpret the results from KRR systems to assess their performance and accuracy, including identifying and addressing potential issues. • Conduct usability testing and gather user feedback to improve the design and functionality of KRR systems.
6	**Enhancing Communication and Collaboration**	• Communicate complex KRR concepts and solutions effectively to both technical and non-technical audiences through written reports, presentations, and discussions. • Collaborate effectively with interdisciplinary teams, including domain experts, developers, and stakeholders, to develop and implement KRR systems.

		• Provide and receive constructive feedback in collaborative settings, using it to improve KRR systems and processes.
7	**Conducting Research and Development**	• Conduct research in KRR to explore new theories, models, and technologies, and contribute to the advancement of the field. • Develop and test novel KRR algorithms and techniques through experimentation and prototyping. • Document and present research findings clearly and effectively, contributing to the academic and professional community in KRR.

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

Course Outcomes (COs)

COs	Description
M23BCS505A.1	**Understand and Apply** Representation Techniques
M23BCS505A.2	**Analyze and Implement** Reasoning Methods.
M23BCS505A.3	**Design and Develop** KRR Systems
M23BCS505A.4	**Evaluating** KRR systems using appropriate metrics and benchmarks

CO-PO-PSO Mapping

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
M23BCS505A.1	3	-	-	-	-	-	-	-	-	-	-	-	3	-
M23BCS505A.2	-	3	-	-	-	-	-	-	-	-	-	-	-	3
M23BCS505A.3	-	-	3		-	-	-	-	-	-	-	-	3	-
M23BCS505A.4	-	-	-	3	-	-	-	-	-	-	-	-	-	3
M23BCS505A	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**	**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	**20**	**20**	**20**	**20**	**100**

10. Future with this Subject:

- **Enhanced AI Systems:** Future KRR systems will likely feature advanced reasoning capabilities, enabling them to solve more complex problems and make nuanced decisions. Combining KRR with other AI techniques like machine learning and natural language processing to create more intelligent and adaptable systems.
- **More Intelligent and Autonomous Systems:** Development of autonomous systems that can independently acquire and reason about new knowledge, leading to smarter and more adaptive agents. KRR will enhance decision support systems by enabling more sophisticated reasoning and scenario analysis.
- **Better Human-Computer Interaction-**Improved ability for KRR systems to understand and reason about natural language, leading to more intuitive human-computer interactions.

5th Semester	Professional Elective-I (PE) CLOUD COMPUTING	M23BCS505B

1. Prerequisites

S/L	Proficiency	Prerequisites
1	**Programming Fundamentals**	• Students should have a solid understanding of programming concepts, particularly in Python, as it is widely used in data science for data manipulation, analysis, and machine learning. • Knowledge of data structures (e.g., lists, dictionaries) and control structures (e.g., loops, conditionals) is essential.
2	**Mathematics:**	• Understanding of solving linear and quadratic equations • Proficiency in differential and integral calculus, including applications. • Familiarity with geometric shapes, angles, trigonometric functions, and their properties.
3	**Computer Networks and Security**	• Computer Networks, Network Security • Understanding of network protocols, TCP/IP, DNS, and basic network configurations. • Information Security, Cryptography
4	**Operating Systems**	• Operating Systems, Systems Programming. • Knowledge of process management, memory management, file systems, and system calls.
5	**Fundamentals of Probability**	• Knowledge of probability theory, including conditional probability, Bayes' theorem, and probability distributions, is essential. This will help students understand the statistical underpinnings of many data science algorithms, such as Naive Bayes

2. Competencies

S/L	Competency	KSA Description
1	Introduction to cloud computing	**Knowledge:** Understanding the definition, scope, and significance of Cloud computing. Awareness of the Historical Developments, Building Cloud Computing Environments, Amazon Web Services (AWS), Google App Engine. **Skills:** Ability to articulate the role and impact of Cloud in various industries. Skill in identifying the different components of the Cloud workflow. **Attitudes:** Curiosity about the evolving field of Cloud and its applications. Appreciation for the interdisciplinary nature of Cloud, integrating statistics, mathematics, and domain knowledge.
2	Virtualization	**Knowledge:** Understanding the Cloud computing that enables the creation and management of virtual instances of physical resources, such as servers, storage, and networks.. **Skills:** To problem-solving and project management capabilitie **.** **Attitudes:** The right mindset can significantly impact how effectively one can implement, manage, and optimize virtualized environments
3	Cloud Computing Architecture	**Knowledge:** Understanding the Detailed overview of the knowledge components related to cloud computing architecture ub-components required for cloud computing. These components typically consist of a front-end platform (client or device), back-end platforms (servers, storage), a cloud-based delivery, and a network (usually the internet). **Skills:** Blend of technical skills, strategic thinking, and an understanding of the underlying principles and best practices, Cloud Service Model Expertise, Virtualization and Networking **Attitudes:**

		Play a crucial role in the effective design, implementation, and management of cloud computing architecture.
4	Cloud Platforms in Industry	**Knowledge:** Understanding of Compute services, Storage services, Communication services, Additional services. Google Architecture and core concepts, Application life cycle. **Skills:** Edge Computing **,** Architectural Design, Data Management and Analytics and Troubleshooting and Support **Attitudes:** Attention to detail in cloud platforms
5	Cloud Applications	**Knowledge:** Competency-based knowledge for cloud applications typically encompasses a variety of skills across multiple domains, including infrastructure, development. **Skills:** Cloud applications are focused on technical proficiency, problem-solving, and the ability to leverage cloud platforms to create, deploy, and manage applications efficiently. **Attitudes:** Attention to detail in cloud Application.

3. Syllabus

CLOUD COMPUTING SEMESTER – V			
Course Code	**M23BCS505B**	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 Theory**	Total Marks	**100**
Credits	**03**	Exam Hours	**03**

Course Objectives:
1. Compare cloud computing environment utilized for real time applications.
2. Identify various models of cloud computing.
3. Analyze how to design cloud native applications.
4. Examine the importance of Cloud Virtualization Technologies.

Module -1

Introduction ,Cloud Computing at a Glance, Historical Developments, Building Cloud Computing Environments, Amazon Web Services (AWS), Google App Engine, Microsoft Azure, Hadoop, Force.com and Salesforce.com, Manjrasoft Aneka
Textbook 1: Chapter 1: 1.1,1.2 and 1.3

Module -2

Virtualization: Introduction, Characteristics of Virtualized, Environments Taxonomy of Virtualization Techniques, Execution Virtualization, Other Types of Virtualization, Virtualization and Cloud Computing, Pros and Cons of Virtualization, Technology Examples.
Textbook 1 : Chapter 3: 3.1 to 3.6

Module -3

Cloud Computing Architecture: Introduction, Cloud Reference Model, Types of Clouds, Economics of the Cloud, Open Challenges.
Textbook 1: Chapter 4: 4.1 to 4.5

Module -4

Cloud Platforms in Industry
Amazon web services: - Compute services, Storage services, Communication services, Additional services. Google AppEngine: - Architecture and core concepts, Application life cycle, Cost model, Observations.
Textbook 1: Chapter 9: 9.1 to 9.2

Module -5

Cloud Applications
Scientific applications: - HealthCare: ECG analysis in the cloud, Biology: gene expression data analysis for cancer diagnosis, Geoscience: satellite image processing. Business and consumer applications: CRM and ERP, Social networking, media applications.
Textbook 1: Chapter 10: 10.1 to 10.2

Textbooks

1. Rajkumar Buyya, Christian Vecchiola, and Thamrai Selvi Mastering Cloud Computing McGraw

Hill Education.
2. Toby Velte, Anthony Velte, Cloud Computing: A Practical Approach, McGraw-Hill Osborne Media.

Reference Books

1. George Reese, Cloud Application Architectures: Building Applications and Infrastructure in the Cloud, O'Reilly Publication.

Weblinks and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=1N3oqYhzHv4
- https://www.youtube.com/watch?v=RWgW-CgdIk0

4. Syllabus Timeline

S/L	Syllabus Timeline	Description
1	Week 1-3:	Introduction ,Cloud Computing at a Glance, Historical Developments, Building Cloud Computing Environments, Amazon Web Services (AWS), Google AppEngine, Microsoft Azure, Hadoop, Force.com and Salesforce.com
2	Week 4-6:	**Virtualization:** Introduction, Characteristics of Virtualized, Environments Taxonomy of Virtualization Techniques, Execution Virtualization, Other Types of Virtualization, Virtualization and Cloud Computing, Pros and Cons of Virtualization
3	Week 8-11:	**Cloud Computing Architecture:** Introduction, Cloud Reference Model, Types of Clouds, Economics of the Cloud, Open Challenges
4	Week 7-8:	**Cloud Platforms in Industry** Amazon web services: - Compute services, Storage services, Communication services, Additional services. Google AppEngine: - Architecture and core concepts, Application life cycle, Cost model.
5	Week 9-12:	**Cloud Applications** Scientific applications: - HealthCare: ECG analysis in the cloud, Biology: gene expression data analysis for cancer diagnosis, Geoscience: satellite image processing. Business and consumer applications: CRM and ERP, Social networking, media applications.

5. Teaching-Learning Process Strategies

S/L	TLP Strategies:	Description
1	Lectures and Interactive Discussions	Provide clear, concise explanations of key concepts, theories, and algorithms in each module. Use visual aids, such as slides and diagrams, to enhance understanding.
2	Case Studies and Real-World Applications	Incorporate visual aids like videos/animations to enhance understanding of concepts. Incorporate case studies like the Real Direct example in Week 4 to demonstrate the application of data science concepts in real-world scenarios. This helps students see the relevance of what they are learning.
3	Collaborative Learning	Encourage collaborative learning for improved competency application.
4	Project-Based Learning	Organize students into small groups to discuss complex topics, such as the ethical implications of data science
5	Lectures and Interactive Discussions	Provide clear, concise explanations of key concepts, theories, and algorithms in each module. Use visual aids, such as slides and diagrams, to enhance understanding.

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

7. Learning Objectives

S/L	Learning Objectives	Description
1	Introduction to Cloud Computing	Students will be able to define cloud computing and explain its significance in the context Cloud Computing Environments.
2	Virtualization	Students will be able know the Characteristics of Virtualized, Environments Taxonomy of Virtualization Techniques, Execution Virtualization, Other Types of Virtualization.
3	Cloud Computing Architecture:	Cloud Reference Model, Types of Clouds, Economics of the Cloud, Open Challenges.
4	Cloud Platforms in Industry	Amazon web services: - Compute services, Storage services,Communication services, Additional services. Google AppEngine: - Architecture and core concepts, Application life cycle, Cost model
5	Cloud Applications	Students will be able know cloud application like Health ECG analysis in the cloud, and gene expression data analysis for cancer diagnosis.

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

Course Outcomes (COs)

COs	Description
M23BCS505B.1	Compare cloud computing environment utilized for real time applications.
M23BCS505B.2	Identify various models of cloud computing.
M23BCS505B.3	Analyze how to design cloud native applications.
M23BCS505B.4	Examine the importance of Cloud Virtualization Technologies.

CO-PO-PSO Mapping

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
M23BCS505B.1	3	-	-	-	-	-	-	-	-	-	-	-	3	3
M23BCS505B.2	3	-	-	-	-	-	-	-	-	-	-	-	3	3
M23BCS505B.3	3	3	-	3	-	3	-	-	-	-	-	3	3	3
M23BCS505B.4	3	-	-	-	-	-	-	-	-	-	-	-	3	3
M23BCS505B	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:

- **Serverless Architectures**: Simplifying application deployment and scaling by abstracting server management. This includes further advancements in Function as a Service (FaaS) and Backend as a Service (BaaS).
- **Edge Computing**: Expanding cloud capabilities to the edge of the network to reduce latency and improve performance, particularly for IoT and real-time applications.
- **Artificial Intelligence and Machine Learning**: Integrating AI and ML with cloud services to enable more intelligent automation, enhanced analytics, and better decision-making capabilities
- **Security and Privacy**: Advancing encryption, identity management, and threat detection to address growing concerns about data protection and compliance in cloud environments.
- **Quantum Computing**: Exploring how quantum computing can be integrated into cloud platforms to tackle complex problems beyond the capabilities of classical computers.
- **Advanced Networking**: Developing new networking technologies and protocols to support the growing demands of cloud computing, including better support for high-speed data transfer and network slicing.

5th Semester	Professional Elective –I Probability & Statistics for AI & ML	M23BCA505C

1. Prerequisites

S/L	Proficiency	Prerequisites
1	**Basic Statistics**	• Basic arithmetic and algebra; familiarity with data representation (tables, graphs). • Understanding and calculating measures of central tendency and dispersion.
2	**Statistical Methods: Correlation and Regression**	• Familiarity with correlation and regression analysis, including solving problems using Pearson's and rank correlation, and fitting regression lines. • Understanding of linear equations and the ability to plot data on Cartesian coordinates.
3	**Curve Fitting (Least Squares Method)**	• Familiarity with polynomial functions and basic calculus (optional but helpful). • Understanding the curve fitting (linear, exponential, quadratic) using the method of least squares.
4	**Multivariate Statistics**	• Ability to analyze multivariate data, compute covariance and correlation matrices, perform PCA, cluster analysis, and multivariate regression. • Strong foundation in statistics and matrix algebra; understanding of covariance and correlation concepts from earlier modules.
5	**Probability**	• Proficient in understanding probability concepts, applying addition/multiplication theorems, and solving problems using Bayes' Theorem. • Basic set theory and understanding of logical statements (e.g., "if-then" conditions); comfort with algebraic manipulation.
6	**Probability Distributions**	• Ability to work with different probability distributions (Binomial, Poisson, Exponential, Normal), and solve related problems. • Understanding of random variables and probability concepts from the previous module; basic calculus (for continuous distributions).
7	**Sampling Theory and Hypothesis Testing**	• Proficient in understanding sampling distributions, calculating standard errors, and performing hypothesis tests (t-tests, Chi-square tests). • Knowledge of probability distributions, familiarity with statistical inference, and basic understanding of sample vs. population concepts.

2. Competencies

S/L	Competency	KSA Description
1	**Data Analysis and Interpretation**	**Knowledge:** Understanding of central tendency, dispersion, skewness, kurtosis. **Skills:** Ability to calculate and interpret these measures for various datasets. **Attitudes:** Attention to detail and critical thinking when analyzing data patterns.
2	**Correlation and Regression Analysis**	**Knowledge:** Grasp of correlation types and regression concepts, including Pearson's and rank correlation. **Skills:** Ability to perform and interpret correlation and regression analysis. **Attitudes:** Logical reasoning and analytical mindset in statistical modeling.
3	**Curve Fitting**	**Knowledge:** Familiarity with least squares method and curve types (linear, quadratic, and exponential). **Skills:** Proficiency in fitting curves to data and interpreting the results. **Attitudes:** Precision and methodical approach in curve fitting exercises.
4	**Multivariate**	**Knowledge:**

	Statistical Analysis	Comprehensive understanding of multivariate data, covariance, correlation matrices, PCA, and cluster analysis. **Skills:** Capability to apply multivariate techniques in real-world data scenarios. **Attitudes:** Curiosity and innovation in exploring complex datasets and deriving insights.
5	**Probability and Statistical Inference**	**Knowledge:** In-depth knowledge of probability theory, distributions, sampling theory, and hypothesis testing. **Skills:** Competence in solving probability problems, applying distributions, and conducting hypothesis tests. **Attitudes:** Analytical and objective mindset in making probabilistic inferences.

3. Syllabus

Professional Elective –I **Probability & Statistics for AI & ML** **SEMESTER – V**			
Course Code	**M23BCA505C**	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 Theory**	Total Marks	**100**
Credits	**03**	Exam Hours	**03**

Course Objectives:

1. To study the basics of statistics, measure central tendency and dispersion.
2. Develop statistical methods for correlation, regression analysis, curve fitting and Multivariate statistics.
3. Explore the principles of probability.
4. Understand the principles of probability distribution.
5. Explain the sampling theory, errors and chi distribution.

Module -1

Basic Statistics: Measures of central tendency, measures of dispersion, range quartile deviation, mean deviation, standard deviation, coefficient of variation, Skewness and Kurtosis, problems.
Statistical Methods: correlation and regression –Karl Pearson's coefficient of correlation and rank correlation problems, regression analysis-lines of regression, problems.

Module -2

Curve fitting: curve fitting by the method of least square-fitting the curves of the form Y=ax+b, y=abx , y=ax2+bx+c
Multivariate Statistics: Introduction to Multivariate Data, Covariance and Correlation Matrices, Principal Component Analysis (PCA), Cluster Analysis, Multivariate Regression.

Module -3

Probability: Introduction, sample space and events, Axioms of probability, Addition and multiplication theorems, conditional probability, Bayes' Theorem, problems.

Module -4

Probability Distributions: Random variables (discrete and continuous), probability mass/density function, Binomial, Poisson, Exponential and normal distributions- problems (no derivations for mean and standard deviation)

Module -5

Sampling theory: Introduction to sampling distributions, standard error, type-I and type-II errors. Test of hypothesis of means, students' distribution, Chi-square distribution as a test of goodness of fit problems.

TEXTBOOKS:

1. B. S. Grewal: "Higher Engineering Mathematics", Khanna publishers,44th Ed.2018.
2. Fundamentals of Mathematical Statistics by Guptha, S.C & Kapoor, V.K .
3. "Applied Multivariate Statistical Analysis", Richard A. Johnson and Dean W. Wichern, Pearson, 6th Edition (2007)

REFERENCE BOOKS:

1. "An Introduction to Multivariate Statistical Analysis", T.W. Anderson, Wiley-Interscience, 3rd Edition (2003)
2. Introduction to Statistical Methods by Guptha ,C.B and Vijay Guptha (1988).
3. "Introduction to Multivariate Analysis", Chris Chatfield and Alexander J. Collins, Chapman and

Hall/CRC, 1st Edition (1980).

4. Syllabus Timeline

S/L	Syllabus Timeline	Description
1	Week 1-3: Descriptive Statistics	Introduction to the course, overview of key concepts in statistics, and review of basic statistics principles. Introduction to Descriptive Statistical Techniques. In-depth study of descriptive statistical techniques, including measures of central tendency and dispersion. Practical exercises and examples.
2	Week 4-5: Curve Fitting and Model Building	Introduction to curve fitting techniques. Hands-on practice with linear and polynomial regression models. Implementing curve fitting techniques to model data. Introduction to evaluation metrics for model performance.
3	Week 6-7: Correlation and Regression	Analysis of relationships between variables using correlation techniques. Practice with correlation coefficients and scatter plots. Regression techniques for predicting and understanding relationships between variables. Focus on simple and multiple regression models.
4	Week 8-9: Multivariate Analysis and Advanced Methods	Introduction to multivariate statistical methods, including Principal Component Analysis (PCA) and factor analysis. Exploration of advanced multivariate statistical methods and their applications. Practical exercises and case studies.
5	Week 10-12: Probability Theory	Evaluation of probability theory and distributions. Application of probability theory in modeling uncertainty.

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 probability concepts.
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)

Theory Course with 3 Credits: Professional Elective Course (PE)

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 for Professional Elective Course (PE)

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 Examinations:

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	Analyze Central Tendency and Dispersion	Students will be able to compute and interpret measures of central tendency (mean, median, and mode) and dispersion (range, variance, standard deviation) for different datasets, helping them understand data distribution and variability.
2	Apply Correlation and Regression Techniques	Students will learn to calculate and interpret correlation coefficients (Pearson's and rank) and perform regression analysis, enabling them to model and predict relationships between variables in real-world data.
3	Perform Curve Fitting Using Least Squares Method	Students will gain proficiency in fitting linear, quadratic, and exponential curves to data using the least squares method, allowing them to analyze trends and make predictions based on historical data.
4	Conduct Multivariate Statistical Analysis	Students will develop the ability to analyze complex datasets using multivariate techniques such as PCA, covariance, and correlation matrices, as well as cluster analysis, helping them in dimensionality reduction and pattern recognition in large datasets.
5	Solve Probability and Probability Distribution Problems	Students will be able to apply the principles of probability and work with various probability distributions (Binomial, Poisson, Exponential, Normal) to model uncertainty and predict outcomes in uncertain environments.
6	Implement Sampling Theory and Hypothesis Testing	Students will be equipped to apply sampling techniques, calculate standard errors, and conduct hypothesis tests, including Chi-square tests, enabling them to make data-driven decisions and assess the validity of their findings.

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

Course Outcomes (COs)

COs	Description
M23BCA505C.1	Apply Descriptive Statistical Techniques to Summarize Data
M23BCA505C.2	Implement Curve Fitting Techniques to Model and Predict Data Trends
M23BCA505C.3	Analyze Relationships Using Correlation and Regression Techniques
M23BCA505C.4	Analyze Multivariate Statistical Methods for Complex Data Analysis
M23BCA505C.5	Evaluate the Effectiveness of Probability Theory and Distributions in Modelling Uncertainty

CO-PO-PSO Mapping

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
M23BCA505C.1	3	-	-	-	-	-	-	-	-	-	-	-	**3**	**3**
M23BCA505C.2	-	3	-	-	-	-	-	-	-	-	-	-	**3**	**3**
M23BCA505C.3	-	-	3	3	-	-	-	-	-	-	-	-	**3**	**3**
M23BCA505C.4	-	-	-	3	-	-	-	-	-	-	-	-	**3**	**3**
M23BCA505C.5	-	-	3	-	3	-	-	-	-	-	-	-	**3**	**3**
M23BCA505C	**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**

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:

- **Enhanced Predictive Analytics**: Probability and statistics form the backbone of predictive analytics. Advanced probabilistic models and statistical methods will continue to improve the accuracy and reliability of predictions in various domains, from finance to healthcare.
- **Advanced Machine Learning Models**: The development of sophisticated ML models, such as Bayesian networks and generative models relies heavily on probability and statistics. These models use probabilistic reasoning to make inferences and generate new data.
- **Improved Data Interpretation and Visualization**: Statistical methods will enhance the interpretation and visualization of complex data sets. Techniques such as dimensionality reduction and clustering will help in extracting meaningful insights from high-dimensional data.
- **Robust Uncertainty Modeling**: Handling uncertainty is a crucial aspect of AI and ML. Probabilistic models will advance in addressing uncertainty in predictions and decisions, improving robustness and reliability.
- **Personalized AI Systems**: Statistical methods will drive the personalization of AI systems, enabling tailored recommendations and experiences based on individual preferences and behaviors.
- **Ethical and Fair AI**: Understanding and mitigating biases in AI systems is crucial. Statistical methods will be employed to analyze and address biases in data and models, ensuring fairness and ethical use of AI.
- **Advancements in Bayesian Methods**: Bayesian methods will continue to play a significant role in AI and ML, providing a framework for learning and updating models with new data.
- **Integration with Quantum Computing**: The intersection of probability, statistics, and quantum computing will open new avenues for processing and analyzing data.

5th Semester	Professional Elective-I (PE) Advanced Java	M23BCS505D

1. Prerequisites

S/L	Proficiency	Prerequisites
1	**Core Java Fundamentals**	Understanding of variables, data types, operators, and basic control flow statements. Proficiency in classes, objects, inheritance, polymorphism, encapsulation, and abstraction. Ability to handle exceptions using try-catch blocks, and understanding of custom exceptions. Familiarity with reading from and writing to files using Java I/O streams.
2	**Advanced Java Concepts**	Understanding threads, synchronization, concurrent data structures, Knowledge of generic classes, methods, and the use of bounded types. Deep knowledge of collections of Java Collections Framework.
3	**Java Standard Libraries**	Understanding the Basic classes and interfaces, Advanced I/O operations, file handling.
4	**Development Tools and Environment**	Setting up a development environment for Advanced Java is essential. Getting experience with Integrated Development Environments (IDEs) like IntelliJ IDEA, Eclipse, or NetBeans. Familiarity with build automation tools like Maven or Gradle.
5	**Databases and Persistence**	Basic understanding of SQL for querying and manipulating databases. Knowledge of Java Database Connectivity for integrating Java applications with databases.
6	**Software Development Principles**	Familiarity with principles for writing clean, maintainable, and scalable code. Understanding basic software design and architectural concepts.

2. Competencies

S/L	Competency	KSA Description
1	**Java Language Features**	**Knowledge:** Mastery in creating and using generic classes, methods, and interfaces. Understanding and creating custom annotations, and interacting with reflection and frameworks. **Skills:** Learning the basic concepts of Advanced java.
2	**Frameworks and Libraries**	**Knowledge:** Deep knowledge of Spring Core, Spring Boot, Spring Data, Spring Security, and Spring Cloud. **Skills:** Practicing the concept of functional programming
3	**Java EE / Jakarta EE**	**Knowledge:** Understanding Proficiency in creating and managing servlets and JSP pages and Knowledge of object-relational mapping, entity management, and query languages **Skills:** Understanding the concept of JSP,Servlets and libraries.
4	**Code Optimization**	**Knowledge:** Techniques for optimizing Java code, including efficient algorithm design, minimizing synchronization, and reducing resource consumption. **Skills:** Applying the different efficient algorithm to obtain optimized java programming.

3. Syllabus

Advanced Java SEMESTER – V			
Course Code	**M23BCS505D**	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 Theory**	Total Marks	**100**
Credits	**03**	Exam Hours	**03**
Course objectives: This course will enable students to 1.Understanding the fundamentals of the collection framework 2.Demonstrate the fundamental concepts of String Operations, applets and Swing applications 3. Design and Develop web applications using java Servlets and JSP. 4. Apply database interaction through java Database Connectivity.			
Module -1			
The collections and Framework: Collections Overview, The Collection Interfaces, The Collection Classes, Accessing a collection Via an Iterator, Storing User Defined Classes in Collections, The			

Random Access Interface, Working With Maps, Comparators, The Collection Algorithms, Arrays,, The legacy Classes and Interfaces. **Text Book 1: Chapter 20**
Module -2
String Handling : The String Constructors, String Length, Special String Operations, Character Extraction, String Comparison, Searching Strings, Modifying a String, Data Conversion Using value Of( ), Changing the Case of Characters Within a String, joining strings, Additional String Methods, StringBuffer , StringBuilder **Text Book 1: Chapter 18**
Module -3
Introducing Swing: The Origin of Swing, Swing Is Built on AWT, Two Key Swing Features, The MVC Connection, Components and Containers, The Swing Packages, A Simple Swing Application, Event Handling. **Exploring Swing:**JLabel and ImageIcon,JTextField,The Swing Buttons-JButton, JToggle Button, Check Boxes, Radio Buttons. **Text Book 1: Chapter 32 and Chapter 33**
Module -4
Introducing servlets: Background; The Life Cycle of a Servlet; Using Tomcat for Servlet Development; A simple Servlet; The Servlet API; The Jakarta. Servlet Package; Reading Servlet Parameter; The Jakarta .servlet.http package; Handling HTTP Requests and Responses; Using Cookies; Session Tracking. **Java Server Pages (JSP):** JSP tags, Variables and Objects, Methods, Control statements, Loops, Request String. **Text Book 1: Chapter 36** **Text Book 2: Chapter 11**
Module -5
JDBC Objects: The Concept of JDBC; JDBC Packages; A Brief Overview of the JDBC process; Database Connection; Statement Objects; ResultSet; Metadata, Data types; Exceptions. **Text Book 2: Chapter 06**
Text Books: 1. Herbert Schildt: JAVA the Complete Reference, Twelth Edition, Tata McGraw-Hill. 2.Jim Keogh,The Complete Reference J2EE, **Reference Books:** 1. Y. Daniel Liang: Introduction to JAVA Programming, 7th Edition, Pearson Education, 2007. 2. Stephanie Bodoff et al: The J2EE Tutorial, 2nd Edition, Pearson Education, 2004. 3. Uttam K Roy, Advanced JAVA programming, Oxford University press, 2015.

4. Syllabus Timeline

S/L	Syllabus Timeline	Description
1	Week1-2: **The collections and Framework**	**Competency**: **Collections** are data structures used to store, retrieve, and manipulate groups of objects **Knowledge:** The knowledge of collections typically involves: Lists, Sets, Maps, Queues, and Stacks. **Skills:** Know the characteristics and use cases of arrays, lists, sets, maps, queues, and stacks. Being familiar with the collection libraries and APIs of the programming languages.
2	Week 3-4: **String Handling**	**Competency**: Handling strings is essential for many programming tasks, as strings are a fundamental data type used for text processing and manipulation **Knowledge:** a deep understanding of strings is crucial for software development, as strings are one of the most fundamental data types used in programming **Skills:** Acquiring a range of skills related to text manipulation, processing, and formatting.

3	Week 5-6: **Introducing and Exploring Swing**	**Competency**: Swing is the Java GUI toolkit for building graphical user interfaces (GUIs) which involves mastering a variety of concepts and skills to create robust, responsive, and well-designed desktop applications **Knowledge:** encompasses understanding the core concepts, components, and capabilities of the Swing framework for building graphical user interfaces (GUIs) in Java, **Skills:** Involving a range of abilities related to designing, implementing, and managing graphical user interfaces (GUIs) in Java.
4	Week 7-8: **Introducing servlets**	**Competency**: **Servlets** involves a comprehensive understanding of Java Servlets, which are server-side components used to handle requests and generate responses in a web application. **Knowledge:** Encompasses understanding the Java Servlets work as part of the Java EE (Enterprise Edition) platform for building web applications. **Skills:** Involve a range of abilities related to designing, implementing, and managing server-side components of web applications using Java Servlets.
5	Week 9-10: **JDBC Objects**	**Competency**: Involves understanding and effectively using Java Database Connectivity (JDBC) components to interact with relational databases. **Knowledge:** Understanding the core components and their interactions within the Java Database Connectivity (JDBC) API **Skills:** Involve effectively using Java Database Connectivity (JDBC) components to interact with relational databases such as executing SQL queries, managing database transactions, and optimizing database interactions inJava 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 programming 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**	Integrating backend (Java) with frontend technologies (HTML, CSS, JavaScript).Involves setting clear learning objectives, designing a comprehensive curriculum, using diverse instructional strategies, and providing ample practical experiences

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

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%.

7. Learning Objectives

S/L	Learning Objectives	Description
1	**Master Advanced Java Concepts**	Ensuring that students gain a deep understanding of complex Java concepts, tools, and frameworks, enabling them to develop robust, scalable, and efficient applications
2	**Proficiency in JDBC**	Establish connections to various types of databases using JDBC. Execute SQL queries and updates, handle result sets, and manage transactions. Implement advanced JDBC techniques such as batch processing and stored procedures.
3	**Web Applications Using Servlets and JSP**	Understand, implementing and managing Java Servlets for handling HTTP requests and responses.
4	**Practical Application**	Develop projects that require integration of multiple technologies and address real-world challenges. Build complex, real-world applications incorporating advanced Java concepts and frameworks.

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

Course Outcomes (COs)

COs	Description
M23BCS505D.1	Solve the problem by applying the collection classes and Interfaces used in Java.
M23BCS505D.2	Apply the different modifications on Strings by using various String operations.
M23BCS505D.3	Build the GUI-based application which handles the different events of Swing components.
M23BCS505D.4	Develop web-based applications using the concept of Java servlets and JSP.
M23BCS505D.5	Utilize the concept of JDBC connectivity to model the database applications.

CO-PO-PSO Mapping

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO 9	PO 10	PO11	PO12	PSO1	PSO 2
M23BCS505D.1	3													
M23BCS505D.2		3												
M23BCS505D.3			3										3	3
M23BCS505D.4				3								3	3	3
M23BCS505D.5					3							3	3	3
Avg	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**

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.

- **Continued Evolution of Java:** Facilitates better interoperability between Java and native code, such as C and C++, which could expand Java's usability in systems programming.
- **Adoption of Modern Frameworks and Libraries:** Continued evolution of these tools to simplify the development of micro services and cloud-native applications. Integration with new cloud technologies and services.
- **Enhanced Performance and Scalability:**Evolution of garbage collection algorithms to improve latency and throughput for Java applications. Increased use of reactive programming to build scalable and resilient systems that can handle high loads and real-time data.
- **Integration with Emerging Technologies:** Expanded support for integrating AI and ML capabilities into Java applications with libraries like DeepLearning4J and others. Use of AI-driven tools to enhance development practices, such as automated code analysis and debugging.
- **Development Practices and Tools:** Improved tools and practices for monitoring and managing the performance and health of Java applications in production environments. Advanced Integrated Development Environments (IDEs) and tools providing enhanced code assistance, debugging, and profiling capabilities.

5th Semester	Project Work (PW) MINI PROJECT	M23BCA506

1. Prerequisites

S/L	Proficiency	Prerequisites
1	Basic Engineering Principles	Fundamental courses in the respective engineering stream
2	Application of Theoretical Knowledge in Practical Scenarios	Knowledge of the core subjects of the respective stream
3	Project Design and Planning	Familiarity with design tools and project management techniques.
4	Multidisciplinary Collaboration	Basic knowledge of related disciplines (e.g., Mechanical students should have a basic understanding of Electronics, etc.).
5	Technical Communication	Writing technical reports and presenting technical content

2. Competencies

S/L	Competency	KSA Description
1	Problem Identification and Analysis	**Knowledge:** Understanding the problem domain and relevant engineering concepts. **Skill:** Ability to analyze and break down complex problems into manageable parts. **Attitude:** Attention to detail and a systematic approach to problem-solving.
2	Solution Design and Implementation	**Knowledge:** Familiarity with design methodologies and tools. **Skill:** Proficiency in creating prototypes or models using appropriate technologies. **Attitude:** Creativity and innovation in developing solutions.
3	Interdisciplinary Collaboration	**Knowledge:** Understanding of basic concepts from other engineering disciplines. **Skill:** Effective communication and teamwork in a multidisciplinary environment. **Attitude:** Openness to different perspectives and willingness to collaborate.
4	Technical Documentation and Presentation	**Knowledge:** Standards and practices for technical writing and reporting. **Skill:** Ability to document the project effectively and present it to an audience. **Attitude:** Confidence and clarity in communication.
5	Project Management	**Knowledge:** Understanding of project timelines, resource allocation, and risk management. **Skill:** Ability to plan, execute, and monitor a project from start to finish. **Attitude:** Responsibility and accountability in managing project tasks.

3. Project Timeline

S/L	Timeline	Description
1	**Week 1-2:** Introduction and Problem Definition	Students will define their project problem, scope, and objectives with the guidance of their mentors.
2	**Week 3-4:** Research and Feasibility Study	Conduct background research, explore existing solutions, and evaluate the feasibility of different approaches.
3	**Week 5-6:** Design and Planning	Develop a detailed project plan, including design specifications, timelines, and resource requirements.
4	**Week 7-8:** Prototype Development	Begin building the initial prototype or model, focusing on core functionalities.
5	**Week 9-10:** Testing and Refinement	Test the prototype, identify issues, and refine the design to improve performance.
6	**Week 11:** Final Implementation and Documentation	Complete the final implementation of the project and prepare detailed documentation.
7	**Week 12:** Presentation and Evaluation	Present the project to a committee for evaluation, followed by a Q&A session.

4. Assessment Details (both CIE and SEE)

Continuous Internal Evaluation:

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.

SEE: There shall be no SEE.

5. Learning Objectives

S/L	Learning Objectives	Description
1	Identify and Analyze Engineering Problems	Students will learn to identify real-world engineering problems, analyze them, and propose feasible solutions.
2	Design and Implement Solution(s)	Students will gain experience in designing and implementing engineering solutions using appropriate tools and methodologies.
3	Collaborate Effectively in Teams	Students will develop teamwork skills through collaboration with peers from different engineering disciplines.
4	Communicate Technical Information	Students will enhance their ability to document and present technical information effectively.

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

Course Outcomes (COs)

COs	Description
M23BCA506.1	Apply engineering principles to identify, formulate, and solve real-world problems.
M23BCA506.2	Design and develop prototypes or models that address specific engineering challenges.
M23BCA506.3	Collaborate with team members to complete the project successfully.
M23BCA506.4	Document and present the project effectively, demonstrating clear communication skills.

CO-PO-PSO Mapping

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
M23BCA506.1	3	3	-	-	-	-	-	-	3	-	-	3	3	-
M23BCA506.2	3	3	3	-	-	-	3	-	-	-	3	3	3	-
M23BCA506.3	-	3	2	3	-	3	-	-	-	-	-	3	3	
M23BCA506.4	-	-	-	3	3	-	-	3	-	3	-	3	3	-
M23BCA506	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**-**

6. Future with this Subject

The mini-project course will serve as a foundation for more complex and comprehensive project work in the final year, such as the capstone project. The skills developed here, including problem-solving, design, teamwork, and communication, will be crucial for successful completion of future courses and for professional practice in engineering.

5th Semester	Ability Enhancement (AE) Research Methodology and IPR	M23BRMK507

1. **Prerequisites**

S/L	Proficiency	Prerequisites
1.	Basic Understanding of Research Concepts:	Students should have a foundational understanding of what research entails, including its purpose, types, and significance in academic and professional contexts. **Research and Its Types**: Know the differences between basic and applied research, as well as qualitative, quantitative, mixed methods, Variable, Understand dependent, independent, and control variables. **Hypothesis Formation:** Grasp how to formulate and test hypotheses.
2.	Familiarity with Research Design	**Technical Writing:** Proficiency in academic and technical writing is essential. This includes the ability to write clear, concise, and well-structured research papers, essays, and reports. **Experimental Designs:** Learn about different experimental setups, such as controlled experiments, field experiments, and natural experiments. **Non-Experimental Designs**: Understand case studies, longitudinal studies, and cross-sectional studies.
3.	Statistical and Analytical Skills:	**Descriptive Statistics**: Know how to summarize and describe data using measures of central tendency and variability. **Inferential Statistics:** Understand concepts like hypothesis testing, confidence intervals, and p-values. **Data Analysis Software:** Familiarity with tools like SPSS, R, or Python for analyzing data.
4.	Familiarity with Intellectual Property Concepts:	**Introduction to IPR**: A basic understanding of intellectual property rights, including what they are, the different types (patents, trademarks, copyrights, trade secrets), and their significance. **IP Law Basics:** Awareness of basic IP laws and regulations, both at the national and international levels, as they relate to protecting intellectual property. **Ethical Considerations**: Understanding the ethical considerations in research and IP, including issues like copyright infringement, patent rights, and the moral obligations of researchers.
5.	Background in Relevant Academic Discipline:	**Subject-Specific Knowledge**: Depending on the focus of the research methodology course, students should have foundational knowledge in the specific academic discipline (e.g., engineering, social sciences, business) to which the research methodologies will be applied. **Problem-Solving Skills**: Strong problem-solving skills to apply research methodologies effectively within their field of study.
6	Communication and Collaboration Skills:	**Effective Communication**: Ability to effectively communicate research ideas, methodologies, and findings both in written and verbal formats. **Collaboration:** Experience working in teams, as research often involves collaborative efforts, requiring the ability to work effectively with others.
7	Computer and Internet Proficiency:	**Research Tools:** Familiarity with online databases, academic journals, and research tools like Google Scholar, JSTOR, and others for conducting literature reviews and gathering research material. **Document Preparation**: Proficiency in using word processors (e.g., Microsoft Word) and presentation tools (e.g., PowerPoint) to prepare and present research findings. These prerequisites ensure that students are adequately prepared to engage with the material covered in Research Methodology and IPR courses, enabling them to conduct meaningful research and understand the complexities of intellectual property rights.
8	Critical Thinking and Problem-Solving:	**Analytical Skills**: Develop the ability to critically assess research methods and results. **Problem-Solving:** Be able to identify potential issues in research design and implementation.

2. Competencies

S/L	Competency	KSA Description
1.	Research Methodology and Intellectual Property Rights (IPR)	**Knowledge:** Research Design, Data Collection Methods, Statistical Analysis, Research Ethics, And Intellectual Property Rights (IPR): Types of Intellectual Property, IPR Laws and Regulations, IP Management. **Skills:** Critical Analysis, Data Management, Technical Writing, Project Management, And Intellectual Property Rights (IPR): Legal Research, IP Documentation, Negotiation and Licensing, Ethical Decision-Making. **Attitudes:** Curiosity and Open-Mindedness, Integrity and Ethical Responsibility, Persistence and Resilience, Intellectual Property Rights: Respect for Intellectual Property, Proactive Protection, Collaboration and Fairness.
2.	Defining the Research Problem	**Knowledge:** Concept of a Research Problem, Importance of the Research Problem, Contextual Knowledge, Types of Research Problems **Skills:** Critical Thinking, Literature Review, Clarity and Precision. Problem Formulation: Narrowing the Focus, Feasibility Assessment, Hypothesis Development. Alignment with Objectives: Alignment with Research Goals, Stakeholder Consideration. **Attitudes:** Curiosity and Inquisitiveness: Desire to Explore, Open-Mindedness, Critical Reflection: Reflective Thinking, Adaptability, Ethical Responsibility: Ethical Consideration, Responsibility to the Field.
3.	Reviewing the literature	**Knowledge:** Understanding of Literature Review: Purpose of a Literature Review, Types of Literature, Theoretical Frameworks, Literature Search Strategies: Search Tools and Databases, Keywords and Boolean Operators, Critical Reading and Analysis: Evaluating Sources, Synthesizing Information. **Skills:** Literature Search: Efficient Searching, Citation Management, Critical Evaluation: Analytical Reading, Comparative Analysis, Synthesis and Writing: Integrating Literature, Structured Writing, Paraphrasing and Quoting, Ethical Use of Literature: Avoiding Plagiarism, Bias Identification. **Attitudes:** Curiosity and Open-Mindedness: Intellectual Curiosity, Open-Mindedness, Critical Reflection: Skeptical Inquiry, Reflective Thinking, Respect for Academic Integrity: Ethical Responsibility, Responsibility to the Field.
4.	Research Design	**Knowledge:** Research design refers to the overall strategy utilized to answer research questions. A research design typically outlines the theories and models underlying a project. **Skills:** Ability to search for, locate, extract, organize, evaluate and use or present information that is relevant to a particular topic **Attitudes:** A process of detailed and methodical investigation into some area of study.
5.	Design of Sample Surveys	**Knowledge:** Sample survey design is a very mature and deeply rooted discipline in the statistical literature. **Skills:** Mastering the art (and science) of running your own surveys takes time and practice. **Attitudes**: A study design is a set of decisions (design parameters) about what and how much data to collect, and when (how often, for how long) and where to collect it.
6.	Testing of Hypotheses	**Knowledge:** Understand statistical method, used to determine if there is enough evidence in a sample data to draw conclusions about a problem statement. **Skills:** Hypothesis testing is a fundamental concept in statistics that allows us to draw conclusions about a population based on a sample of data. It is a systematic approach used to evaluate whether a claim or hypothesis about the population is supported by the evidence provided by the sample. **Attitudes:** Hypothesis testing is used to assess the plausibility of a hypothesis by using sample data. The test provides evidence concerning the plausibility of the hypothesis, given the data.
7.	Intellectual Property:	**Knowledge:** Protects the work of inventors, artists, writers, and creators, as well as the reputation of individuals, brands, and organization. **Skills:** Refers to creations of the mind, such as inventions, literary ,artistic works and designs;

		Attitudes: IPR provide certain exclusive rights to the inventors or creators of that property, in order to enable them to reap commercial benefits from their creative efforts or reputation.

3. Syllabus

Research Methodology and IPR SEMESTER – V			
Course Code	**M23BRMK507**	CIE Marks	**50**
Number of Lecture Hours/Week(L: T: P: S)	**(2:2:0:0)**	SEE Marks	**50**
Total Number of Lecture Hours	**40 hours Theory**	Total Marks	**100**
Credits	**03**	Exam Hours	**03**

Course Objectives:

1. To give an overview of the research methodology and explain the technique of defining a research problem.
2. To explain the functions of the literature review in research.
3. To explain carrying out a literature search, its review, developing theoretical and conceptual frameworks and writing a review.
4. To explain various research designs and their characteristics
5. To explain the details of sampling designs, measurement and scaling techniques and also different methods of data collections
6. To explain the art of interpretation and the art of writing research reports.
7. To explain various forms of the intellectual property, its relevance and business impact in the changing global business environment.

Module -1

Research Methodology: Introduction, Meaning of Research, Objectives of Research, Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Research Process, Criteria of Good Research.

Defining the Research Problem: Research Problem, Selecting the Problem, Necessity of Defining the Problem.

Module -2

Reviewing the literature: Place of the literature review in research, Bringing clarity and focus to research problem, Improving research methodology, Broadening knowledge base in research area, Enabling contextual findings, Review of the literature, searching the existing literature, reviewing the selected literature.

Research Design: Meaning of Research Design, Need for Research Design, Features of a Good Design, Important Concepts Relating to Research Design, Different Research Designs.

Module -3

Design of Sample Surveys: Design of Sampling: Introduction, Sample Design, Sampling and Non-sampling Errors, Sample Survey versus Census Survey, Types of Sampling Designs**.**

Measurement and Scaling: Qualitative and Quantitative Data, Classifications of Measurement Scales, Goodness of Measurement Scales, Sources of Error in Measurement, Techniques of Developing Measurement Tools, Scaling, Scale Classification Bases, Scaling Technics.

Module -4

Testing of Hypotheses: Hypothesis, Basic Concepts Concerning Testing of Hypotheses, Testing of Hypothesis, Test Statistics and Critical Region, Critical Value and Decision Rule, Procedure for Hypothesis Testing, Hypothesis Testing for Mean, Proportion, Variance, for Difference of Two Mean, for Difference of Two Proportions, for Difference of Two Variances, P-Value approach, Power of Test, Limitations of the Tests of Hypothesis**.**

Module -5

Interpretation and Report Writing: Meaning of Interpretation, Technique of Interpretation, Precaution in Interpretation, Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report.

Intellectual Property: The Concept, Intellectual Property System in India, Development of TRIPS Complied Regime in India, Patents Act, 1970, Trade Mark Act, 1999,The Designs Act, 2000, The Geographical Indications of Goods (Registration and Protection) Act1999, Copyright Act,1957,The Protection of Plant Varieties and Farmers' Rights Act, 2001,The Semi-Conductor Integrated Circuits Layout Design Act, 2000, Trade Secrets, Utility Models, IPR and Biodiversity, The Convention on Biological Diversity (CBD) 1992, Competing Rationales for Protection of IPRs, Leading International Instruments Concerning IPR, World Intellectual Property Organization (WIPO).

TEXTBOOKS:

1. Research Methodology: Methods and Techniques C.R. Kothari, Gaurav Garg New Age International 4th Edition, 2018.
2. Research Methodology a step-by step guide for beginners. (For the topic Reviewing the literature under module2) Ranjit Kumar SAGE Publications Ltd 3rd Edition, 2011REFERENCE TEXTBOOK:
3. Study Material (For the topic Intellectual Property under module 5) Professional Program Intellectual Property Rights, Law and Practice, The Institute of Company Secretaries of India, Statutory Body Under an Act of Parliament, September 2013

Reference Books

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

4. Syllabus Timeline

S/L	Syllabus Timeline	Description
1	Week 1-3: Research Methodology and Defining the Research Problem	**Competency:** Understand the research methodology and problem statements on research. If necessary defines the problem. **Knowledge:** Understand the various functions Research Methods. **Skills**: Know the functions of Research Methods versus Methodology, Research and Scientific Method, Research Process, Criterias of Good Research.
2	Week 4-6: Reviewing the literature and Research Design	**Competency:** Understand the concept of reviewing the literature and broadening knowledge base in research area. **Knowledge**: Understanding of Literature Review: Purpose of a Literature Review, Types of Literature, Theoretical Frameworks, Literature Search Strategies: Search Tools and Databases, Keywords and Boolean Operators, Critical Reading and Analysis. **Skills**: and able to identify Features of a Good Design, Important Concepts Relating to Research Design.
3	Week 8-11: Design of Sample Surveys: Design of Sampling and Measurement and Scaling:	**Competency:** Studying the different types, Sampling and Non-sampling Errors, Sample Survey versus Census Survey. **Knowledge:** Sample survey design is a very mature and deeply rooted discipline in the statistical literature. **Skills:** Learn the qualitative and Quantitative Data, Classifications of Measurement Scales, Goodness of Measurement Scales, and Sources of Error in Measurement.
4	Week 7-8: Testing of Hypotheses	**Competency:** Studying the concept of Basic Concepts Concerning Testing of Hypotheses, Testing of Hypothesis and Test Statistics. **Knowledge**: Understand statistical method, used to determine if there is enough evidence in a sample data to draw conclusions about a problem statement. **Skills:** Able to learn the critical Region, Critical Value and Decision Rule, Procedure for Hypothesis Testing and limitation.
5	Week 9-12: Interpretation and Report Writing and Intellectual Property:	**Competency:** Studying Types of Intellectual Property, IPR Laws and Regulations, IP Management. **Knowledge**: Research Design, Data Collection Methods, Statistical Analysis, Research Ethics, and Intellectual Property Rights (IPR): **Skills**: Learning report writing and The Concept, Intellectual Property System in India, Development of TRIPS Complied Regime in India, Patents Act, 1970, Trade Mark Act, 1999,The Designs Act, 2000, The Geographical Indications of Goods (Registration and Protection) Act1999, Copyright Act,1957

5. Teaching-Learning Process Strategies

S/L	TLP Strategies:	Description
1	Interactive Lectures and Seminars	**Engaging Presentations:** Use interactive lectures to introduce key concepts in research methodology and IPR. Incorporate multimedia presentations, real-world examples, and case studies to make complex topics accessible and engaging. **Guest Lectures**: Invite experts in research methodology, data analysis, and

		IPR to provide insights from their professional experiences. This helps bridge the gap between theory and practice and offers students diverse perspectives.
2	Case-Based Learning	**Real-Life Scenarios:** Utilize case studies that illustrate the application of research methodology and IPR in various fields. For example, examine how companies protect their intellectual property, or how researchers design studies to answer specific research questions. **Problem-Solving Exercises:** Present students with real or hypothetical research problems or IP issues and have them work in groups to develop solutions. This fosters critical thinking and collaborative skills.
3	Research Projects and Assignments	**Practical Research Assignments**: Assign students individual or group research projects where they must define a research problem, review literature, design a study, and analyze data. This hands-on approach reinforces theoretical concepts. **IPR Analysis Projects**: Students can be tasked with evaluating the IP strategy of a particular company or analyzing a legal case involving intellectual property. This encourages the application of IPR knowledge to real-world situations.
4	Workshops and Hands-On Training	**Data Analysis Workshops**: Conduct workshops that provide students with practical training in data analysis software (e.g., SPSS, R, NVivo). These sessions should include step-by-step guidance on how to process and analyze research data. **IP Documentation Practice:** Organize workshops where students learn to draft and file patents, trademarks, and copyrights. This practical experience is crucial for understanding the technical and legal aspects of IP management.
5.	Collaborative Learning	**Group Discussions:** Facilitate small group discussions where students can debate research methodologies or the ethical implications of IP laws. This encourages peer-to-peer learning and helps students articulate their understanding. **Peer Review:** Implement peer review processes where students evaluate each other's research proposals or IP strategies. This not only improves their critical thinking but also fosters a collaborative learning environment.

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 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	Understanding Research Fundamentals	To give an overview of the research methodology and explain the technique of defining a research problem. To explain the functions of the literature review in research.
2	Conducting Literature Reviews	To explain carrying out a literature search, its review, developing theoretical and conceptual frameworks and writing a review.
3	Designing Research Methodologies	To analyse the various research designs and their characteristics
4	Data Collection and Analysis	To analyse and understand the details of sampling designs, measurement and scaling techniques and also different methods of data collections
5	Understanding Intellectual Property Rights (IPR)	To explain the art of interpretation and the art of writing research reports and Analyse various forms of the intellectual property, its relevance and business impact in the changing global business environment

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

Course Outcomes (COs)

COs	Description
M23BRMK507.1	Understand the research methodology and problem along with scientific method and process.
M23BRMK507.2	Analyse the Literature Review and research design process.
M23BRMK507.3	Design the sample survey and measurement and scaling.
M23BRMK507.4	Analyse the testing hypothesis of variance and limitations of research concepts.
M23BRMK507.5	Apply and analyse the research report and The Geographical Indications of Goods (Registration and Protection) Act1999,World Intellectual Property Organisation

CO-PO-PSO Mapping

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
M23BRMK507.1	3	-	-	-	-	-	-	-	-	-	-	-	3	-
M23BRMK507.2	-	3	3	-	-	-	-	-	-	-	-	-	3	-
M23BRMK507.3	-	3	3	-	-	-	-	-	-	-	-	-	3	-
M23BRMK507.4	-	3	3	-	-	-	-	-	-	-	-	-	3	-
M23BRMK507.5	-	-	3	-	-	-	-	-	-	-	-	-	3	-
M23BRMK507	**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:

1. Academic Advancement

- **Pursuing Higher Education:** Mastery of research methodology and IPR provides a strong foundation for advanced studies, such as pursuing a Ph.D. or other research-intensive postgraduate programs. This subject equips students with the necessary skills to conduct independent research and contribute original knowledge to their field.
- **Academic Publishing:** Understanding research methodology enhances the ability to publish research findings in peer-reviewed journals, contributing to academic discourse and establishing a scholarly reputation.

2. Professional Opportunities

- **Research and Development (R&D):** Proficiency in research methodology is critical for careers in R&D across various industries, including technology, pharmaceuticals, and social sciences. Professionals can lead or contribute to innovation projects, product development, and experimental research.
- **Intellectual Property Management:** Knowledge of IPR opens up career paths in IP management, including roles such as patent agents, IP consultants, or legal advisors in technology transfer offices or law firms specializing in IP rights.
- **Consulting and Advisory Roles:** Expertise in research methodology and IPR can lead to consulting opportunities, where professionals provide advice on research design, data analysis, and IP strategy to businesses, government agencies, or non-profit organizations.

3. Entrepreneurship and Innovation

- **Startups and Innovation:** Understanding IPR is crucial for entrepreneurs and innovators who wish to protect their inventions, trademarks, or creative works. This knowledge enables them to navigate the legal landscape, secure patents, and manage IP assets effectively.
- **Technology Transfer:** Professionals with expertise in research methodology and IPR can work in technology transfer, facilitating the commercialization of research innovations from universities and research institutions to the market.

4. Contribution to Society

- **Policy Development:** Expertise in research methodology and IPR is valuable for contributing to policy development in areas such as innovation, education, healthcare, and intellectual property law. Professionals can work with governmental and international organizations to shape policies that promote ethical research and protect intellectual property rights.
- **Social Impact Research:** Professionals can engage in research that addresses societal challenges, such as public health, environmental sustainability, or social equity. Understanding research methodology ensures that such research is rigorous, valid, and capable of informing public policy and practice.

5. Lifelong Learning and Professional Development

- **Continuous Education:** The field of research methodology and IPR is dynamic, with ongoing advancements in research techniques, data analysis tools, and IP laws. Professionals committed to this subject will engage in lifelong learning, attending workshops, conferences, and courses to stay current with developments.
- **Networking and Collaboration:** Future opportunities in this subject involve building strong professional networks and collaborating with experts across disciplines. This collaborative approach enhances research quality and broadens the impact of one's work.

6. Ethical and Sustainable Research

Promoting Ethical Research: As research and innovation continue to evolve, there will be an increasing focus on ethical considerations, including the responsible conduct of research, equitable access to IP, and the sustainable use of resources. Professionals in this field will play a critical role in promoting ethical research practices and advocating for policies that balance innovation with social responsibility.

7. Influence on Future Innovations

Shaping the Future of Research and IP: Mastery of research methodology and IPR enables professionals to influence the direction of future research and innovation. Whether through groundbreaking research, the development of new IP strategies, or contributions to the legal framework, individuals in this field will be at the forefront of shaping how knowledge is created, shared, and protected.

5th Semester	Basic Science (BS) ENVIRONMENTAL STUDIES	M23BESK508

1. Prerequisites

S/L	Proficiency	Prerequisites
1	Understanding Ecosystems	Basic knowledge of biology, environmental science, and ecological systems.
2	Comprehending Natural Resource Management	Familiarity with energy systems, environmental management, and global sustainability practices.
3	Knowledge of Environmental Pollution	Understanding of chemical processes, industrial impacts, and environmental science fundamentals.
4	Addressing Global Environmental Concerns	Knowledge of climate science, environmental policies, and global ecological challenges.
5	Awareness of Environmental Legislation	Familiarity with national and international environmental laws, policies, and regulations.

2. Competencies

S/L	Competency	KSA Description
1	Ecosystem Analysis	**Knowledge**: Ecosystem structure, sustainability principles, SDGs. **Skills**: Identifying ecosystem components, and understanding sustainability targets. **Attitudes**: Appreciating biodiversity, and promoting sustainability.
2	Resource Management	**Knowledge**: Renewable and non-renewable energy systems, sustainable practices. **Skills**: Analyzing case studies, and evaluating energy systems. **Attitudes**: Supporting sustainable resource use, and critical thinking on global issues.
3	Pollution Mitigation	**Knowledge**: Pollution sources, impacts, and legislation. **Skills**: Assessing pollution control measures, and implementing waste management strategies. **Attitudes**: Advocating for environmental protection, and responsible waste disposal.
4	Global Environmental Awareness	**Knowledge**: Climate change, groundwater depletion, global policies. **Skills**: Investigating global environmental challenges, and proposing solutions. **Attitudes**: Engaging in global environmental discussions, and supporting international efforts.
5	Environmental Legal Framework	**Knowledge**: Key environmental acts and regulations. **Skills**: Applying legal knowledge to environmental issues, and understanding EIA processes. **Attitudes**: Valuing legal frameworks, and ensuring compliance with environmental laws.

3. Syllabus

ENVIRONMENTAL STUDIES SEMESTER – V			
Course Code	**M23BESK508**	CIE Marks	**50**
Number of Lecture Hours/Week(L: T: P: S)	**(2:0:0:0)**	SEE Marks	**50**
Total Number of Lecture Hours	**25 hours Theory**	Total Marks	**100**
Credits	**02**	Exam Hours	**02**

Course Objectives: Students will be able,

1.Understand the structure and function of various ecosystems like forests, deserts, wetlands, rivers, oceans, and lakes.

2. Explore natural resource management techniques, including energy systems and disaster management, and assess their sustainability.

3.Examine environmental pollution sources and impacts, and learn corrective and preventive measures alongside waste management strategies.

4.Investigate global environmental issues such as climate change and groundwater depletion, and the role of environmental legislation in addressing these issues.

Module -1
ECOSYSTEMS (STRUCTURE AND FUNCTION): Forest, Desert, Wetlands, River, Oceanic and Lake. Sustainability: 17 SDGs- History, targets, implementation , Capacity Development
Module -2
NATURAL RESOURCE MANAGEMENT Advances in Energy Systems (Merits, Demerits, Global Status and Applications): Hydrogen, Solar, OTEC, Tidal and Wind. Natural Resource Management (Concept and case-studies): Disaster Management, Sustainable Mining - case studies and Carbon Trading.
Module -3
ENVIRONMENTAL POLLUTION & WASTE MANAGEMENT Environmental Pollution (Sources, Impacts, Corrective and Preventive measures, Relevant Environmental Acts, Case-studies): Surface and Ground Water Pollution; Noise pollution; Soil Pollution and Air Pollution. Waste Management: Bio-medical Wastes; Solid waste; Hazardous wastes; E-wastes; Industrial and Municipal Sludge.
Module -4
Global Environmental Concerns (Concept, policies and case-studies): Ground water depletion/recharging, Climate Change; Acid Rain; Ozone Depletion; Radon and Fluoride problem in drinking water; Resettlement and rehabilitation of people, Environmental Toxicology.
Module -5
ENVIRONMENTAL LEGISLATION : Water Act 1974, Air Act 1981, Environmental Protection Act 1984, Solid Waste Management Rules-2016, E- Waste management Rule - 2022, Biomedical Waste management- 2016. Environmental Impact Assessment
TEXTBOOKS: 1. Environmental studies, Benny Joseph, Tata Mcgraw-Hill 2nd edition 2012 2. Environmental studies, S M Prakash, pristine publishing house, Mangalore 3rd edition-2018 **REFERENCE BOOKS:** 1. Benny Joseph, Environmental studies, Tata Mcgraw-Hill 2nd edition 2009 2. M.Ayi Reddy Textbook of environmental science and Technology, BS publications 2007 3. Dr. B.S Chauhan, Environmental studies, university of science press 1st edition **VIDEO LINKS:** 1. Weblink: https://sdgs.un.org/goals Video Lectures 2. https://archive.nptel.ac.in/courses/109/105/109105190/

4. Syllabus Timeline

S/L	Syllabus Timeline	Description
1	**Week 1-2**	Introduction to ecosystems, exploring their structure and function with a focus on sustainability and SDGs.
2	**Week 3-4**	Understanding natural resource management, advances in energy systems, and disaster management through case studies.
3	**Week 5-6**	Examination of environmental pollution sources, impacts, and preventive measures, along with waste management strategies.
4	**Week 7-8**	Exploration of global environmental concerns such as climate change, groundwater depletion, and related policies.
5	**Week 9-10**	Study of environmental legislation, including key environmental acts and the process of Environmental Impact Assessment (EIA).
6	**Week 11-12**	Revision

5. Teaching-Learning Process Strategies

S/L	TLP Strategies:	Description
1	Interactive Lectures:	Utilize chalk and talk along with PowerPoint presentations and animations to engage students in theoretical and practical understanding
2	Case Study Analysis:	Present real-world scenarios and case studies to help students apply theoretical knowledge to practical situations, particularly in natural resource management and pollution control.
3	Fieldwork and Site Visits	Encourage hands-on learning through field visits to environmental labs, green buildings, and treatment plants, followed by documentation and analysis of the processes observed.
4	Collaborative Learning	Promote group projects and discussions, enabling students to collaborate and learn from each other, particularly in global environmental concerns and energy systems.

6. Assessment Details (both CIE and SEE)

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) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous internal Examination (CIE)

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the regulations, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

The sum of two tests, two assignments, will be out of 100 marks and will be scaled down to 50 marks.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examinations (SEE)

SEE paper shall be set for **50 questions**, each of the 01 marks. **The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is 01 hour.** The student has to secure a minimum of 35% of the maximum marks meant for SEE.

7. Learning Objectives

S/L	Learning Objectives	Description
1	Analyze the structure and function of various ecosystems.	Students will learn about the characteristics and interactions within ecosystems such as forests, deserts, wetlands, rivers, oceans, and lakes.
2	Evaluate natural resource management techniques.	Students will assess the merits and demerits of various energy systems and learn sustainable management practices through case studies.
3	Investigate environmental pollution and waste management.	Students will understand the sources and impacts of environmental pollution, along with strategies for pollution control and waste management.
4	Explore global environmental concerns and policies.	Students will study global issues like climate change and groundwater depletion, and examine the role of environmental legislation in addressing these challenges.
5	Understand environmental legislation and its application.	Students will gain insights into key environmental acts and regulations, and learn how to apply them in real-world scenarios.

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

Course Outcomes (COs)

COs	Description
M23BESK508.1	Analyze the structure and functions of various ecosystems and evaluate their sustainability
M23BESK508.2	Apply knowledge of natural resource management and advances in energy systems to assess their global impacts
M23BESK508.3	Investigate environmental pollution sources and apply waste management strategies in real-world scenarios
M23BESK508.4	Critically analyze global environmental concerns and assess the effectiveness of environmental policies
M23BESK508.5	Demonstrate an understanding of environmental legislation and apply it to ensure sustainable practices

CO-PO-PSO Mapping

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
M23BESK508.1	3	-	-	-	-	-	-	-	-	-	-	3
M23BESK508.2	-	3	-	-	-	-	-	-	-	-	-	3
M23BESK508.3	-	-	3	-	-	-	-	-	-	-	-	3
M23BESK508.4	-	-	-	3	-	-	-	-	-	-	-	3
M23BESK508.5	-	-	-		3	-	-	-	-	-	-	3
M23BESK508	**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

This course provides a foundational understanding of environmental science that is crucial for advanced studies in environmental engineering, sustainability, and policy-making. It equips students with the knowledge and skills to tackle global environmental challenges and supports interdisciplinary research, making it a valuable asset for careers in environmental management, consulting, and advocacy.

5thSemester	Non-Credit Mandatory Course(NCMC) National Service Scheme(NSS)	M23BNSK509

Non-Credit Mandatory Courses(NCMC) National Service Scheme(NSS)			
Course Code	**M23BNSK509**		
Number of Lecture Hours/Week(L:T:P:S)	**(0:0:2:0)**	CIE Marks	**100**
Total Number of Lecture Hours	-	SEE Marks	**-**
Credits	**0**	Total Marks	**100**
Activities Report Evaluation by College NSS Officer at the end of every semester(3rd to 6thsemester)			

Course objectives:

National Service Scheme (NSS) will enable students to:

1. Understand the community in general in which they work.
2. Identify the needs and problems of the community and involve them in problem–solving.
3. Develop among themselves a sense of social & civic responsibility & utilize their knowledge in finding practical solutions to individual and community problems.
4. Develop competence required for group-living and sharing of responsibilities & gain skills in mobilizing community participation to acquire leadership qualities and democratic attitudes.
5. Develop capacity to meet emergencies and natural disasters & practice national integration and social harmony in general.

General Instructions-Pedagogy:

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. In addition to the traditional lecture method, different types of innovative teaching methods may be adopted so that the activities will develop students' theoretical and applied social and cultural skills.
2. State the need for NSS activities and its present relevance in the society and Provide real-life examples.
3. Support and guide the students for self-planned activities.
4. You will also be responsible for assigning homework, grading assignments and quizzes, and documenting students' progress in real activities in the field.
5. Encourage the students for group work to improve their creative and analytical skills.

Contents :

1. Organic farming, Indian Agriculture (Past, Present and Future)Connectivity for marketing.
2. Waste management– Public, Private and Govt organization, 5R's.
3. Setting of the information imparting club for women leading to contribution in social and economic issues.
4. Water conservation techniques–Role of different stakeholders–Implementation.
5. Preparing an action able business proposal for enhancing the village in come and approach for implementation.
6. Helping local schools to achieve good results and enhance their enrolment in Higher/technical/vocational education.
7. Developing Sustainable Water management system for rural areas and implementation approaches.
8. Contribution to any national level initiative of Government of India. For eg. Digital India, Skill India, Swatch Bharat, Atmanirbhar Bharath, Make in India, Mudra scheme, Skill development programs etc.
9. Spreading public awareness under rural out reach programs.(minimum 5 programs).
10. Social connect and responsibilities.
11. Plantation and adoption of plants. Know your plants.
12. Organize National integration and social harmony events/workshops/seminars.(Minimum 02 programs).
13. Govt.school Rejuvenation and helping them to achieve good infrastructure.

NOTE:

Student/s in individual or in a group should select any one activity in the beginning of each semester till end of that respective semester for successful completion as per the instructions of NSS officer with the consent of HOD of the department.

At the end of every semester, activity report should be submitted for evaluation.

Distribution of Activities – Semester wise from 3rd to 6th semester.

Sem	Topics / Activities to be Covered
3rdSem for 25 Marks	1. Organic farming, Indian Agriculture (Past, Present, and Future) Connectivity for marketing. 2. Waste management– Public, Private and Govt organization, 5R's. 3. Setting of the information imparting club for women leading to contribution in social and economic issues.
4thSem for 25 Marks	1. Water conservation techniques– Role of different stakeholders–Implementation. 2. Preparing an actionable business proposal for enhancing the village income and approach for implementation. 3. Helping local schools to achieve good results and enhance their enrolment in Higher/technical/ vocational education.
5thSem for 25 Marks	1. Developing Sustainable Water management systems for rural areas and implementation approaches. 2. Contribution to any national-level initiative of the Government of India. For eg. Digital India, Skill India, SwachhBharat, Atmanirbhar Bharath, MakeinIndia, Mudrascheme, Skill development programs etc. 3. Spreading public awareness under rural out reach programs.(minimum 5 programs). 4. Social connect and responsibilities.
6thSemfor 25 Marks	1. Plantation and adoption of plants. Know your plants. 2. Organize National integration and social harmony events/workshops/seminars.(Minimum 02 programs). 3. Govt.school Rejuvenation and helping them to achieve good infrastructure.

Course outcomes (Course Skill Set):

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

Cos	Description
M23BNSK509.1	Understand the importance of his/her responsibilities towards society.
M23BNSK509.2	Analyse the environmental and societal problems/issues and will be able to design solutions for the same.
M23BNSK509.3	Evaluate the existing system and to propose practical solutions for the same for sustainable development.
M23BNSK509.4	Implement government or self-driven projects effectively in the field.
M23BNSK509.5	Develop capacity to meet emergencies and natural disasters & practice national integration and social harmony in general.

Pedagogy–Guidelines

Sl No	Topic	Group size	Location	Activity execution	Reporting	Evaluation of the Topic
1.	Organic farming, Indian Agriculture (Past, Present, and Future) Connectivity for marketing.	May be individual or team	Farmers land/ Villages/ roadside/ community area /College campus etc	Site selection / proper consultation/ Continuous monitoring/ Information board	Report should be submitted by an individual to the concerned evaluation authority	Evaluation as per the rubrics of the scheme and syllabus by NSS officer
2.	Waste management– Public, Private and Govt organization,5R's.	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/ Government	Site selection / proper consultation/ Continuous monitoring/ Information board	Report should be submitted by an individual to the concerned evaluation	Evaluation as per the rubrics of the scheme and syllabus by

			Schemes officers /campus etc…		authority	NSS officer
3.	Setting of the information imparting club for women leading to contribution in social And economic issues.	May be individual or team	Women empowerment groups/ Consulting NGOs & Govt Teams / College campus etc…	Group selection/ proper consultation / Continuous monitoring / Information board	Report should be submitted by an individual to the concerned evaluation authority	Evaluation as per the rubrics of the scheme and syllabus by NSS officer
4.	Water conservation techniques – Role of different stakeholders– Implementation.	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/ Government Schemes officers / Campus etc…	Site selection/ Proper consultation/ Continuous monitoring/ Information board	Report should be submitted by an individual to the concerned evaluation authority	Evaluation as per the rubrics of the scheme and syllabus by NSS officer
5.	Preparing an actionable business proposal for enhancing the village income and approach for implementation.	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/ Government Schemes officers /campus etc…	Group selection/ proper consultation / Continuous monitoring / Information board	Report should be submitted by an individual to the concerned evaluation authority	Evaluation as per the rubrics of the scheme and syllabus by NSS officer
6.	Helping local schools to achieve good results and enhance their enrolment in Higher/ technical/ vocational education.	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/ Government Schemesofficers /campus etc…	School selection/ proper consultation / Continuous monitoring / Information board	Report should be submitted by an individual to the concerned evaluation authority	Evaluation as per the rubrics of the scheme and syllabus by NSS officer
7.	Developing Sustainable Water management system for rural areas and implementation approaches.	May be individual or team	Villages/City Areas / Grama panchayat/ public associations/ Government Schemes officers /campus etc…	Site selection/ proper consultation/ Continuous monitoring / Information board	Report should be submitted by an individual to the concerned evaluation authority	Evaluation as per the rubrics of the scheme and syllabus by NSS officer
	Contribution to any			Group		

8.	national-level initiative of the Government of India. For eg. Digital India, Skill India, Swachh Bharat, Atmanirbhar Bharath, Make in India, Mudrascheme, Skill development programs etc.	May be individual or team	Villages/City Areas / Grama panchayat/ public associations/ Government Schemesofficers /campus etc…	selection/ proper consultation/ Continuous monitoring / Information board	Report should be submitted by an individual to the concerned evaluation authority	Evaluation as per the rubrics of the scheme and syllabus by NSS officer
9.	Spreading public awareness under rural out reach programs.(minimum 5 programs).Social connect and responsibilities.	May be individual or team	Villages/City Areas / Grama panchayat/ public associations/ Government Schemesofficers /campus etc…	Group selection/ proper consultation/ Continuous monitoring / Information board	Report should be submitted by an individual to the concerned evaluation authority	Evaluation as per the rubrics of the scheme and syllabus by NSS officer
10.	Plantation and adoption of plants. Know your plants.	May be individual or team	Villages/City Areas / Grama panchayat/ public associations/ Government Schemesofficers /campus etc…	Place selection/ proper consultation/ Continuous monitoring / Information board	Report should be submitted by an individual to the concerned evaluation authority	Evaluation as per the rubrics of the scheme and syllabus by NSS officer
11.	Organize National integration and social harmony events /workshops /seminars.(Minimum 02 programs).	May be individual or team	Villages/City Areas / Grama panchayat/ public associations/ Government Schemes officers /campus etc…	Place selection/ proper consultation/ Continuous monitoring / Information board	Report should be submitted by an individual to the concerned evaluation authority	Evaluation as per the rubrics of the scheme and syllabus by NSS officer
12.	Govt. school Rejuvenation and helping them to achieve good infrastructure.	**May be individual or team**	Villages/City Areas / Grama panchayat/ public associations/ Government Schemes officers /campus etc…	Place selection/ proper consultation/ Continuous monitoring / Information board	Report should be submitted by an individual to the concerned evaluation authority	Evaluation as per the rubrics of the scheme and syllabus by NSS officer

It may differ depending on local resources available for the study as well as environment and climatic differences, location, and time of execution.

Plan of Action ((Execution of Activities For Each Semester)

Sl. No	Practice Session Description
1.	**Lecture session by NSS Officer**
2.	**Students Presentation on Topics**
3.	**Presentation-1,Selection of topic, PHASE-1**

4.	**Commencement of activity and its progress -PHASE-2**
5.	**Execution of Activity**
6.	**Execution of Activity**
7.	**Execution of Activity**
8.	**Execution of Activity**
9.	**Execution of Activity**
10.	**Case-study-based Assessment, Individual performance**
11.	**Sector wise study and its consolidation**
12.	**Video-based seminar for 10-minutes by each student At the end of the semester with a Report.**

- In every semester from 3rd semester to 6th semester, Each student should do activities according to the scheme and syllabus.
- At the end of every semester student performance has to be evaluated by the NSS officer for the assigned activity progress and its completion.
- At last in 6th semester consolidated report of all activities from 3rd to 6thsemester, compiled report should be submitted as per the instructions.

Assessment Details:

Weightage	**CIE– 100%**	
Presentation-1 Selection of topic, PHASE-1	**10 Marks**	• Implementation strategies of the project(NSS work). • The last Report should be signed by the NSS Officer, the HOD, and the principal. • At-last Report should be evaluated by the NSS officer of the institute. • Finally, the consolidated marks sheet should be sent to the university and made available at the LIC visit.
Commencement of activity and its progress - PHASE-2	**10 Marks**	
Case Study-based Assessment Individual Performance with Report	**10 Marks**	
Sector-wise study & its consolidation	**10 Marks**	
Video based seminar for 10 minutes byeach student At the end of semester with Report. Activities.	**10 Marks**	
Total marks for the course in each semester	**50 Marks**	

Marks scored for 50 by the students should be Scale down to 25 marks In each semester for CIE entry in the VTU portal.

25 marks CIE entry will be entered in University IA marks portal at the end of each semester 3rd to 6th sem, Report and assessment copy should be made available in the department semester wise

Students should present the progress of the activities as per the schedule in the prescribed practical session in the field.
There should be positive progress in the vertical order for the benefit of society in general.

Suggested Learning Resources:
Books:

1. NSS Course Manual, Published by NSS Cell, VTU Belagavi.
2. Government of Karnataka, NSS cell, activities reports and manual.
3. Government of India, NSS cell, Activities reports and manual.

5th Semester	Non-Credit Mandatory Courses(NCMC) PHYSICAL EDUCATION (SPORTS & ATHLETICS) - III	M23BPEK509

Non-Credit Mandatory Course (NCMC) PHYSICAL EDUCATION (SPORTS & ATHLETICS) -III			
Course Code	**M23BPEK509**	CIE Marks	**100**
Number of Lecture Hours/Week(L:T:P:S)	**(0:0:2:0)**	SEE Marks	-
Total Number of Lecture Hours	**-**	Total Marks	**100**
Credits	**0**	Exam Hours	**-**

Semester-V

PHYSICAL EDUCATION (SPORTS & ATHLETICS)—III

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

COs	Description
M23BPEK509.1	Understand the ethics and moral values in sports and athletics.
M23BPEK509.2	Perform in the selected sports or athletics of the student's choice.
M23BPEK509.3	Understand the roles and responsibilities of organization and administration of sports and games.

Module-1

Ethics and Moral Values **(5hours)**

A. Ethics in Sports
B. Moral Values in Sports and Games

Module-2

Specific Games(Anyone to be selected by the student) **(20hours)**

A. Volley ball—Attack,Block,Service,Upper Hand Pass and Lower hand Pass.
B. Throwball—Service,Receive,Spinattack,NetDrop & Jumpthrow.
C. Kabaddi—Handtouch,ToeTouch,ThighHold,Anklehold and Bonus.
D. Kho-Kho—Giving Kho,SingleChain,Pole dive,Pole turning,3-6Up.
E. TableTennis—Service(ForeHand&BackHand),Receive(ForeHand&BackHand),Smash.
F. Athletics(Track/FieldEvents)—Any event as per availability of Ground.

Module-3

Role of Organisation and administration **(5 hours)**

Sl. No.	Activity
1.	Participation of student in all the modules
2.	Quizzes—2,each of 15 marks
3.	Final presentation/exhibition/Participation in competitions/practical on specific tasks assigned to the students

5thSemester	Non-Credit Mandatory Course(NCMC) Yoga	M23BYOK509

Non-Credit Mandatory Courses(NCMC) Yoga			
Course Code	**M23BYOK509**		
Number of Lecture Hours/Week(L: T: P: S)	**0:0:2:0**	CIE Marks	**100**
Total Number of Lecture Hours	-	SEE Marks	**-**
Credits	**0**	Total Marks	**100**
Evaluation Method: Objective type Theory / Practical / Viva-Voce			

Course objectives:

1. To enable the student to have good Health.
2. To practice mental hygiene.
3. To possess emotional stability.
4. To integrate moral values.
5. To attain a higher level of consciousness.

The Health Benefits of Yoga

The benefits of various yoga techniques have been supposed to improve

- body flexibility,
- performance,
- stress reduction,
- attainment of inner peace, and
- self-realization.

The system has been advocated as a complementary treatment to aid the healing of severalailments such as

- coronary heart disease,
- depression,
- anxiety disorders,
- asthma, and
- extensive rehabilitation for disorders including musculoskeletal problems and traumatic brain injury.

The system has also been suggested as behavioral therapy for smoking cessation and substance abuse (including alcohol abuse).

If you practice yoga, you may receive these physical, mental, and spiritual benefits:

- Physical
  1. Improved body flexibility and balance
  2. Improved cardiovascular endurance (stronger heart)
  3. Improved digestion
  4. Improved abdominal strength
  5. Enhanced overall muscular strength
  6. Relaxation of muscular strains
  7. Weight control
  8. Increased energy levels
  9. Enhanced immune system
- Mental
  1. Relief of stress resulting from the control of emotions
  2. Prevention and relief from stress-related disorders
  3. Intellectual enhancement, leading to improved decision-making skills
- Spiritual
  1. Life with meaning, purpose, and direction
  2. Inner peace and tranquility
  3. Contentment

Yoga Syllabus

Semester V

- Patanjali's Ashtanga Yoga its need and importance.
- Ashtanga Yoga

1. Asana
2. Pranayama
3. Pratyahara

- Asana its meaning by name, technique, precautionary measures and benefits of each asana
- Different types of Asanas

a. Sitting 1. Ardha Ushtrasana 2. Vakrasana 3. Yogamudra in Padmasana
b. Standing 1. UrdhvaHastothanasana 2. Hastapadasana 3. ParivrittaTrikonasana 4. Utkatasana
c. Prone line 1. Padangushtha Dhanurasana 2. Poorna Bhujangasana / Rajakapotasana
d. Supine line 1. Sarvangasana 2. Chakraasana 3. Navasana/Noukasana 4. Pavanamuktasana

- Revision of practice 60 strokes/min 3 rounds
- Meaning by name, technique, precautionary measures and benefits of each Pranayama 1. Ujjayi 2. Sheetali 3. Sheektari

Course outcomes (Course Skill Set):
At the end of the course, the student will be able to:

COs	Description
M23BYOK509.1	Understand the meaning, aim and objectives of Yoga.
M23BYOK509.2	Perform Suryanamaskar and able toTeach its benefits.
M23BYOK509.3	Understand and teach different Asanasbyname,its importance,methods and ben
M23BYOK509.4	Instruct Kapalabhati and its need and importance.
M23BYOK509.5	Teach different types of Pranayamaby its name,precautions,procedure and use
M23BYOK509.6	Coach different types of Kriyas, method to follow and usefulness.

Assessment Details (both CIE and SEE)

- Students will be assessed with internal test by a. Multiple choice questions b. Descriptive type questions (Twointernal assessment tests with 25 marks/test)
- Final test shall be conducted for whole syllabus for 50 marks.
- Continuous Internal Evaluation shall be for 100 marks (including IA test)

Suggested Learning Resources:
Books:

1. Yogapravesha in Kannada by Ajitkumar
2. Light on Yoga by BKS Iyengar
3. Teaching Methods for Yogic practices by Dr. M L Gharote & Dr. S K Ganguly
4. Yoga Instructor Course hand book published by SVYASA University, Bengaluru
5. Yoga for Children –step by step – by Yamini Muthanna

Web links and Video Lectures
(e-Resources):Refer links

6. https://youtu.be/KB-TYlgd1wE
7. https://youtu.be/aa-TG0Wg1Ls

6th Semester	Integrated Professional Course (IPC) Advanced Machine Learning	M23BCA601

1. Prerequisites

To tackle advanced machine learning effectively, you need a solid foundation in several key areas. Here's a breakdown of the prerequisites:

S/L	Proficiency	Prerequisites
1	Mathematics	• **Linear Algebra:** Understanding vectors, matrices, eigenvalues, and eigenvectors is crucial, especially for algorithms involving transformations and dimensionality reduction. • **Calculus:** Familiarity with derivatives and integrals, particularly partial derivatives, is important for optimization and learning algorithms. • **Probability and Statistics:** Knowledge of probability distributions, statistical inference, hypothesis testing, and Bayesian methods is essential for understanding data and model evaluation. • **Discrete Mathematics:** Concepts like combinatorics and graph theory can be useful, especially for understanding certain algorithms and their complexities.
2	Programming Skills	• **Python:** Proficiency in Python is almost a must, as it's the most widely used language in machine learning due to its extensive libraries and frameworks. • **Libraries and Frameworks:** Familiarity with libraries like NumPy, pandas, scikit-learn, TensorFlow, Keras, and PyTorch will be very helpful.
3	Basic Machine Learning Concepts	• **Supervised Learning:** Understanding regression, classification, and techniques like decision trees, SVMs, and neural networks. • **Unsupervised Learning:** Familiarity with clustering algorithms (e.g., k-means, hierarchical clustering) and dimensionality reduction techniques (e.g., PCA). • **Model Evaluation:** Knowledge of metrics like accuracy, precision, recall, F1-score, ROC-AUC, and methods for cross-validation.
4	Data Handling	• **Data Preprocessing:** Skills in cleaning, transforming, and handling missing values in data. • **Feature Engineering:** Techniques for creating, selecting, and optimizing features to improve model performance.
5	Algorithms and Complexity	• **Algorithm Design:** Understanding of algorithmic complexity, time and space complexity, and data structures. • **Optimization:** Familiarity with optimization techniques like gradient descent and advanced methods (e.g., Adam optimizer).
6	Machine Learning Theory	• **Bias-Variance Tradeoff:** Understanding how model complexity impacts performance. • **Overfitting and Regularization:** Techniques like L1/L2 regularization, dropout, and early stopping. • **Model Selection and Hyperparameter Tuning:** Knowledge of methods like grid search and random search.
7	Deep Learning (for advanced topics)	• **Neural Networks:** Understanding the architecture of neural networks, including layers, activation functions, and backpropagation. • **Advanced Architectures:** Knowledge of convolutional neural networks (CNNs), recurrent neural networks (RNNs), and transformers. • **Frameworks:** Proficiency in using deep learning frameworks like TensorFlow and PyTorch for building and training models.

2. Competencies

To excel in advanced machine learning, you'll need to develop a set of competencies that go beyond the basics. Here's a detailed overview of the key competencies required

S/L	Competency	KSA Description
1	**Fundamental Concepts**	**Knowledge:** Neural Network Architecture, Training and Optimization, Loss Functions. **Skills:** Programming and Implementation: Python Proficiency, Model Development, Data Pre-processing. **Attitudes:** Curiosity and Continuous Learning: A willingness to explore new deep learning techniques, stay updated with advancements, and integrate cutting-edge methods.
2	**Advanced Techniques**	**Knowledge:** Machine Learning Algorithms, Regularization and Optimization, Decision tree Learning, ANN Learning. **Skills:** Model Evaluation and Optimization: Hyper parameter Tuning, Performance Assessment: **Attitudes:** Critical Thinking: Problem Solving, Analytical Mind-set.
3	**Mathematics and Statistics**	**Knowledge:** Linear Algebra, Calculus, Probability and Statistics. **Skills:** Problem-Solving and Application: Project Implementation, Experimentation. **Attitudes:** Ethical Considerations: Responsibility, Transparency.
4	**Machine Learning Fundamentals**	**Knowledge:** Supervised and Unsupervised Learning, Model Evaluation. **Skills:** Advanced Techniques: ANN Learning, Biased Learning **Attitudes:** Collaboration and Communication: Teamwork, Effective Communication.

3. Syllabus

Advanced Machine Learning **SEMESTER – VI**			
Course Code	**M23BCA601**	CIE Marks	**50**
Number of Lecture Hours/Week(L: T: P: S)	**(2:2:0:0)**	SEE Marks	**50**
Total Number of Lecture Hours	**40 hours Theory**	Total Marks	**100**
Credits	**04**	Exam Hours	**03**

Course Objectives:

1. Study the concepts of Supervised Learning Algorithms.
2. To solve Neural Networks problems in machine learning.
3. Understand the Bayesians Learning to classify Machine Learning models.
4. Analyze Unsupervised Machine Learning techniques.
5. Compare Analytical Learning approach with Inductive Learning approach.

Module -1

Concept Learning: Concept learning task, Concept learning as search, Find-S algorithm, Version space, Candidate Elimination algorithm, Remarks on Version spaces and Candidate Elimination, Inductive Bias.
Decision Tree Learning: Decision tree representation, Appropriate problems for decision tree learning, Basic decision tree learning algorithm, hypothesis space search in decision tree learning, Inductive bias in decision tree learning, Issues in decision tree learning.
Text Book1, Sections: 1.1 – 1.3, 2.1-2.7. Sections: 3.1-3.7

Module -2

Artificial Neural Networks: Introduction, Neural Network representation, Appropriate problems, Perceptrons, Multilayered Networks and the Back propagation algorithm.
Evaluating Hypothesis: Motivation, Estimating Hypothesis Accuracy, Basics of Sampling Theorem, General Approach for deriving Confidence Intervals, Difference in error of two hypothesis, Comparing Learning Algorithms.

Text book 1, Sections: 4.1 – 4.6, Sections: 5.1-5.6

Module -3

Bayesian Learning: Introduction, Bayes Theorem, Bayes Theorem and concept learning, Maximum Likelihood and Least squared Error Hypothesis, Maximum Likelihood hypothesis for predicting probabilities, MDL principle, Naive Bayes classifier, Bayesian belief networks, EM algorithm
Text book 1, Sections: 6.1 – 6.6, 6.9, 6.11, 6.12.

Module -4

Instance Based Learning: Introduction, K-Nearest Neighbor Learning, Locally Weighted Regression, Radial Basis Function, Case-Based Reasoning.
Reinforcement Learning: Introduction, The Learning Task, Q Learning, Non deterministic Rewards and Actions.
Text book 1, Sections:, 8.1-8.5. Sections: 13.1 – 13.4.

Module -5

Analytical Learning: Introduction, Learning with perfect Domain Theories: ProLog-EGB, Remarks on Explanation Based Learning.
Combining Inductive and Analytical Learning: Inductive Analytical Approaches to Learning, Using prior knowledge to Initialize the hypothesis, Using prior knowledge to alter the Search objective, Using prior knowledge to augment search objective.
Text book 1, Sections:, 11.1-11.3. Sections: 12.2 – 12.5.

Lab Experiments:

1. Implement and demonstrate the FIND-S algorithm for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a .CSV file.
2. For a given set of training data examples stored in a .CSV file, implement and demonstrate the Candidate-Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples.
3. Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge toclassify a new sample.
4. Build an Artificial Neural Network by implementing the Backpropagation algorithm and test the same using appropriate data sets.
5. Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.
6. Assuming a set of documents that need to be classified, use the naïve Bayesian Classifier model to perform this task. Built-in Java classes/API can be used to write the program. Calculate the accuracy, precision, and recall for your data set.
7. Write a program to construct a Bayesian network considering medical data. Use this model to demonstrate the diagnosis of heart patients using standard Heart Disease Data Set. You can use Java/Python ML library classes/API.
8. Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same data set for clustering using k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering. You can add Java/Python ML library classes/API in the program.
9. Write a program to implement k-Nearest Neighbor algorithm to classify the iris data set. Print both correct and wrong predictions. Java/Python ML library classes can be used for this problem.
10. Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs.

TEXTBOOKS:

1. Tom M. Mitchell, Machine Learning, India Edition 2013, McGraw Hill Education.
2. Machine Learning: A Probabilistic Perspective by Kevin P. Murphy, MIT Press, 2012.

REFERENCE BOOKS:

1. Trevor Hastie, Robert Tibshirani, Jerome Friedman, h The Elements of Statistical Learning, 2nd edition, springer series in statistics.
2. Ethem Alpaydın, Introduction to machine learning, second edition, MIT press.

4. Syllabus Timeline

S/L	Syllabus Timeline	Description
1	Week 1-2:	**Introduction:** Well posed learning problems, Designing a Learning system, Perspective and Issues in Machine Learning. **Concept Learning:** Concept learning task, Concept learning as search, Find-S algorithm, Version space, Candidate Elimination algorithm, Remarks on Version spaces and Candidate Elimination, Inductive Bias.

2	Week 3-4:	**Decision Tree Learning:** Decision tree representation, Appropriate problems for decision tree learning, Basic decision tree learning algorithm, hypothesis space search in decision tree learning, Inductive bias in decision tree learning, Issues in decision tree learning.
3	Week 5-6:	**Artificial Neural Networks:** Introduction, Neural Network representation, Appropriate problems, Perceptron's, Multilayered Networks and the Back propagation algorithm.
4	Week 7-8:	**Bayesian Learning:** Introduction, Bayes Theorem, Bayes Theorem and concept learning, Maximum Likelihood and Least squared Error Hypothesis, Maximum Likelihood hypothesis for predicting probabilities, MDL principle, Naive Bayes classifier, Bayesian belief networks, EM algorithm
5	Week 9-10:	**Evaluating Hypothesis:** Motivation, Estimating Hypothesis Accuracy, Basics of Sampling Theorem, General Approach for deriving Confidence Intervals, Difference in error of two hypothesis, Comparing Learning Algorithms. **Instance Based Learning:** Introduction, K-Nearest Neighbor Learning, Locally Weighted Regression, Radial Basis Function, Case-Based Reasoning, **Reinforcement Learning:** Introduction, Learning Task, Q Learning

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 Machine learning concepts.
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.

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**
	TotalMarks		**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
	TotalMarks		**100%**	**25**	**10**

Final CIE Marks =(A) + (B)

Semester End Examination pattern:

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. The question paper may include at least one question from the laboratory component.
5. Marks scored will be proportionally scaled down to 50 marks

7. Learning Objectives

S/L	Learning Objectives	Description
1	Foundational Knowledge	**Understand the basic principles of machine learning**, including supervised, unsupervised, and reinforcement learning. **Recognize and explain common types of machine learning algorithms** such as regression, classification, clustering, and dimensionality reduction. **Understand the differences between various learning paradigms** and their appropriate use cases.
2	Data Preparation and Preprocessing	**Acquire, clean, and preprocess data** for machine learning tasks. **Apply techniques for handling missing values, outliers, and data normalization**. **Understand and implement feature engineering** to improve model performance.
3	Model Selection and Evaluation	**Understand different types of machine learning models** and their strengths and weaknesses (e.g., linear regression, decision trees, support vector machines, k-nearest neighbors). **Implement and train machine learning models** using libraries such as scikit-learn, Tensor Flow, or PyTorch. **Evaluate model performance** using metrics such as accuracy, precision, recall, F1 score, ROC curves, and cross-validation techniques. **Understand concepts like bias-variance tradeoff and model evaluation** to ensure robustness and generalization.
4	Algorithm Implementation and Tuning	**Implement core machine learning algorithms** from scratch to understand their mechanics. **Apply techniques for hyper parameter tuning** to optimize model performance. **Understand and apply strategies for model validation** and selection, including train/test splits and cross-validation.
5	Practical Applications	**Apply machine learning algorithms to real-world datasets** and problems, including those from diverse domains such as finance, healthcare, and e-commerce. **Build end-to-end machine learning pipelines** that include data ingestion, preprocessing, modeling, and evaluation. **Develop and deploy machine learning models** for practical applications, including integration into software systems.

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

Course Outcomes (COs)

COs	Description
M23BCA601.1	Understand and Apply the concepts of Supervised Learning Algorithms.
M23BCA601.2	Apply Neural Networks to solve problems in machine learning.
M23BCA601.3	Apply Bayesians Learning to classify Machine Learning models.
M23BCA601.4	Analyze Unsupervised Machine Learning techniques.
M23BCA601.5	Differentiate Analytical Learning with Inductive Learning.

CO-PO-PSO Mapping

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
M23BCA601.1	2	3	-	-	-	-	-	-	-	-	-	-	3	3
M23BCA601.2	-	3	-	-	-	-	-	-	-	-	-	-	3	3
M23BCA601.3	-	3	-	-	3	-	-	-	-	-	-	-	3	3
M23BCA601.4	-	-	3	-	3	-	-	-	-	-	-	-	3	3
M23BCA601.5	-	3	-	-	3	-	-	-	-	-	-	-	3	3
M23BCA601	2	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**	**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	**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:

Expanding Theoretical Foundations

- **New Algorithms and Models:** Research will continue to develop novel machine learning algorithms and models, including more efficient optimization techniques, advanced neural network architectures, and hybrid models combining different learning paradigms.
- **Explainability and Interpretability:** There will be a growing focus on making machine learning models more interpretable and explainable, to better understand their decisions and ensure trustworthiness.
- **Robustness and Generalization:** Advances will aim to make models more robust to adversarial attacks and better at generalizing from limited data.

Interdisciplinary Integration

- **Integration with Other AI Technologies:** Machine learning will increasingly intersect with other AI fields such as natural language processing (NLP), computer vision, and robotics to create more advanced and integrated systems.
- **Cross-disciplinary Applications:** ML will be applied in diverse fields like genomics, environmental science, economics, and social sciences, leading to new interdisciplinary research and applications.

Real-World Applications

- **Healthcare:** Enhanced diagnostic tools, personalized treatment plans, drug discovery, and predictive health monitoring.
- **Finance:** Improved fraud detection, risk assessment, automated trading, and customer insights.
- **Transportation:** Development of autonomous vehicles, smart traffic management systems, and logistics optimization.

Enhanced Computational Techniques

- **Quantum Machine Learning:** Exploration of quantum computing to accelerate machine learning tasks and solve problems that is currently intractable with classical computers.
- **Edge Computing:** Deploying machine learning models on edge devices to enable real-time decision-making and reduce latency.

Automated Machine Learning (AutoML)

- **Simplifying Model Development:** AutoML tools will make it easier for non-experts to develop and deploy machine learning models by automating aspects of model selection, hyperparameter tuning, and feature engineering.

Education and Workforce Development

- **Skill Development:** There will be an increasing need for education and training programs to equip individuals with the skills necessary to work in machine learning and related fields.
- **Collaborative Research:** Encouraging interdisciplinary and collaborative research to tackle complex problems and drive innovation in machine learning.

6th Semester	Professional Core (PC) ROBOTIC PROCESS AUTOMATION	M23BCA602

1. Prerequisites

S/L	Proficiency	Prerequisites
1	Basic Programming Knowledge	• Familiarity with at least one programming language, such as Python, Java, C#, or VBScript, is essential for understanding how to create automation scripts and logic.
2	Understanding of Software Development Life Cycle (SDLC)	• Knowledge of SDLC principles, including requirements gathering, design, development, testing, and deployment, is important for structuring RPA projects effectively.
3	Experience with Workflow Design	• Prior experience in designing and mapping business processes or workflows helps in identifying automation opportunities and creating efficient RPA solutions.
4	Familiarity with Business Processes	• Understanding common business processes in areas like finance, HR, supply chain, and customer service is crucial for identifying tasks suitable for automation.
5	Basic Database Knowledge	• Knowledge of databases, including how to perform basic SQL queries, is important for integrating RPA solutions with databases and handling data efficiently.
6	Problem-Solving and Analytical Skills	• Strong problem-solving and analytical skills are necessary for identifying inefficiencies, creating automation strategies, and troubleshooting issues in RPA development.
7	Experience with Automation Tools	• Familiarity with any automation tools or platforms, even outside of RPA (like Selenium for web automation), can be beneficial in understanding the concepts of automation.

2. Competencies

S/L	Competency	KSA Description
1	RPA Fundamentals	**Knowledge:** Knowledge of RPA history, key concepts, and types of processes for automation. **Skills:** Ability to apply RPA concepts to real-world scenarios. **Attitudes:** Eagerness to explore RPA's potential and limitations.
2	RPA Tools and Technologies	**Knowledge:** Knowledge of UiPath, Blue Prism, Automation Anywhere, and other tools. **Skills:** Proficiency in using RPA tools for developing, testing, and deploying bots. **Attitudes:** Openness to learning and adapting to different RPA tools.
3	Business Processes	**Knowledge:** Knowledge of common business processes in finance, HR, supply chain, etc. **Skills:** Ability to analyze and map business processes for automation. **Attitudes:** Focus on optimizing business processes through automation.
4	Programming and Scripting	**Knowledge:** Understanding of programming languages like Python, Java, and VBScript. **Skills:** Skill in writing scripts to enhance automation processes. **Attitudes:** Attention to detail in coding and debugging scripts.
5	Workflow Design	**Knowledge:** Knowledge of workflow design principles and best practices. **Skills:** Ability to create, map, and optimize workflows using RPA tools. **Attitudes:** Commitment to continuous improvement of workflow efficiency.

3. Syllabus

ROBOTIC PROCESS AUTOMATION SEMESTER – VI			
Course Code	**M23BCA602**	CIE Marks	**50**
Number of Lecture Hours/Week(L: T: P: S)	**(3:2:0:0)**	SEE Marks	**50**
Total Number of Lecture Hours	**40 hours Theory**	Total Marks	**100**
Credits	**04**	Exam Hours	**03**

Course Objectives:

- To understand basic concepts of RPA
- To Describe IIPA, where it can be applied and how it implemented
- To Describe the different types of variables, Control Flow and data manipulation techniques
- To Understand Image, Text and nata Tables Automation
- To Describe various types of Exceptions and strategies to handle

Module -1

RPA Foundations- What is RPA – Flavors of RPA- History of RPA- The Benefits of RPA- The downsides of RPA- RPA Compared to BPO, BPM and BPA - Consumer Willingness for Automation- The Workforce of the Future- RPA Skills-On-Premise Vs. the Cloud- Web Technology- Programming Languages and Low Code- OCR-Databases-APls- Al-Cognitive Automation-Agile, Scrum, Kanban and Waterfall Devops-Flowcharts.

Textbook 1: Ch 1, Ch 2

Module -2

RPA Platforms- Components of RPA- RPA Platforms- About UiPath - The future of automation - Record and PIay - Downloading and installing UiPath Studio -Learning Ui Path Studio - Task recorder - Step-by-step examples using the recorder.

Textbook 2: Ch l, Ch 2, RBT; L1, L2

Module -3

Sequence, Flowchart, and Control Flow-Sequencing the workflow- Activities-Control flow, various types of loops, and decision making-Step-by-step example using Sequence and Flowchart-Step-by-step example using Sequence and Control flow-Data Manipulation-Variables and Scope-Collections-Arguments - Purpose and use-Data table usage with examples-Clipboard management-File operation with step-by-step example-CSV/Excel to data table and vice versa [with a step-by-step example).

Textbook 2: Ch 3, Ch 4

Module -4

Taking Control of the Controls- Finding and attaching windows- Finding the control- Techniques for waiting for a control- Act on controls - mouse and keyboard activities- Working with UiExplorer- Handling events- Revisit recorder- Screen Scraping- When to use OCR- Types of OCR available- How to use OCR-Avoiding typical failure points.

Textbook 2: Ch 5

Module -5

Exception Handling, Debugging, and Logging- Exception handling- Common exceptions and ways to handle them- Logging and taking screenshots-Debugging techniques- Collecting crash dumps- Error reporting- Future of RPA.

Text book 2: Ch 8 Text book 1; Ch 13

Text Books:

1. Tom Taulli, The Robotic Process Automation Handbook: A Guide to Implementing RPA Systems,2020, ISBN-13 (electronic):978-7-4842-5729-6, Publisher: A press
2. Alok Mani Tripathi, Learning Robotic Process Automation, Publisher: Packt Publishing Release Date: March 2018 ISBN: 9787788470940

Reference Books:

1. Frank Casale, Rebecca Dilla, Heidi Jaynes, Lauren Livingston, "Introduction to Robotic Process Automation: a Primer", Institute of Robotic Process Automation.
2. Richard Murdoch, Robotic Process Automation: Guide To Building Software Robots, Automate Repetitive Tasks & Become An RPA Consultant
3. Srikanth Merianda, Robotic Process Automation Tools, Process Automation and their benefits: Understanding RPA and Intelligent Automation
4. https:/www.uipath.com/rpa/robotic-process-automation.

4. Syllabus Timeline

S/L	Syllabus Timeline	Description
1	Week 1-3: **RPA Foundations**	What is RPA – Flavors of RPA- History of RPA- The Benefits of RPA- The downsides of RPA- RPA Compared to BPO, BPM and BPA - Consumer Willingness for Automation- The Workforce of the Future- RPA Skills-On-Premise Vs. the Cloud- Web Technology- Programming Languages and Low Code- OCR-Databases-APIs- Al-Cognitive Automation-Agile, Scrum, Kanban and Waterfall Devops- Flowcharts.
2	Week 4-6: **RPA Platforms**	Components of RPA- RPA Platforms- About UiPath - The future of automation - Record and PIay - Downloading and installing UiPath Studio -Learning Ui Path Studio - Task recorder - Step-by-step examples using the recorder.
3	Week 7-8: **Sequence, Flowchart, and Control Flow**	Sequencing the workflow- Activities-Control flow, various types of loops, and decision making-Step-by-step example using Sequence and Flowchart-Step-by-step example using Sequence and Control flow-Data Manipulation-Variables and Scope-Collections-Arguments - Purpose and use-Data table usage with examples-Clipboard management-File operation with step-by-step example-CSV/Excel to data table and vice versa
4	Week 7-9: **Taking Control of the Controls**	Finding and attaching windows- Finding the control- Techniques for waiting for a control- Act on controls - mouse and keyboard activities- Working with UiExplorer- Handling events- Revisit recorder- Screen Scraping- When to use OCR- Types of OCR available- How to use OCR- Avoiding typical failure points.
5	Week 10-12: **Exception Handling**	Exception Handling, Debugging, and Logging- Exception handling- Common exceptions and ways to handle them- Logging and taking screenshots- Debugging techniques- Collecting crash dumps- Error reporting- Future of RPA.

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	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	Laboratory Learning	Utilize the facilities available in the laboratories to understand the behavior of the materials by performing few experiments.

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.

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

7. Learning Objectives

S/L	Learning Objectives	Description
1	Understand the Core Concepts of RPA	Develop a comprehensive understanding of Robotic Process Automation, including its definition, history, types of automation, and key benefits for businesses.
2	Familiarize with RPA Tools and Platforms	Gain knowledge of various RPA tools such as UiPath, Blue Prism, and Automation Anywhere, learning their features, use cases, and how to choose the right tool for specific business needs.
3	Identify Suitable Processes for Automation	Learn to analyse business processes and identify tasks that are repetitive, rule-based, and suitable for automation, ensuring efficiency and accuracy in operations.
4	Design and Map Automated Workflows	Master the skills needed to design, document, and map out workflows for automation, including understanding process flows, dependencies, and potential bottlenecks.
5	Develop RPA Solutions Using Industry Tools	Acquire hands-on experience in developing, configuring, and deploying RPA solutions using industry-leading tools, ensuring that students can create functional and scalable bots.

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

Course Outcomes (COs)

COs	Description
M23BCA602.1	To Understand the basic concepts of RPA
M23BCA602.2	To Describe various components and platforms of RPA
M23BCA602.3	To Describe the different types of variables, control flow and data manipulation techniques
M23BCA602.4	To Understand various control techniques and OCR in RPA
M23BCA602.5	To Describe various types and strategies to handle exceptions

CO-PO-PSO Mapping

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
M23BCA602.1	3	-	-	-	-	-	-	-	-	-	-	-	3	3
M23BCA602.2	-	3	-	-	-	-	-	-	-	-	-	-	3	3
M23BCA602.3	-	3	-	-	-	-	-	-	-	-	-	-	3	3
M23BCA602.4	3	-	-	-	-	-	-	-	-	-	-	-	3	3
M23BCA602.5	-	3	-	-	-	-	-	-	-	-	-	-	3	3
M23BCA602	**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:

- **Increased Demand for RPA Professionals**

  Job Market Growth: As businesses continue to adopt RPA to streamline operations and reduce costs, the demand for skilled RPA professionals will increase, leading to more job opportunities in this field.

  Specialized Roles: The course will prepare students for specialized roles such as RPA Developer, RPA Consultant, Automation Architect, and RPA Analyst, which are becoming increasingly essential in modern organizations.

- **Expansion of RPA Use Cases**

  Industry Applications: The course will evolve to cover a broader range of industry-specific RPA applications, such as healthcare automation, financial services, supply chain management, and customer service.

  Complex Process Automation: As RPA tools become more advanced, the course will delve into automating more complex processes, including those requiring cognitive capabilities and decision-making.

- **Integration with Emerging Technologies**

  AI and Machine Learning: The course will increasingly focus on the integration of RPA with artificial intelligence (AI) and machine learning (ML) to create intelligent automation solutions that can handle unstructured data, make predictions, and continuously improve performance.

  Internet of Things (IoT): As IoT devices become more prevalent, the course will explore how RPA can interact with IoT systems to automate data collection, monitoring, and response processes.

- **Focus on Hyper automation**

  End-to-End Automation: The future of the course will include a focus on hyper automation, which involves automating as many business processes as possible using a combination of RPA, AI, ML, and other advanced technologies.

  Workflow Automation Platforms: The course will teach students how to work with integrated platforms that support hyper automation, enabling them to design and manage complex automated workflows.

- **Emphasis on Compliance and Ethical Automation** Regulatory Compliance: With growing concerns over data privacy and security, the course will place greater emphasis on teaching students how to implement RPA solutions that comply with legal and regulatory requirements.

  Ethical Considerations: The future curriculum will likely include more content on the ethical implications of automation, ensuring that students are equipped to develop RPA solutions that are socially responsible and align with organizational values.

- **Continual Evolution of RPA Tools**

  Tool Updates and New Features: The course will keep pace with the continual evolution of RPA tools, incorporating the latest updates, features, and best practices to ensure students are trained on cutting-edge technology.

  Low-Code/No-Code Platforms: As low-code and no-code RPA platforms become more popular, the course will provide training on how to leverage these tools to develop automation solutions quickly and efficiently.

- **Global Adoption and Collaboration**

  Cross-Border Collaboration: As RPA becomes a global phenomenon, the course will include content on how to manage and collaborate on RPA projects across different regions and cultures, addressing the challenges of global implementation.

  Remote RPA Development: With the rise of remote work, the course will cover how to manage and develop RPA projects in a distributed work environment, using cloud-based tools and collaboration platforms.

6th Semester	Professional Elective -II (PE) BLOCKCHAIN TECHNOLOGY	M23BCS603A

1. Prerequisites

S/L	Proficiency	Prerequisites
1.	Basic Programming Skills	Understanding of programming concepts and knowledge of languages like Python, JavaScript, or C++ is essential.
2.	Data Structures	Familiarity with data structures such as linked lists, hash maps, and graphs is crucial.
3.	Basic Knowledge of Computer Security	A good grasp of cryptographic principles is important for securing blockchain transactions.
4.	Distributed Systems and Networking	Understanding how distributed systems work and the basics of networking can help grasp how blockchain nodes communicate and maintain consensus.
5.	Basic Knowledge of Economics	Since blockchain often intersects with cryptocurrencies, having a basic understanding of economic principles can be beneficial.

2. Competencies

S/L	Competency	KSA Description
1.	**Blockchain Fundamentals**	**Knowledge:** Understand the basic concepts of blockchain, including its architecture, how it works, and its various applications. **Skills:** Explain blockchain concepts clearly and apply them in practical scenarios. **Attitudes:** Curiosity and eagerness to explore new technologies and their potential impacts.
2.	**Decentralized system & Cryptography**	**Knowledge:** Familiarity with decentralized networking and cryptographic principles such as public-key cryptography, cryptographic hashing, and digital signatures. **Skills:** Implement cryptographic algorithms like Secret Key Cryptography (SKC), Public Key Cryptography (PKC) & Hash Functions. **Attitudes:** Attention to detail and a strong focus on security and privacy.
3.	**Basic Knowledge of Cryptocurrency**	**Knowledge:** • Understand the basic principles of Bitcoin, including its creation, blockchain technology, mining process, and transaction mechanisms. • Familiarity with various alternative cryptocurrencies like Ethereum, Litecoin, Ripple, and others, including their unique features and use cases. **Skills:** • Proficiency in programming languages such as Python, Solidity, and JavaScript for developing blockchain applications and smart contracts. • Understanding and implementing security measures to protect digital wallets, private keys, and transactions from potential threats. **Attitudes:** • Commitment to ethical practices in cryptocurrency development.
4.	**Smart Contracts**	**Knowledge:** Understanding of smart contracts, particularly on platforms like Ethereum, and how they automate and enforce agreements. **Skills:** Proficiency in writing and deploying smart contracts using languages like python. **Attitudes:** Precision and thoroughness in coding to ensure accuracy and reliability.
5.	**Understanding Different Blockchains**	**Knowledge:** Understanding of non-Cryptocurrency Applications like supply chain management, IoT and others. **Skills:** Proficiency in blockchain fundamentals. **Attitudes:** Willingness to adapt to the rapidly changing landscape of blockchain.

3. Syllabus

BLOCKCHAIN TECHNOLOGY SEMESTER – VI			
Course Code	**M23BCS603A**	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 Theory**	Total Marks	**100**
Credits	**03**	Exam Hours	**03**

Course objectives: This course will enable students to:

1. Define and explain the fundamentals of Blockchain
2. Illustrate the technologies of blockchain
3. Describe the models of blockchain
4. Analyze and demonstrate the Ethereum

Module -1

Blockchain 101: Distributed systems, History of blockchain, Introduction to blockchain, Types of blockchain, CAP theorem and blockchain, Benefits and limitations of blockchain.
Text Book 1: Chapter 1

Module -2

Decentralization and Cryptography: Decentralization using blockchain, Methods of decentralization, Routes to decentralization, Decentralized organizations. Cryptography and Technical Foundations: Cryptographic primitives, Asymmetric cryptography, Public and private keys
Text Book 1: Chapter 2, Chapter 4

Module -3

Bitcoin and Alternative Coins:
A: Bitcoin, Transactions, Blockchain, Bitcoin payments
B: Alternative Coins
Theoretical foundations, Bitcoin limitations, Namecoin, Litecoin, Primecoin, Zcash
Text Book 1: Chapter 5, Chapter 6, Chapter 8

Module -4

Smart Contracts and Ethereum 101:
Smart Contracts: Definition, Ricardian contracts.
Ethereum 101: Introduction, Ethereum blockchain, Elements of the Ethereum blockchain, Precompiled contracts.
Text Book 1: Chapter 9, Chapter 10

Module -5

Alternative Blockchains: Blockchains
Blockchain-Outside of Currencies: Internet of Things, Government, Health, Finance, Media
Text Book 1: Chapter 17

Text Books:

1. Mastering Blockchain - Distributed ledgers, decentralization and smart contracts explained, Imran Bashir, Packt Publishing Ltd, Second Edition, ISBN 978-1-78712-544-5, 2017.
2. Mastering Blockchain: Programming Blockchain Applications using C# and .NET Core by Alessandro De Angelis, Packt Publishing, 2019.

Reference Books:

1. Bitcoin and Cryptocurrency Technologies, Arvind Narayanan, Joseph Bonneau, Edward Felten, 2016
2. Blockchain Basics: A Non-Technical Introduction in 25 Steps, Daniel Drescher, Apress, First Edition, 2017
3. Mastering Bitcoin: Unlocking Digital Cryptocurrencies, Andreas M. Antonopoulos, O'Reilly Media, First Edition, 2014

4. Syllabus Timeline

S/L	Syllabus Timeline	Description
1	Week 1-2: Blockchain 101	• **Competency**: Blockchain Fundamentals • **Knowledge**: Understand the basic concepts of blockchain, including its architecture, how it works, and its various applications. • **Skills**: Explain blockchain concepts clearly and apply them in practical scenarios.
2	Week 3-4:	• **Competency**: Decentralized system & Cryptography

	Decentralization and Cryptography	• **Knowledge**: Familiarity with decentralized networking and cryptographic principles such as public-key cryptography, cryptographic hashing, and digital signatures. • **Skills:** Implement cryptographic algorithms like Secret Key Cryptography (SKC), Public Key Cryptography (PKC) & Hash Functions.
3	Week 5-6: Bitcoin and Alternative Coins	• **Competency:** Basic Knowledge of cryptocurrency • **Knowledge**: Understand the basic principles of Bitcoin, including its creation, blockchain technology, mining process, and transaction mechanisms. Familiarity with various alternative cryptocurrencies like Ethereum, Litecoin, Ripple, and others, including their unique features and use cases. • **Skills**: Proficiency in programming languages such as Python, Solidity, and JavaScript for developing blockchain applications and smart contracts. Understanding and implementing security measures to protect digital wallets, private keys, and transactions from potential threats.
4	Week 7-8: Smart Contracts and Ethereum 101	• **Competency:** Smart Contracts • **Knowledge:** Understanding of smart contracts, particularly on platforms like Ethereum, and how they automate and enforce agreements. • **Skills:** Writing and deploying smart contracts using languages like python.
5	Week 9-10: Alternative Blockchains	• **Competency:** Understanding Different Blockchains • **Knowledge**: Understanding of non-Cryptocurrency Applications like supply chain management, IoT and others. • **Skills**: Proficiency in blockchain fundamentals.

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 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	Understanding Blockchain Technology Fundamentals	Students will grasp the fundamental concepts of blockchain and it's decentralized way of function, including smart contracts, cryptocurrencies, non-crypto blockchains
2	Developing blockchain applications	Students will learn to develop and implement blockchain applications, smart contracts and for real world scenarios using programming languages like python.
3	Project-Based Learning	Through hands-on projects, students will apply their knowledge of blockchain to design, develop and implement blockchain applications, reinforcing their understanding of theoretical concepts
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 blockchain technology, including transparency and compliance with regulations, cautious and strategic approach to managing risks associated with cryptocurrency investments and trading, best practices for securing blockchain networks and applications.

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

Course Outcomes (COs)

COs	Description
M23BCS603A.1	Explain fundamentals of blockchain and how it works.
M23BCS603A .2	Implement security measures through cryptographic principles.
M23BCS603A .3	Describe fundamentals of cryptocurrencies and their role in economics.
M23BCS603A .4	Analyse and demonstrate the Ethereum.
M23BCS603A .5	Analyse and demonstrate Hyperledger fabric.

CO-PO-PSO Mapping

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
M23BCS603A.1	3												3	3
M23BCS603A .2		3											3	3
M23BCS603A .3			3										3	3
M23BCS603A .4	3												3	3
M23BCS603A .5	3												3	3
M23BCS603A	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**

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 "Blockchain Technology" course in the seventh semester of the B.E program lays a strong foundation for several future opportunities in the industry. The contributions of this subject extend across various areas, enhancing the students' understanding and skills in the field of Blockchain and Cryptocurrencies. Here are some notable contributions:

- **Enhanced Security and Transparency:** Blockchain's decentralized nature ensures that data is secure and transparent, reducing the risk of fraud and tampering. In supply chain management, companies are using blockchain to track the journey of products from origin to consumer, ensuring authenticity and reducing counterfeiting.
- **Decentralized Finance (DeFi):** DeFi platforms are revolutionizing traditional financial systems by providing decentralized financial services without intermediaries.
- **Integration with Emerging Technologies:** Blockchain is being integrated with other emerging technologies like Artificial Intelligence (AI) and the Internet of Things (IoT) to create innovative solutions.
- **Enterprise Adoption:** More enterprises are adopting blockchain technology to improve efficiency, reduce costs, and enhance security. Companies like Walmart and Maersk are using blockchain for supply chain management, while financial institutions are exploring blockchain for secure and transparent transactions.
- **Regulatory Developments:** As blockchain technology matures, regulatory frameworks are evolving to provide clearer guidelines and foster innovation. Governments are exploring Central Bank Digital Currencies (CBDCs) to leverage blockchain for secure and efficient digital currencies.
- **Non-Fungible Tokens (NFTs):** NFTs are expanding beyond digital art to include various applications such as virtual real estate, gaming, and intellectual property. Platforms like Decentral and Axie Infinity use NFTs to create virtual worlds and gaming ecosystems where users can own and trade digital assets.
- **Industry Applications:** Blockchain has the potential to drive significant social and economic changes, promoting financial inclusion and transparency. Blockchain-based platforms like Stellar are working to provide financial services to unbanked populations, enabling cross-border transactions with lower fees. By learning blockchain technology, you can position yourself at the forefront of these exciting developments and contribute to shaping the future of various industries.

6th Semester	Professional Elective -II (PE) GENERATIVE AI	M23BCA603B

1. Prerequisites

S/L	Proficiency	Prerequisites
1	Machine Learning (ML):	• **Supervised Learning:** Knowledge of how supervised learning works, including concepts like training, validation, and testing. • **Unsupervised Learning:** Understanding unsupervised learning techniques, which are often used in generative models for tasks like clustering and dimensionality reduction.
2	Mathematics and Statistics:	• **Linear Algebra:** Concepts such as matrices, vectors, and tensor operations are crucial, as they are foundational to many ML algorithms. • **Calculus:** Understanding derivatives and integrals helps with gradient-based optimization methods. • **Probability and Statistics:** Basic concepts such as distributions, expectation, variance, and Bayesian methods are essential for understanding model behavior and training.
3	Programming Skills:	• **Python:** The primary language used in ML and AI, with libraries like TensorFlow, PyTorch, and scikit-learn. • **Libraries and Frameworks:** Familiarity with machine learning frameworks and libraries that facilitate the creation and training of generative models.
4	Deep Learning Fundamentals:	• **Neural Networks:** Understanding how neural networks work, including concepts like activation functions, backpropagation, and optimization algorithms. • **Architectures:** Knowledge of various neural network architectures such as feedforward networks, convolutional neural networks (CNNs), and recurrent neural networks (RNNs).
5	Generative Model Concepts:	• **Generative Adversarial Networks (GANs):** Understanding the architecture and training of GANs, which involve a generator and a discriminator. • **Variational Autoencoders (VAEs):** Knowledge of VAEs and how they use probabilistic methods to generate data. • **Autoregressive Models:** Understanding models that generate data sequentially, like GPT (Generative Pre-trained Transformer).
6	Data Handling and Preprocessing:	• **Data Collection:** Techniques for gathering and curating datasets relevant to the generative tasks. • **Data Preprocessing:** Methods for cleaning, normalizing, and augmenting data to prepare it for model training.
7	Ethical and Practical Considerations:	• **Bias and Fairness:** Understanding how generative models can propagate biases present in training data and the ethical implications of generated content. • **Model Evaluation:** Techniques for assessing the quality and realism of generated data.
8	Experimentation and Tuning:	• **Hyperparameter Tuning:** Methods for optimizing the performance of generative models by adjusting parameters. • **Evaluation Metrics:** Knowledge of metrics to evaluate generative models, such as Inception Score (IS) and Fréchet Inception Distance (FID) for image generation.

2. Competencies

S/L	Competency	KSA Description
1	Deep Learning Expertise	**Knowledge:** Understanding of foundational architectures such as feedforward neural networks (FNNs) and their components (layers, activation functions). Proficiency with deep learning frameworks such as TensorFlow, PyTorch, Keras, and their associated libraries for building and training models. **Skills:** Ability to design and implement neural network architectures tailored to specific

		tasks and data types. Skills in applying training techniques and algorithms effectively, including handling large datasets and managing computational resources. **Attitudes:** Willingness to explore and experiment with new architectures and techniques to solve complex problems.
2	Mathematical and Statistical Knowledge	**Knowledge:** Understanding matrix multiplication, inversion, and decomposition techniques (e.g., Singular Value Decomposition). Understanding of convex functions and optimization problems, though less common in generative models, is useful for certain algorithms. **Skills:** Ability to formulate mathematical models and equations for machine learning and generative algorithms. **Attitudes:** Precision in mathematical computations and statistical analyses to ensure the accuracy and reliability of models.
3	Programming and Technical Skills	**Knowledge:** In-depth knowledge of Python, which is the primary language for AI and machine learning tasks. Understanding Python's syntax, libraries, and tools relevant to AI, such as NumPy, Pandas, and Matplotlib. **Skills:** Ability to write clean, efficient, and maintainable code for developing machine learning models and algorithms. Proficiency in using deep learning frameworks to build, train, and fine-tune models. **Attitudes:** A meticulous approach to coding and technical implementation to avoid errors and ensure accurate results.
4	Data Management and Preprocessing	**Knowledge:** Familiarity with common data formats and structures (e.g., JSON, CSV, images in PNG/JPEG, text files). Knowledge of various data types relevant to generative AI, such as images, text, audio, and structured data. **Skills:** Proficiency in applying data cleaning techniques to ensure data quality and usability. Skills in implementing data augmentation techniques to create diverse and representative datasets. **Attitudes:** A meticulous approach to handling and processing data to ensure high-quality inputs for model training.
5	Ethical Considerations and Evaluation	**Knowledge:** Understanding of foundational ethical principles relevant to AI, such as fairness, accountability, and transparency. Familiarity with relevant regulations, guidelines, and standards such as GDPR, CCPA, and industry-specific ethical guidelines for AI. **Skills:** Ability to use statistical and analytical techniques to identify biases in data and model outputs. **Attitudes:** Attention to detail with the commitment 0f ethical practices and an understanding of the responsibility to consider the societal implications of AI technologies.

3. Syllabus

GENERATIVE AI SEMESTER – VI			
Course Code	**M23BCA603B**	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 Theory**	Total Marks	**100**
Credits	**03**	Exam Hours	**03**

Course Objectives:

1. To explain the core principles and concepts of generative artificial intelligence.
2. To explore various types of generative modelling techniques.
3. To analyze the limitations of traditional RNNs and LSTMs.
4. To develop skills in implementing and training generative models.
5. To encourage critical thinking about the ethical implications of generative AI.

Module -1

Overview of Generative AI: Introduction to Neural Network based Language Models- Recurrent Neural Networks, Gated Recurrent Unit, Encoder-Decoder Networks, Probability and Statistics for Generative AI- Bayesian networks, Markov chains.

Module -2

Transformers and Large Language Models (LLMs): Language Models, Transformer Architecture, Motivation for Transformer, Architecture, Encoder-Decoder Architecture, Attention, Position-wise Feed-Forward Networks, Advantages and Limitations of Transformer Architecture**.**

Module -3

Data privacy and safety with LLMs: Safety-focused improvements for LLM generations, Navigating user privacy and commercial risks, Understanding the rules of the road: Data policies and regulations.

The evolution of created content: The rise of synthetic media, Generatuve AI:Transform creative workflows, Intectual prperty in the LLMera.

Module -4

Networks and Models: Autoencoders, Variational Autoencoders, latent space, Generative Adversarial Networks (GANs)- Deep Convolutional GAN (DCGAN),Wasserstein GAN, Conditional GAN, Autoregressive Models- Long Short-Term Memory Network (LSTM), Diffusion Models- Types of Diffusion Models, Architecture,Latent Diffusion Model (LDM), Benefits and Significance.

Module -5

Applications and Ethical Implications: Applications - ChatGPT Architecture, Google Bard, Claude 2, Falcon AI, LLaMa 2, Dolly 2, DALL-E 2, Midjourney. Ethics- Bias and Fairness in Generative Models.

TEXTBOOKS:

1. Generative Deep Learning: A Practical Guide by David Foster
2. Applied Generative AI for Beginners: Practical Knowledge on Diffusion Models,ChatGPT, and Other LLMs by Akshay Kulkarni, Adarsha Shivananda, Anoosh Kulkarni and Dilip Gudivada.
3. "Introduction to Generative AI", Numa Dhamani, Kindle Edition, 2024.

Reference Books:

- Generative AI by Tom Taulli
- Deep Learning by Ian Goodfellow, Yoshua Bengio, and Aaron Courville
- Generative Adversarial Networks: An Introductory Guide by Luke Metz
- Autoencoders: Neural Networks for Unsupervised Learning by Ian Goodfellow1.
- https://elearn.nptel.ac.in/shop/iit-workshops/completed/leveraging-generative-ai-for-teaching-programming-course s/?v=c86ee0d9d7ed
- https://elearn.nptel.ac.in/shop/iit-workshops/completed/introduction-to-language-models/?v=c86ee0d9d7ed

4. Syllabus Timeline

S/L	Syllabus Timeline	Description
1	Week 1-3: Foundations of AI and Neural Networks	Introduction to Neural Network based Language Models- Recurrent Neural Networks, Gated Recurrent Unit, Encoder-Decoder Networks, Probability and Statistics for Generative AI- Bayesian networks, Markov chains.
2	Week 4-6: Analysis of Advanced Neural Network Architectures	Language Models, Transformer Architecture, Motivation for Transformer, Architecture, Encoder-Decoder Architecture, Attention, Position-wise Feed-Forward Networks, Advantages and Limitations of Transformer Architecture**.**

3	Week 8-11: Data Preprocessing	Safety-focused improvements for LLM generations, Navigating user privacy and commercial risks, Understanding the rules of the road: Data policies and regulations. The rise of synthetic media, Generatuve AI: Transform creative workflows, Intectual prperty in the LLMera.
4	Week 7-8: Data privacy and safety with LLMs The evolution of created content	Autoencoders, Variational Autoencoders, latent space, Generative Adversarial Networks (GANs)- Deep Convolutional GAN (DCGAN),Wasserstein GAN, Conditional GAN, Autoregressive Models- Long Short-Term Memory Network (LSTM), Diffusion Models- Types of Diffusion Models, Architecture,Latent Diffusion Model (LDM), Benefits and Significance.
5	Week 9-12: Generative AI Applications	Applications - ChatGPT Architecture, Google Bard, Claude 2, Falcon AI, LLaMa 2, Dolly 2, DALL-E 2, Midjourney. Ethics- Bias and Fairness in Generative Models.

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	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	Laboratory Learning	Utilize the facilities available in the laboratories to understand the behavior of the materials by performing few experiments.

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

7. Learning Objectives

S/L	Learning Objectives	Description
1	Deep Learning Expertise	Utilize the concept of foundational architectures such as feedforward neural networks (FNNs) and their components (layers, activation functions). Proficiency with deep learning frameworks such as TensorFlow, PyTorch, Keras, and their associated libraries for building and training models.
2	Mathematical and Statistical Knowledge	Utilize the concept of matrix multiplication, inversion, and decomposition techniques (e.g., Singular Value Decomposition). Understanding of convex functions and optimization problems, though less

		common in generative models, is useful for certain algorithms.
3	Programming and Technical Skills	In-depth knowledge of Python, which is the primary language for AI and machine learning tasks. Understanding Python's syntax, libraries, and tools relevant to AI, such as NumPy, Pandas, and Matplotlib.
4	Data Management and Preprocessing	Familiarity with common data formats and structures (e.g., JSON, CSV, images in PNG/JPEG, text files). Knowledge of various data types relevant to generative AI, such as images, text, audio, and structured data.
5	Ethical Considerations and Evaluation	Understanding of foundational ethical principles relevant to AI, such as fairness, accountability, and transparency. Familiarity with relevant regulations, guidelines, and standards such as GDPR, CCPA, and industry-specific ethical guidelines for AI.

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

Course Outcomes (COs)

COs	Description
M23BCA603B.1	Understand and apply the core concepts, principles, and applications of generative AI.
M23BCA603B.2	Analyze and compare different generative modeling techniques.
M23BCA603B.3	Analyse the improvement in LLMs generations and navigations
M23BCA603B.4	Evaluate the performance of generative models.
M23BCA603B.5	Identify the ethical implications of generative AI

CO-PO-PSO Mapping

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
M23BCA603B.1	3	-	-	-	-	-	-	-	-	-	-	-	3	3
M23BCA603B.2	-	3	-	-	-	-	-	-	-	-	-	-	3	3
M23BCA603B.3	-	-	3	-	-	-	-	-	-	-	-	-	3	3
M23BCA603B.4	-	-	-	3	-	-	-	-	-	-	-	-	3	3
M23BCA603B.5	-	-	3	-	-	-	-	-	-	-	-	-	3	3
M23BCA603B	**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:

Creativity and Content Generation

- **Art and Media**: Generative AI will continue to revolutionize art, music, and media by enabling new forms of creativity and automation. Artists and creators can use AI to generate unique content, explore new styles, and collaborate with AI systems to enhance their work.

- **Entertainment**: AI-generated scripts, stories, and interactive experiences will become more prevalent, providing personalized content and immersive experiences.

Personalization

- **Customized Experiences**: AI will enable highly personalized experiences in various fields, including education, marketing, and healthcare. For example, AI-driven educational tools can tailor learning materials to individual students' needs and learning styles.
- **Customer Service**: Enhanced chatbots and virtual assistants will offer more personalized and effective customer support, improving user satisfaction and engagement.

Healthcare

- **Drug Discovery**: Generative AI models will accelerate drug discovery and development by predicting molecular structures and potential interactions, leading to faster and more cost-effective development of new treatments.
- **Medical Imaging**: AI will improve diagnostic accuracy by generating high-quality images and analyzing complex patterns in medical data, aiding in early detection and personalized treatment plans.

Research and Innovation

- **Scientific Research**: AI will assist in generating hypotheses, analyzing large datasets, and simulating experiments, leading to faster scientific discoveries and innovations.
- **Technology Development**: New AI-driven technologies and solutions will emerge; pushing the boundaries of what is possible and leading to advancements in areas such as robotics, autonomous systems, and smart infrastructure.

6th Semester	Professional Elective -II (PE) BIG DATA ANALYTICS	M23BCA603C

1. Prerequisites

S/L	Proficiency	Prerequisites
1	Programming Skills	• **Programming Languages**: Proficiency in programming languages like Python, R, or Java is often required since these languages are commonly used in data analysis and handling large datasets. • **Data Structures and Algorithms**: A strong understanding of basic data structures (arrays, lists, stacks, queues) and algorithms (sorting, searching) is essential for handling and processing data efficiently.
2	Database Knowledge	• **SQL**: Knowledge of SQL (Structured Query Language) for querying databases, understanding how to retrieve, manipulate, and manage data stored in relational databases. • **NoSQL Databases**: Familiarity with NoSQL databases like MongoDB, Cassandra, or Hadoop for handling unstructured or semi-structured data.
3	Basic Knowledge of Data Handling	• **Data Cleaning and Preprocessing**: Understanding the importance of cleaning data, handling missing data, and preprocessing data for analysis. • **Data Visualization**: Basic skills in creating visual representations of data using tools like Matplotlib, Tableau, or Power BI.
4	Domain Knowledge (Context-Specific)	• Depending on the specific application of Big Data Analytics (e.g., healthcare, finance, marketing), some domain-specific knowledge might be required to understand and interpret data effectively.

2. Competencies

S/L	Competency	KSA Description
1	Data Handling and Storage	• **Knowledge**: Understand the architecture and functioning of both relational and non-relational databases. • **Skills**: Efficiently query and manipulate large datasets using SQL and NoSQL databases. • **Abilities**: Evaluate the appropriate storage solutions based on data structure and use cases.
2	Big Data Ecosystem Proficiency	• **Knowledge**: Familiarity with the Hadoop ecosystem, including tools like Hive and Spark. • **Skills**: Implement distributed data processing tasks using Hadoop and Spark. • **Abilities**: Optimize Big Data workflows for improved efficiency and scalability.

3. Syllabus

BIG DATA ANALYTICS SEMESTER – VI			
Course Code	M23BCA603C	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 Theory**	Total Marks	**100**
Credits	**03**	Exam Hours	**03**

Course Objectives:

The objective of learning Hadoop in a Big Data context is to provide students with a comprehensive understanding of its distributed computing framework, enabling them to efficiently store, process, and analyze vast amounts of data across clusters of computers. By mastering Hadoop's core components, such as HDFS (Hadoop Distributed File System) and Map Reduce, students will gain the skills needed to handle large-scale data processing tasks, optimize resource utilization, and develop scalable solutions. The course also aims to familiarize students with related tools in the Hadoop ecosystem, such as Hive and Pig, to enhance their ability to perform complex data queries and analytics.

Module -1

Meet Hadoop: Data ,Data Storage and Analysis , Querying All Your Data , Beyond Batch , Comparison with Other Systems : Relational Database Management Systems , Grid Computing , Volunteer Computing , A Brief History of Apache Hadoop **The Hadoop Distributed File system:** The Design of HDFS , HDFS Concepts ,Blocks , Name nodes and Data nodes , Block Caching ,HDFS Federation , HDFS High Availability , The Command-Line Interface ,Basic File system Operations , Hadoop File systems , Interfaces , The Java Interface , Reading Data from a Hadoop URL , Reading Data Using the File System API ,Writing Data , Directories , Querying the File system ,Deleting Data , Data Flow , Anatomy of a File Read , Anatomy of a File Write , Coherency Model , Parallel Copying with distcp , Keeping an HDFS Cluster Balanced
Module -2
MapReduce: A Weather Dataset , Data Format , Analyzing the Data with Unix Tools , Analyzing the Data with Hadoop , Map and Reduce , Java MapReduce , Scaling Out , Data Flow , Combiner Functions , Running a Distributed MapReduce Job , Hadoop Streaming.
Module -3
Pig: Installing and Running Pig ,Execution Types ,Running Pig Programs ,Grunt ,Pig Latin Editors ,An Example ,Generating Examples ,Comparison with Databases ,Pig Latin ,Structure ,Statements ,Expressions ,Types ,Schemas ,Functions ,Macros ,User-Defined Functions ,A Filter UDF ,An Eval UDF ,A Load UDF ,Data Processing Operators ,Loading and Storing Data ,Filtering Data ,Grouping and Joining Data ,Sorting Data ,Combining and Splitting Data ,Pig in Practice ,Parallelism ,Anonymous Relations ,Parameter Substitution.
Module -4
Hive: Installing Hive ,The Hive Shell, An Example ,Running Hive ,Configuring Hive ,Hive Services ,The Megastore ,Comparison with Traditional Databases ,Schema on Read Versus Schema on Write ,Updates, Transactions, and Indexes ,SQL-on-Hadoop Alternatives ,Hive QL ,Data Types ,Operators and Functions ,Tables ,Managed Tables and External Tables ,Partitions and Buckets ,Storage Formats ,Importing Data ,Altering Tables ,Dropping Tables ,Querying Data ,Sorting and Aggregating ,MapReduce Scripts ,Joins ,Subqueries ,Views ,User-Defined Functions ,Writing a UDF ,Writing a UDAF.
Module -5
Flume: Installing Flume, Transactions and Reliability, Batching The HDFS Sink, Partitioning and Interceptors .File Formats ,Fan Out ,Delivery Guarantees ,Replicating and Multiplexing Selectors ,Distribution: Agent Tiers ,Delivery Guarantees ,Sink Groups ,Integrating Flume with Applications ,Component Catalogue Spark Applications- Jobs, Stages, and Tasks, A Scala Standalone Application, Anatomy of a Spark Job Run - Job Submission, DAG Construction, Task Scheduling, Task Execution.
TEXTBOOKS: 1.Tom White ,"Hadoop – The Definitive Guide; Storage and Analysis at Internet scale", , 4th Edition, 2015,O'Reilly, Shroff Publishers & Distributers Pvt. Ltd., ISBN – 978-93-5213-067-2 2. DT Editorial Services "Big Data – Black Book" Dreamtech Press, Edition – 2015, ISBN - 978-93-511-9-757-7 **REFERENCE BOOKS:** 1. Dirk deRoos, Paul C. Zikopoulos, Roman B. Melnyk, Bruce Brown, Rafael Coss, "Hadoop for Dummies",2014, John Wiley & Sons, Inc., ISBN: 978-1-118-60755-8 (pbk); ISBN 978-1-118-65220-6 (ebk); ISBN 978-1-118-70503-2 (ebk) 2. Nathan Marz and James Warren,"Big Data Principles and best practices of scalable real-time data systems",April 2015, ISBN 9781617290343 **VIDEO LINKS:** **https://www.youtube.com/watch?v=D9W6LRhJGME** **https://www.youtube.com/watch?v=KCEPoPJ8sWw** **https://www.youtube.com/watch?v=OP8BsGnqi9c**

4. Syllabus Timeline

S/L	Syllabus Timeline	Description
1	Week 1-3: **The Hadoop Distributed File system**	Understanding the concept of Hadoop's data storage, analysis, and querying capabilities, compare it with other systems, and learn the design and operation of the Hadoop Distributed File System (HDFS), including key concepts like blocks, Name Nodes, Data Nodes, high availability, and file system operations using the Java interface, along with data flow and cluster balancing techniques.
2	Week 4-6: **MapReduce**	Analyze datasets using MapReduce, mastering Java MapReduce, data flow, distributed jobs, and Hadoop streaming.

3	Week 8-11: **Pig**	Students will learn to install and run Pig, write Pig Latin scripts, use data processing operators, and implement user-defined functions for data loading, filtering, grouping, joining, and sorting, while exploring parallelism, parameter substitution, and practical applications of Pig.
4	Week 7-8: **Hive**	Students will learn to install, configure, and run Hive, explore Hive QL, manage data with tables, partitions, and buckets, and perform data querying, sorting, aggregation, and joins. They will also compare Hive with traditional databases, understand schema on read/write, and create user-defined functions (UDFs and UDAFs).
5	Week 9-12: **Flume**	Students will learn to install and configure Flume, manage transactions, batching, partitioning, and file formats, and ensure reliable data delivery with Flume components. They will also explore Spark applications, understanding job stages, tasks, and the anatomy of a Spark job run, including job submission, DAG construction, and task execution.

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	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	Laboratory Learning	Utilize the facilities available in the laboratories to understand the behavior of the materials by performing few experiments.

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

7. Learning Objectives

S/L	Learning Objectives	Description
1	Hadoop	Data Storage and Analysis , Querying All Your Data , Beyond Batch , Comparison with Other Systems : Relational Database Management Systems , Grid Computing , Volunteer Computing , A Brief History of Apache Hadoop
2	Map Reduce	Weather Dataset , Data Format , Analyzing the Data with Unix Tools , Analyzing the Data with Hadoop , Map and Reduce , Java Map Reduce , Scaling Out , Data Flow , Combiner Functions ,
3	Pig	Installing and Running Pig ,Execution Types ,Running Pig Programs ,Grunt ,Pig Latin Editors ,An Example ,Generating Examples ,Comparison with Databases ,Pig

		Latin ,Structure ,Statements ,Expressions ,Types ,Schemas ,Functions ,Macros ,User-Defined Functions
4	Hive	Installing Hive ,The Hive Shell, An Example ,Running Hive ,Configuring Hive ,Hive Services ,The Meta store ,Comparison with Traditional Databases ,Schema on Read Versus Schema
5	Flume	Installing Flume, Transactions and Reliability, Batching The HDFS Sink, Partitioning and Interceptors.

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

Course Outcomes (COs)

COs	Description
M23BCA603C.1	Understand and identify various data storage and analysis systems, including relational databases, grid computing, and Apache Hadoop, focusing on querying and processing large datasets.
M23BCA603C.2	Module and Process data using MapReduce and Hadoop.
M23BCA603C.3	Make Use of Pig for data manipulation and scripting.
M23BCA603C.4	Analyse Hive for data querying and management, including installation, configuration, and performance comparison with traditional databases.
M23BCA603C.5	Implement and configure Flume for data ingestion and Analyse Spark job stages, tasks, and execution processes.

CO-PO-PSO Mapping

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
M23BCA603C.1	3	-	-	-	-	-	-	-	-	-	-	-	3	-
M23BCA603C.2	3	-	-	-	3	-	-	-	-	-	-	-	3	-
M23BCA603C.3	-	3	-	-	3	-	-	-	-	-	-	-	-	3
M23BCA603C.4	-	3	2	-	3	-	-	-	-	-	-	-	-	3
M23BCA603C.5	**-**	**3**	2	-	3	-	-	-	-	-	-	-	-	3
M23BCA603C	**3**	**3**	**2**	**-**	**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:

- **Emerging Technologies:** Analyse new technologies and innovations such as AI-driven analytics, machine learning, and deep learning, and their impact on big data processing and insights.
- **Real-Time Analytics:** Understand the increasing importance of real-time data analytics and stream processing, and how they enhance decision-making and operational efficiency.
- **Data Privacy and Security:** Examine advancements in data privacy, security measures, and ethical considerations, addressing challenges related to data protection and compliance.

6th Semester	Professional Elective -II (PE) SOCIAL NETWORK ANALYSIS	M23BCS603D

1. Prerequisites

S/L	Proficiency	Prerequisites
1	Mathematics	Graph Theory: Understanding concepts like nodes, edges, paths, and centrality measures (e.g., degree centrality, closeness centrality). Probability: Basics of probability theory can be useful for understanding stochastic processes in networks.
2	Statistical	Proficiency in statistical methods to analyse network data, including descriptive statistics, hypothesis testing, and regression analysis.
3	Computational	Programming: Familiarity with programming languages such as Python, R, or Java is important for implementing SNA algorithms and processing data.
4	Data Handling and Management	Data Collection: Skills in collecting and cleaning data from various sources, including social media, surveys, or databases.
5	Structural Analysis:	Basic Concepts: Understanding fundamental graph theory concepts such as types of networks (e.g., directed, undirected, weighted) and network metrics (e.g., clustering coefficient, network density). Advanced Metrics: Knowledge of more advanced metrics like community detection, network robustness, and dynamic network analysis.
6	Data Interpretation:	Visualization: Ability to create and interpret network visualizations to identify patterns, clusters, and outliers. Statistical Analysis: Skills in applying statistical techniques to validate network findings and draw meaningful conclusions.
7	Practical Application	Case Studies: Experience with real-world data and case studies to understand practical challenges and solutions in network analysis.

2. Competencies

S/L	Competency	KSA Description
1	**Introduction**	**Knowledge:** Semantic Web principles and technologies, Social Web concepts and platforms, Network analysis methodologies Key concepts in social network analysis. **Skills:** Web development basics, Data mining and analysis Use of network analysis tools **Attitudes:** Attention to detail in calculations and diagrams. Persistence in analyzing complex load scenarios.
2	**Modeling and visualization**	**Knowledge:** Graph theory fundamentals Social network analysis principles, Data visualization techniques Centrality measures in network analysis **Skills:** Implementing graph algorithms Creating and interpreting node-edge diagrams Developing matrix-based network representations, Designing hybrid network visualizations **Attitudes:** Analytical mind set for interpreting complex network structures Curiosity about social dynamics and their digital representations
3	**Extraction and mining communities in web social networks**	**Knowledge:** Definitions of social network structures and dynamics Familiarity with community detection algorithms Knowledge of web archiving techniques and formats Understanding of multi-relational and dynamic network models Awareness of decentralized online social networks Grasp of evaluation metrics for community detection. **Skills:**

		Proficiency in programming languages (e.g., Python, R) Experience with network analysis tools (e.g., Network, Gephi) Ability to implement and adapt community detection algorithms Data pre-processing and cleaning **Attitudes:** Respect for user privacy and data protection. Ethical consideration in behaviour prediction and analysis Commitment to transparency in data collection and use Proactive approach to security and trust issues Curiosity about human behaviour and social dynamics Openness to interdisciplinary approaches
4	**Predicting human behaviour and privacy issues**	**Knowledge:** Data management principles and techniques Statistical inference and distribution methods Reality mining concepts and applications Context-awareness in social computing Privacy concepts and regulations in online environments **Skills:** Data collection and analysis Predictive modelling of human behaviour Designing privacy-preserving systems Implementing trust models and algorithms **Attitudes:** Trust in online environment – Trust models based on subjective logic – Trust network analysis – Trust transitivity analysis – Combining trust and reputation – Trust derivation based on trust comparisons – Attack spectrum and counter measures.
5	**Application**	**Knowledge:** Machine learning algorithms and techniques Linguistic analysis methods , Emotion classification models Social media data structures and APIs , Emerging technology trends **Skills:** Programming (e.g., Python, R) Statistical analysis and Data visualization Model development and evaluation, API integration and Network graph analysis. **Attitudes:** It is use for Commitment to data security.

3. Syllabus

SOCIAL NETWORK ANALYSIS SEMESTER – VI			
Course Code	**M23BCS603D**	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 Theory**	Total Marks	**100**
Credits	**03**	Exam Hours	**03**

Course Objectives:

1. Ability to Understand the fundamental concepts and applications of social network analysis
2. Ability to Model and visualize the social network
3. Ability to Extract and Mine Communities in Web Social Networks
4. Ability to evaluate link prediction techniques and cascade models to predict network behavior and changes.
5. Ability to analyze anomaly detection techniques to identify and address malicious activities in networks.

Module -1

Networks and Society, What is Social Network Analysis?, Why do We Study Social Networks? Applications of Social Network Analysis, Preliminaries, Three Levels of Social Network Analysis ,Graph Visualization Tools, Network Measures, Network Basics, Node Centrality, Assortativity ,Transitivity and Reciprocity, Similarity, Degeneracy.
Text Book1:Chapter 1 ,2

Module -2

Network Growth Models, Properties of Real-World Networks, Random Network Model, Ring Lattice Network Model, Watts–Strogatz Model, Preferential Attachment Model, Price's Model, Local-world Network Growth Model, Network Model with Accelerating Growth, Aging in Preferential Attachment,

Link Analysis, Applications of Link Analysis, Signed Networks, Strong and Weak Ties, Link Analysis Algorithms, PageRank,Personalised PageRank, DivRank, SimRank, PathSIM. Text Book1:Chapter 3 ,4
Module -3
Community Structure in Networks, Applications of Community Detection,Types of Communities, Community Detection Methods, Disjoint Community Detection, Overlapping Community Detection,Local Community Detection, Community Detection vs Community Search,Evaluation of Community Detection Methods, Link Prediction, Applications of Link Prediction, Temporal Changes in a Network, Problem Definition. Text Book1:Chapter 5 ,6.1,6.2,6.3
Module -4
Evaluating Link Prediction Methods,Heuristic Models, Probabilistic Models, Supervised Random Walk, Information-theoretic Model, Latest Trends in Link Prediction,Cascade Behaviours and Network Effects ,Preliminaries and Important Terminologies, Cascade Models,Case Study – The "Indignados" Movement , Probabilistic Cascades, Epidemic Models Independent Cascade Models, Cascade Prediction. Text Book1:Chapter 6.4,6.5,6.6,6.7,6.8,6.9, Chapter7
Module -5
Anomaly Detection in Networks,Outliers versus Network-based Anomalies, Challenges,Anomaly Detection in Static Networks, Anomaly Detection in Dynamic Networks Malicious Activities on OSNs, Sockpuppets in OSNs, Collusion on Online Social Networks. Text Book1:Chapter 8,10.1,10.2,10.3
TEXTBOOKS: 1. Social Network Analysis, k Tanmoy Chakraborty , Publisher. Wiley · Publication date. 1 October 2021. 2. Guandong Xu ,Yanchun Zhang and Lin Li,-Web Mining and Social Networking – Techniques and applications, First Edition, Springer, 2011. **REFERENCE BOOKS:** 1. Dion Goh and Schubert Foo,-Social information Retrieval Systems: Emerging Technologies and Applications for Searching the Web Effectively, IGI Global Snippet, 2008. 2. Max Chevalier, Christine Julien and Chantal Soulé-Dupuy, Collaborative and Social Information Retrieval and Access: Techniques for Improved user Modelling, IGI Global Snippet, 2009. 3. John G. Breslin, Alexander Passant and Stefan Decker, -The Social Semantic Web, Springer, 2009. **VIDEO LINKS:** https://youtu.be/v3JaWbAdTTg https://youtu.be/hlAwvj60MI4

4. Syllabus Timeline

S/L	Syllabus Timeline	Description
1	Week 1-3: Introduction Networks And Society	Networks and Society, Three Levels of Social Network Analysis ,Graph Visualization Tools, Network Measures, Network Basics, Node Centrality, Assortativity ,Transitivity and Reciprocity, Similarity, Degeneracy
2	Week 4-6: Network Growth Models And Link Analysis	Properties of Real-World Networks, Random Network Model, Ring Lattice Network Model, Watts–Strogatz Model, Preferential Attachment Model, Price's Model, Local-world Network Growth Model.
3	Week 8-11: Community Structure In Networks	Community Detection Methods, Disjoint Community Detection, Overlapping Community Detection, Local Community Detection, Community Detection vs Community Search, Evaluation of Community Detection Methods, Link Prediction, Applications of Link Prediction, Temporal Changes in a Network, Problem Definition
4	Week 7-8: EVALUATING LINK PREDICTION METHODS	Heuristic Models, Probabilistic Models, Supervised Random Walk, Information-theoretic Model, Latest Trends in Link Prediction, Cascade Behaviors and Network Effects ,Preliminaries and Important Terminologies, Cascade Models, Case Study – The "Indignados" Movement , Probabilistic Cascades, Epidemic Models Independent Cascade Models, Cascade Prediction
5	Week 9-12: ANOMALY DETECTION IN NETWORKS	Outliers versus Network-based Anomalies, Challenges, Anomaly Detection in Static Networks, Anomaly Detection in Dynamic Networks Malicious Activities on OSNs, Sock puppets in OSNs, Collusion on Online Social Networks

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	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	Laboratory Learning	Knowledge about tools related to social networks and implementation of social network visualizations using tools such as Gephi, Cytoscape.

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	Introduction	Web - Limitations of current Web – Development of Semantic Web – Emergence of the Social Web – Statistical Properties of Social Networks Analysis.
2	Modeling and visualization	Visualizing Online Social Networks - A Taxonomy of Visualizations - Graph Representation - Centrality- Clustering - Node-Edge Diagrams - Visualizing Social Networks with Matrix- Based Representations- Node-Link Diagrams
3	Extraction and mining communities in web social networks	Definition of community – Evaluating communities – Methods for community detection and mining – Applications of community mining algorithms – Tools for detecting communities social network infrastructures and communities
4	Predicting human behavior and privacy issues	Understanding and predicting human behaviour for social communities – User data management – Inference and Distribution – Enabling new human experiences – Reality mining – Context – Awareness – Privacy in online social networks – Trust in online environment
5	Application	A Learning Based Approach for Real Time Emotion Classification of Tweets, A New Linguistic Approach to Assess the Opinion of Users in Social Network Environments,

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

Course Outcomes (COs)

Cos	Description
M23BCS603D.1	**Apply** social network analysis techniques, including node centrality, assortativity, transitivity, and reciprocity, to **analyse and interpret** real-world networks.
M23BCS603D.2	***Identify different*** network growth models, link analysis algorithms, and community detection methods to **analyze** and **solve** real-world problems involving network structures, such as social networks, biological networks, and organizational systems
M23BCS603D.3	**Analyse** link prediction methods and network effects, to **interpret** and **examine** the underlying patterns and dynamics in complex networks
M23BCS603D.4	**Analyse** and **evaluate** anomaly detection techniques for static and dynamic networks, including challenges related to malicious activities and collusion in online social networks.

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	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**	**10**	**10**	**50**

Semester End Examination (SEE)

	CO1	CO2	CO3	CO4	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**	**20**	**20**	**100**

10. Future with this Subject:

- **Integration with Artificial Intelligence (AI):** AI and machine learning will continue to enhance SNA by providing more sophisticated tools for pattern recognition, predictive analytics, and automated insights. AI algorithms can identify trends, anomalies, and influence patterns that may not be apparent through traditional methods.

- **Big Data and Real-Time Analysis:** With the growth of big data, SNA will increasingly leverage vast amounts of real-time data from social media platforms, communication networks, and other sources. This will enable more dynamic and timely analysis of social interactions and network structures.

- **Enhanced Visualization Tools:** Advanced visualization techniques will allow for more intuitive and interactive representations of complex social networks. Tools that can effectively illustrate multi-dimensional relationships and evolving networks will improve our ability to understand and communicate findings.

- **Integration with Other Disciplines:** SNA will benefit from integration with fields like psychology, sociology, and economics. Understanding social behaviour and dynamics in a more holistic context will improve the accuracy and relevance of network analyses.

- **Privacy and Ethical Considerations:** As SNA tools become more powerful, there will be increasing focus on privacy and ethical concerns. Developing frameworks to ensure responsible data use, protect individuals' privacy, and address biases will be critical.

- **Personalized Social Network Insights:** Advances in data analysis will enable more personalized insights into individual behaviours and relationships within networks. This could impact areas like targeted marketing, personalized recommendations, and tailored interventions.

- **Block chain and Decentralized Networks:** Block chain technology and decentralized networks may offer new ways to analyze and visualize social interactions. These technologies could provide greater transparency and security in network analysis.

- **Cross-Network Analysis:** Future SNA will likely involve the analysis of multiple interconnected networks, such as combining social networks with professional or academic networks. This can provide a more comprehensive understanding of individuals' roles and influence across different contexts.

- **Increased Focus on Small-Scale Networks:** While much of SNA has focused on large-scale networks, there will be growing interest in understanding smaller, niche networks, including those within organizations or specific communities.

- **Advancements in Data Collection Methods:** New methods for data collection, such as sensors, wearables, and automated scraping tools, will provide richer and more diverse datasets for analysis, enhancing the depth and accuracy of social network insights.

6th Semester	Open Elective –I (OE) Programming in Java	M23BCS604A

1. Prerequisites

S/L	Proficiency	Prerequisites
1	**Basic Programming Concepts**	Understanding the use of variables to store data and understand basic data types like integers, floats, characters, and strings. The use of control structures and Understand how to define and call functions or methods, including parameters and return values.
2	**Understanding of Object-Oriented Programming (OOP)**	Understanding to define classes and create objects in Java and how inheritance allows one class to inherit fields and methods from another. Getting familiar with method overriding and overloading. Learning how to use access modifiers to protect data and ensure a class's internal representation is hidden from the outside.
3	**Basic Knowledge of Java Syntax and Semantics**	Understanding the Java-specific syntax and basic error handling using exceptions.
4	**Development Tools and Environment**	Choosing an IDE or text editor suitable for Java development, such as IntelliJ IDEA, Eclipse, or NetBeans. Learning the usage of the IDE for coding, debugging, and managing your projects. The JDK provides the necessary tools for compiling and running Java programs.
5	**Understanding of Compilation and Execution**	Understanding the difference between source code and bytecode. Understand the process of compiling Java code into bytecode and running it on the Java Virtual Machine (JVM).

2. Competencies

S/L	Competency	KSA Description
1	**Core Java Concepts**	**Knowledge:** Proficiency with Java syntax, including how to write correct and efficient code using Java's syntax rules. **Skills:** Learning the basic concepts of primitive data types in java. **Attitude:** Fundamental to understanding the language and its capabilities.
2	**Object-Oriented Programming**	**Knowledge:** Ability to define and instantiate classes and objects. Understanding method overloading and overriding, and how polymorphism enables flexible code **Skills:** Practicing the concept of functional programming **Attitude:** Principles that shape how developers approach problem-solving and software design.
3	**Java Virtual Machine (JVM) and Performance**	**Knowledge:** Understanding the JVM's role in executing Java applications and how garbage collection works. **Skills:** Understanding the concept of JVM and Execution process. **Attitude:** Component of the Java ecosystem, and its design embodies specific attitudes toward performance and execution.
4	**Development Tools and Practices**	**Knowledge:** Proficiency with build tools like Maven or Gradle for managing dependencies and building projects. Using an Integrated Development Environment (IDE) like IntelliJ IDEA, Eclipse, or NetBeans effectively. **Skills:** Understanding the development of new projects using java. **Attitude:** Commitment to efficiency, quality, collaboration, and continuous improvement.

3. Syllabus

Programming in Java SEMESTER – VI			
Course Code	**M23BCS604A**	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 Theory**	Total Marks	**100**
Credits	**03**	Exam Hours	**03**

Course objectives: This course will enable students to
1.Learn fundamental features of object oriented language and JAVA
2.Set up Java JDK environment to create, debug and run simple Java programs.
3.Learn object oriented concepts using programming examples.
4.Study the concepts of importing of packages and exception handling mechanism.
5.Discuss the String Handling examples with Object Oriented concept

Module -1

An Overview of Java: Object-Oriented Programming, A First Simple Program, A Second Short Program, Two Control Statements, Using Blocks of Code, Lexical Issues, The Java Class Libraries.
Data Types, Variables, and Arrays: Java Is a Strongly Typed Language, The Primitive Types, Integers, Floating-Point Types, Characters, Booleans, A Closer Look at Literals, Variables, Type Conversion and Casting, Automatic Type Promotion in Expressions, Arrays,
Textbook 1: Ch 2,Ch 3.

Module -2

Operators: Arithmetic Operators, The Bitwise Operators, Relational Operators, Boolean Logical Operators, The Assignment Operator, The ? Operator, Operator Precedence, Using Parentheses,
Control Statements: Java's Selection Statements, Iteration Statements, Jump Statements.
Textbook 1: Ch 4,Ch 5.

Module -3

Introducing Classes: Class Fundamentals, Declaring Objects, Assigning Object Reference Variables, Introducing Methods, Constructors, The this Keyword, Garbage Collection, The finalize( ) Method.
A Closer Look at Methods and Classes: Overloading Methods,A Closer Look at Argument Passing, Returning Objects, Recursion, Introducing Access Control,Introducing final.
Inheritance: Inheritance, Using super, Creating a Multilevel Hierarchy, When Constructors Are Called, Method Overriding.
Textbook 1: Ch 6, Ch 7.1-7.9, Ch 8.1-8.5

Module -4

Packages and Interfaces:
Packages, Access Protection, Importing Packages, Interfaces, Exception Handling: Exception-Handling Fundamentals, Exception Types, Uncaught Exceptions, Using try and catch, Multiple catch Clauses, Nested try Statements, throw, throws, finally, Java"s Built-in Exceptions, Creating Your Own Exception Subclasses, Chained Exceptions, Using Exceptions.

Module -5

Type Wrappers, I/O, Applets, and Other Topics: I/O Basics, Reading Console Input, Writing Console Output, The PrintWriter Class, Reading and Writing Files, Applet Fundamentals-Example Program.
String Handling: The String Constructors, String Length, Special String Operations, Character Extraction, String Comparison, Searching Strings, Modifying a String, Data Conversion Using valueOf( ), Changing the Case of Characters Within a String , Additional String Methods, StringBuffer, StringBuilder.

Text Books:
1. Herbert Schildt, Java the Complete Reference, 7th Edition, Tata McGraw Hill, 2007. (Chapters 2, 3, 4, 5, 6,7, 8, 9,10, 12,13,15).
2. Cay S Horstmann, "Core Java - Vol. 1 Fundamentals", Pearson Education, 10th Edition, 2016.
Reference Books:
1. Cay S Horstmann, "Core Java - Vol. 1 Fundamentals", Pearson Education, 10th Edition, 2016.
2. Raoul-Gabriel Urma, Mario Fusco, Alan Mycroft, "Java 8 in Action", Dreamtech Press/Manning Press, 1st Edition, 2014.

4. Syllabus Timeline

S/L	Syllabus Timeline	Description
1	Week1-2: **An Overview of Java**	It involves understanding its fundamental aspects, core features. The knowledge of basic concepts such as variables, datatypes, programming structure and execution environment. Acquiring the knowledge of basic concepts of Java programming**.**
2	Week 3-4: **Operators**	Understanding the usage and applying various types of operators effectively. It involves understanding and applying different types of operators. Usage of different operators to perform specific operations.
3	Week 5-6: **Introducing Classes**	Understanding the design, implement, and utilize classes effectively. Encompasses the understanding of classes concept in programming. Ability to use the concept of classes and object to solve related problems in Java.
4	Week 7-8: **Packages and Interfaces**	It involves understanding purpose, usage, and interaction of packages and interfaces within Java applications. Knowledge of packages and interfaces. Involve a range of abilities related to designing, implementing java application using packages and interfaces.
5	Week 9-10: **Type Wrappers, I/O, Applets, and Other Topics**	Involves understanding and effectively using basic concepts of Applets and string methods. Understanding the Applet viewer and different string methods to perform specific operations. Involve effectively using Applets to build basic GUI application.

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	**Pair Programming**	Incorporate pair programming sessions where students collaborate in pairs to solve coding tasks or work on projects together.
7	**Use of Tools and Resources**	Familiarize students with IDEs like IntelliJ IDEA or Eclipse for coding and debugging. Apply Java concepts to practical problems and projects to demonstrate their utility.
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)

Theory Course with 3 Credits: Open Elective (OE)

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 for Open Elective (OE)

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 Examinations:

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	**Master Advanced Java Concepts**	Ensuring that students gain a deep understanding of complex Java concepts, tools, and frameworks, enabling them to develop robust, scalable, and efficient applications
2	**Apply Object-Oriented Programming principles**	Creating and manipulating classes and objects, and understand the role of constructors. Implementing and using inheritance to create hierarchical relationships between classes. Utilizing method overloading and overriding to achieve polymorphism.
3	**Understand Java's Execution Environment**	Java code is compiled into bytecode and executed on the Java Virtual Machine (JVM). Understand basic concepts of memory management, including garbage collection.
4	**Practical Application**	Developing Practical Programming Skills. Designing and implementing the algorithms for common problems and tasks.

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

Course Outcomes (COs)

COs	Description
M23BCS604A.1	Understanding the basic concepts of java to solve real time problems.
M23BCS604A.2	Apply the object-oriented concepts of java and exception handling concepts to implement java program.
M23BCS604A.3	Analyze I/O and String handling concept to develop an application program.
M23BCS604A.4	Analyze and develop computer programs to solve real world problems in Java.

CO-PO-PSO Mapping

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
M23BCS604A.1	**3**													
M23BCS604A.2		**3**												
M23BCS604A.3			**3**										**3**	**3**
M23BCS604A.4				**3**								**3**	**3**	**3**
M23BCS604A	**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**	**20**		**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	40		**50**

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. Language Evolution: Ongoing updates and feature enhancements in recent versions improve performance, simplify syntax, and introduce new functionalities. This aims to simplify concurrency and scalability with lightweight, user-friendly fibers and continuations.

2. Performance Improvements: The Java Virtual Machine (JVM) continues to receive performance optimizations, improving execution speed and efficiency.

3. **Integration with Emerging Technologies:** Java is increasingly used in big data processing frameworks (like Apache Hadoop and Apache Spark) and artificial intelligence applications. Java's portability and robustness make it suitable for IoT applications and devices.

4. Educational and Enterprise Adoption: Java remains a primary language taught in computer science programs, ensuring a steady influx of new developers. Many large enterprises continue to rely on Java for mission-critical applications, ensuring its relevance in the business world.

5. Development Practices and Tools: Improved tools and practices for monitoring and managing the performance and health of Java applications in production environments. Advanced Integrated Development Environments (IDEs) and tools providing enhanced code assistance, debugging, and profiling capabilities.

6th Semester	Open Elective –I (OE) Introduction to Data Structures	M23BCS604B

1. Prerequisites

S/L	Proficiency	Prerequisites
1	**Basic Programming Concepts**	**Variables and Data Types:** Understanding different data types (int, float, char, etc.) and how to declare and use variables. **Control Structures:** Proficiency with loops (for, while, do-while) and conditional statements (if, else if, else, switch). **Functions:** Understanding how to define and use functions, including parameter passing, return types, and recursion. **Pointers:** Understanding pointers, pointer arithmetic, and how they relate to arrays and functions. **Memory Management:** Familiarity with dynamic memory allocation using malloc(), calloc(), realloc(), and free() functions.
2	**Advanced C Programming Concepts**	**Structures:** Ability to define and use structures to group different data types together. **Unions and Enumerations:** Understanding how to use unions and enumerations. **File I/O:** Basic knowledge of reading from and writing to files in C. **Preprocessor Directives:** Familiarity with macros, #define, #include, and conditional compilation.
3	**Basic Algorithms**	**Sorting Algorithms:** Understanding basic sorting algorithms like Bubble Sort, Selection Sort, and Insertion Sort. **Searching Algorithms:** Familiarity with searching techniques like Linear Search and Binary Search.
4	**Mathematical Concepts**	**Discrete Mathematics:** Basic understanding of sets, functions, relations, and combinatorics.
5	**Problem-Solving Skills**	**Algorithm Design:** Ability to design algorithms for solving problems using data structures. **Debugging and Testing:** Skills in debugging code and testing to ensure correctness and efficiency.

2. Competencies

S/L	Competency	KSA Description
1	**In-Depth Understanding of Data Structures**	**Knowledge (K)** **Arrays:** Understanding static and dynamic arrays, multidimensional arrays, and their applications. **Linked Lists:** Knowledge of singly linked lists, doubly linked lists, and circular linked lists, including their memory structure and use cases. **Stacks and Queues:** Understanding of stack and queue concepts, including their implementation and applications using arrays and linked lists. **Skills (S)** **Coding Proficiency:** Ability to write, debug, and optimize code for implementing various data structures from scratch in C. **Data Structure Operations:** Skill in implementing operations such as insertion, deletion, searching, and traversal for different data structures. **Attitudes: Use of Pointers and Dynamic Memory:** Proficiency in using pointers for creating and manipulating complex data structures, and managing dynamic memory effectively.
2	**Problem-Solving Abilities**	**Knowledge (K)** **Complexity Analysis:** Knowledge of time and space complexity analysis using Big O notation, with the ability to analyze the performance of data structure operations. **Sorting and Searching Algorithms:** Understanding of fundamental algorithms and their integration with data structures. **Recursion and Iteration:** Knowledge of recursive and iterative approaches to solving problems, especially in tree and graph algorithms. **Skills (S)**

		Data Structure Selection: Ability to choose the most appropriate data structure for solving specific problems based on efficiency and complexity considerations. **Debugging:** Skill in identifying and fixing bugs related to pointers, memory allocation, and data structure operations in C code. **Optimization:** Ability to optimize data structures for performance, minimizing time and space complexity through efficient algorithms and code practices. **Attitudes: Practical Application:** Ability to apply knowledge of data structures in solving real-world programming challenges, particularly in system programming, embedded systems, and performance-critical applications. **Scalability and Efficiency:** Ability to design and implement data structures that scale efficiently with large datasets or under high-performance requirements
3	**Errors and Handling the Errors**	**Knowledge:** Understanding of issues with errors. **Skills:** Implementing how to handle the errors through appropriate C++ programming construct. **Attitudes: Appreciation for the way error is handled and making the execution of program in control.**
4	**Reusability of Classes and Methods**	**Knowledge:** Understanding the importance of code reusability through classes and methods reusability. **Skills:** Applying concepts of object orientation with classes and methods. Describing the actually importance of reusability through implementations. **Attitudes:** Openness to learning and using object orientation concepts to achieve code reusability.

3. Syllabus

Introduction to Data Structures **SEMESTER – VI**			
Course Code	**M23BCS604B**	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 Theory**	Total Marks	**100**
Credits	**03**	Exam Hours	**03**

Course Learning Objectives

1. Introduce elementary data structures.
2. Analyze Linear Data Structures: Stack, Queues, Lists
3. Analyze Non Linear Data Structures: Trees
4. Assess appropriate data structure during program development/Problem Solving.

Module -1

Introduction:

Introduction to arrays: one-dimensional arrays, two dimensional arrays, initializing two dimensional arrays, Multidimensional arrays.

Introduction to Pointers: Pointer concepts, accessing variables through pointers, Dynamic memory allocation, pointers applications.

Introduction to structures and unions: Declaring structures, Giving values to members, structure initialization, arrays of structures, nested structure, unions, sizeof() structures.

Textbook 1: Ch 8.3 to 8.15,Ch 12.3 to 12.19

Textbook 2:Ch 2.1 to2.13,2.51 ,2.80 to 2.98

Module -2

Linear Data Structures-Stacks and queues:

Introduction, Stack representation in Memory, Stack Operations, Stack Implementation, Applications of Stack. Introduction, Queues-Basic concept, Logical representation of Queues, Queue Operations and its types, Queue Implementation, Applications of Queue.

Textbook 2: Ch 6.1 to 6.14 ,Ch 8.1,8.2

Module -3

Linear Data Structures-Linked List:

Introduction, Linked list Basic concept, Logical representation of Linked list, Self-Referential structure, Singly-linked List Operations and Implementation, Circular Linked List, applications of Linked list.

Textbook 1: Ch 15.1 ,15.3,15.4,15.8

Textbook 2: Ch 9.2.9.5

Module -4
Non Linear Data Structures – Trees Introduction, Basic concept, Binary Tree and its types, Binary Tree Representation, Binary Tree Traversal, and Binary Search tree, Expression Trees. **Textbook1: Ch 16.1,16.2** **Textbook2:Ch 10.1,10.2,10.4,10.6.3**
Module -5
Sorting and Searching Sorting: Introduction, Bubble sort, Selection sort, Insertion sort Searching: Introduction, Linear search, Binary search. **Textbook1: Ch 17.1,17.2.2, 17.2.4, 17.3.1,17.3.2** **Textbook2: Ch 11.1.,11.2,11.3,11.7,11.10.1,11.10.2**
Textbooks 1. C Programming and data structures, E Balaguruswamy 4th Edition, 2007, McGraw Hill 2. Systematic approach to Data structures using C, A M Padma Reddy, 7thEdition 2007, Sri Nandi Publications. **References** 1. Ellis Horowitz and Sartaj Sahni, Fundamentals of Data Structures in C, 2nd Ed, Universities Press, 2014. 2. Seymour Lipschutz, Data Structures Schaum's Outlines, Revised 1st Ed, McGraw Hill, 2014.

4. Syllabus Timeline

S/L	Syllabus Timeline	Description
1	Week1-2: **Introduction to arrays, Introduction to Pointers**	Introduction to arrays: one-dimensional arrays, two dimensional arrays, initializing two dimensional arrays, Multidimensional arrays. Introduction to Pointers: Pointer concepts, accessing variables through pointers, Dynamic memory allocation, pointers applications. Introduction to structures and unions: Declaring structures, Giving values to members, structure initialization, arrays of structures, nested structure, unions, sizeof() structures.
2	Week 3-4: **Stack and Queues**	Introduction, Stack representation in Memory, Stack Operations, Stack Implementation, Applications of Stack. Introduction, Queues-Basic concept, Logical representation of Queues, Queue Operations and its types, Queue Implementation, Applications of Queue.
3	Week 5-6: **Linear Data Structures-Linked List:**	Introduction, Linked list Basic concept, Logical representation of Linked list, Self-Referential structure, Singly-linked List Operations and Implementation, Circular Linked List, applications of Linked list.
4	Week 7-8: **Non Linear Data Structures – Trees**	Introduction, Basic concept, Binary Tree and its types, Binary Tree Representation, Binary Tree Traversal, Binary Search tree, Expression Trees.
5	Week 9-10: **Sorting and Searching**	Sorting: Introduction, Bubble sort, Selection sort, Insertion sort Searching: Introduction, Linear search, Binary search.

5. Teaching-Learning Process Strategies

S/L	TLP Strategies:	Description
1	**Foundation in C Programming**	**Prerequisite Knowledge**: Ensure students have a solid understanding of C programming basics, including pointers, memory allocation, and structures (struct). **Review Pointers and Memory Management**: Since data structures in C heavily rely on pointers, start with a review of pointer operations and dynamic memory allocation using malloc(), calloc(), realloc(), and free().
2	**Begin with Basic Data Structures**	**Arrays and Strings**: Start with arrays as the simplest form of data structure in C. Teach how strings are handled as arrays of characters, and introduce basic string manipulation functions. **Structures (struct)**: Introduce the concept of structures to group different data types, laying the groundwork for more complex data structures like

		linked lists and trees.
3	**Introduce Linked Lists**	**Singly Linked List**: Begin with singly linked lists, covering concepts like nodes, head pointers, and traversal. Emphasize how pointers are used to link nodes. **Implementation**: Guide students through coding linked list operations such as insertion, deletion, and traversal. **Debugging Practice**: Since pointer errors are common, provide debugging exercises to help students develop problem-solving skills.
4	**Stack and Queue Implementations**	**Stack Using Arrays and Linked Lists**: Teach how to implement stacks using both arrays and linked lists. Discuss the advantages and disadvantages of each approach. **Queue Implementation**: Similar to stacks, introduce queues with both array-based and linked-list-based implementations. Explain the differences between simple queues, circular queues, and priority queues.
5	**Dynamic Memory Management**	**Memory Allocation for Data Structures**: Use examples to show how to allocate and deallocate memory for data structures dynamically. Discuss memory leaks and best practices for managing memory in C.
6	**Advanced Data Structures**	**Trees**: Introduce binary trees and binary search trees, focusing on recursive implementations of tree operations. Explain traversal methods (in-order, pre-order, post-order) and their applications. **Graphs**: Teach basic graph representations using adjacency matrices and adjacency lists. Discuss graph traversal algorithms (BFS and DFS) and their implementation in C. **Hash Tables**: Explain the concept of hashing and collision resolution techniques. Implement a simple hash table using arrays and linked lists.

6. Assessment Details (both CIE and SEE)

Theory Course with 3 Credits: Open Elective (OE)

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 for Open Elective (OE)

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 Examinations:

Theory Course with 4, 3 and 2 Credits: Professional Core Course (PC)/Professional Elective/Open Elective

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 mark

7. Learning Objectives

S/L	Learning Objectives	Description
1	**Understanding Basic Concepts of Data Structures**	**Definition and Types**: Understand what a data structure is and the different types (e.g., linear and non-linear). **Efficiency**: Learn the importance of data structures in terms of time and space complexity. **Data Structure Operations**: Master the basic operations (insertion, deletion,

		traversal, searching, and sorting) on various data structures.
2	**Mastering Linear Data Structures**	**Arrays**: Learn how to use arrays, including dynamic arrays, and understand their memory management. **Linked Lists**: Understand the implementation of singly linked lists, doubly linked lists, and circular linked lists. **Stacks**: Study stack operations (push, pop, peek) and their implementation using arrays or linked lists. **Queues**: Understand queues, including circular queues, and their implementation using arrays or linked lists.
3	**Understanding Non-Linear Data Structures**	**Trees**: Learn about binary trees, binary search trees (BST), AVL trees, and heap trees. Understand tree traversal methods (in-order, pre-order, post-order). **Graphs**: Understand the representation of graphs using adjacency matrices and lists. Study graph traversal techniques (BFS and DFS). **Hash Tables**: Learn about hashing, hash functions, and collision resolution techniques.
4	**Practical Implementation Skills**	**C Programming**: Enhance C programming skills, particularly in relation to implementing data structures from scratch. **Problem Solving**: Apply data structures to solve real-world problems, understanding when and how to use each type of structure. **Debugging and Optimization**: Learn to debug code effectively and optimize data structures for performance.

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

Course Outcomes (COs)

COs	Description
M23BCS604B.1	Apply basic concepts of data structures and linear data structure to solve computational problems.
M23BCS604B.2	Apply dynamic memory management techniques using pointers and implement complex data structures.
M23BCS604B.3	Analyze non-linear data structures like trees and graphs.
M23BCS604B.4	Analyze various algorithms for sorting, searching, and other data operations.

CO-PO-PSO Mapping

Cos/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
M23BCS604B.1	**3**	**-**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**3**	**3**	
M23BCS604B.2	**-**	**-**	**3**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**3**	
M23BCS604B.3	**-**	**-**	**3**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**3**		**3**
M23BCS604B.4	**3**	**-**	**3**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**3**	
M23BCS604B	**3**		**3**	**2**	**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**	**50**

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

Foundation for Advanced Computer Science Concepts

- **Algorithms**: Data structures are the building blocks for designing and analyzing algorithms. A solid understanding of data structures in C prepares you for more advanced topics like algorithm design, complexity analysis, and optimization.
- **Systems Programming**: C is often used in system-level programming (e.g., operating systems, embedded systems). Understanding data structures is crucial for writing efficient and high-performance system code.
- **Artificial Intelligence and Machine Learning**: Efficient data management using appropriate structures is key in AI/ML for handling large datasets and implementing algorithms.
- **Career Opportunities**
- **Software Development**: Knowledge of data structures is essential for software engineers, as it directly impacts the efficiency and performance of software applications. Companies like Google, Microsoft, and Amazon highly value this skill.
- **System Architect or Engineer**: In roles that involve designing large-scale systems (e.g., distributed systems, databases), data structures are vital for ensuring scalability and performance.
- **Embedded Systems Engineer**: C is the language of choice for embedded systems, where efficient data structures are crucial due to limited resources.
- **Database Administrator/Developer**: Understanding data structures helps in optimizing database queries, designing indexing strategies, and improving overall database performance.
- **Game Development**: Game developers use data structures extensively for managing game states, rendering graphics, and handling user input in real-time.

6th Semester	Open Elective –I(OE) Introduction to DBMS	M23BCS604C

1. Prerequisites

S/L	Proficiency	Prerequisites
1	Basic Computer Literacy	A solid understanding of how computers work, file management, and using software applications is essential.
2	Fundamentals of Data and Information	Familiarize yourself with the concepts of data, information, and knowledge. Understand the differences between structured and unstructured data.
3	Basic Programming Concepts	While not mandatory, a familiarity with programming concepts can be helpful, especially if you intend to work with databases in a software development context.
4	Operating System Concepts	Familiarity with concepts like file systems, memory management, and process scheduling can help you understand how a DBMS interacts with the underlying operating system.
5	Problem-Solving Skills	Develop your analytical and problem-solving skills, as designing efficient and effective databases often requires making trade-offs and optimizing for different scenarios.

2. Competencies

S/L	Competency	KSA Description
1	**Data Modeling**	**Knowledge:** Understand the principles of data modeling. **Skills:** Entity-Relationship diagrams (ERDs), **Attitudes:** These concepts help design efficient and organized database.
2	**Relational Algebra and Set Theory**	**Knowledge:** Gain basic knowledge of relational algebra and set theory. **Skills:** The knowledge used to interact with relational databases. **Attitudes:** The foundation of relational databases.
3	**SQL (Structured Query Language):**	**Knowledge:** the basics of SQL, the standard language for data query. **Skills:** Writing queries to retrieve, update, and manipulate data. **Attitudes:** Acquired skill to be used for querying with relational databases.
4	**Normalization**	**Knowledge:** Learn about database normalization. **Skills:** To eliminate redundancy and improve data integrity. **Attitudes:** Understand the concept of normalization for optimizing query performance.
5	**DataBase applications**	**Knowledge:** Gain insight into query optimization strategies. **Skills:** To design data base structure for a particular application. **Attitudes:** To enhance database performance.

3. Syllabus

Introduction DBMS SEMESTER – VI			
Course Code	**M23BCS604C**	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 provide a strong foundation in database concepts, technology, and practice.
2. To practice SQL programming through a variety of database problems.
3. To understand the relational database design principles.
4. To demonstrate the use of concurrency and transactions in database.
5. To design and build database application for real world problems.
6. To become familiar with database storage structures and access techniques.

Module -1
Introduction to DBMS and Database Design **8 hours** Introduction to Databases: Introduction, Characteristics of database approach, Advantages of using the DBMS approach, History of database applications. Overview of Database Languages and Architectures: Data Models, Schemas, and Instances. Three schema architecture and data independence, database languages, and interfaces. The Database System environment. Conceptual Data Modeling using Entities and Relationships: Entity types, Entity sets, attributes, roles, and structural constraints, Weak entity types, ER diagrams, examples, Specialization and Generalization. **Text-1: CH-1.1-1.8, 2.1-2.6, 3.1-310**
Module -2
Relational Models **8hours** Relational Model: Relational Model Concepts, Relational Model Constraints and relational database schemas, Update operations, transactions, and dealing with constraint violations. Relational Algebra and Calculus: Unary and Binary relational operations, additional relational operations (aggregate, grouping, etc.) Examples of Queries in relational algebra, Tuple relational calculus, Domain relational calculus. Mapping Conceptual Design into a Logical Design: Relational Database Design using ER-to-Relational mapping. **Text-1 : CH-5.1-5.3,8.1-8.7,9.1**
Module -3
SQL **8 hours** SQL: SQL data definition and data types, Schema change statements in SQL, specifying constraints in SQL, retrieval queries in SQL, INSERT, DELETE, and UPDATE statements in SQL, Additional features of SQL : Advanced Queries: More complex SQL retrieval queries, Specifying constraints as assertions and action triggers, Views in SQL. **Text-1 CH-6.1-6.5,7.1-7.4**
Module -4
Functional dependencies: **8 hours** Database Design Theory – Introduction to Normalization using Functional and Multivalued Dependencies: Informal design guidelines for relation schema, Functional Dependencies, **Text-1: CH-14.1-14.3**
Module -5
Normalization: Normal Forms based on Primary Keys, Second and Third Normal Forms, Boyce-Codd Normal Form, Multivalued Dependency and Fourth Normal Form, Join Dependencies and Fifth Normal Form. **Text-1:CH-14.4-14.7**
Text Books: 1. Fundamentals of Database Systems, Ramez Elmasri and Shamkant B. Navathe, 7th Edition, 2017, Pearson. 2. Raghu Ramakrishnan and Johannes Gehrke, Database Management Systems, McGraw-Hill, 3rd Edition. **Reference Books:** 1.Data base System Concepts, Silberschatz, Korth, McGraw hill, Sixth Edition 2. An Introduction to Database systems, C.J. Date, A.Kannan, S.Swami Nadhan, Pearson, Eight Edition

4. Syllabus Timeline

S/L	Syllabus Timeline	Description
1	Week 1-3	**Knowledge:** Understand the principles of data modeling **Skills:** Entity-Relationship diagrams (ERDs). These concepts help design efficient and organized database.
2	Week 4-6	**Knowledge:** Gain basic knowledge of relational algebra and set theory. **Skills:** The knowledge used to interact with relational databases and the foundation of relational databases.
3	Week 7-9	**Knowledge:** The basics of SQL, the standard language for data query. **Skills:** Writing queries to retrieve, update, and manipulate data.
4	Week 10-12	**Knowledge:** Learn about database normalization to eliminate redundancy and improve data integrity. **Skills:** Understand the concept of normalization for optimizing query performance.
5	Week 13-15	**Knowledge:** Gain sight into query optimization strategies to enhance database performance. **Skills:** To design data base structure for a particular application.

5. Teaching-Learning Process Strategies

S/L	TLP Strategies:	Description
1	Lecture Method	• Using traditional lecture methods and ICT as and when needed.
2	Video/Animation	• Incorporate visual aids like videos/animations to enhance learning.
3	Collaborative Learning	• Encourage collaborative learning approaches for peer learning.
4	Problem-Based Learning (PBL)	• Implement PBL to enhance analytical skills and practical application.
5	Real-World Application	• Discuss practical applications to connect theoretical concepts with real-world competencies.
6	Programming Assignments	• Assign programming tasks to reinforce practical skills associated with competencies.

6. **Assessment Details (both CIE and SEE)**

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

CIE Split up for Open Elective (OE)

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 Examinations:

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
1	To provide a strong foundation in database concepts, technology, and practice.
2	To practice SQL programming through a variety of database problems.
3	To understand the relational database design principles.
4	To design and build database application for real world problems.
5	To become familiar with database storage structures and access techniques.

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

Course Outcomes (COs):

Cos	Description
M23BCS604C.1	Understand and apply the basic elements of a relational database management system.
M23BCS604C.2	Apply various constraints, techniques and Structured Query Language (SQL) statement for database operations.
M23BCS604C.3	Analyze various database models and normalization for the given application.
M23BCS604C.4	Design and develop entity relationship model and database application.

CO-PO-PSO Mapping:

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
M23BCS604C.1	3	-	-	-	-	-	-	-	-	-	-	-	3	-
M23BCS604C.2	3	-	-	-	2	-	-	-	-	-	-	-	3	3
M23BCS604C.3	-	3	-	-	-	-	-	-	-	-	-	-	-	3
M23BCS604C.4	-	-	3	-	-	-	-	-	-	-	-	-	-	3
M23BCS604C	**3**	**3**	**3**		**2**								**3**	**3**

9. Assessment Plan

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 mark

10.Future with this Subject:

- Data Organization and Storage: Companies can store their data in databases in a structured, organized manner, making it simpler to access and analyze.
- Data Analysis: Databases contain a lot of data, and with the correct tools, organizations can analyze that data to find insights that will help them make business decisions and strategies.
- Efficiency: Databases give companies a centralized area to keep their data, making it more straightforward for staff to retrieve the data they want, minimizing duplication of work and boosting efficiency.
- Security & Privacy: Databases let companies control who has access to their data, ensuring that only authorized users may see and change it. This aids in preventing unauthorized access to and breaches of vital consumer and corporate information.

This course is the foundation for many other courses to follow such as cloud storage, distributed data storage, block chain, Big data, Quantum computing etc.,

6th Semester	Open Elective Introduction to Operating systems	M23BCS604D

1. Prerequisites

S/L	Proficiency	Prerequisites
1	Basic programming skills	Understanding of programming concepts and experience in a programming language such as C, C++, Java, or Python.
2	Computer architecture	Basic understanding of computer organization and architecture, including concepts like memory hierarchy, CPU operations, and input/output systems.
3	Data structures and algorithms	Familiarity with fundamental data structures (arrays, linked lists, trees, etc.) and algorithms (sorting, searching, etc.).
4	Computer Organization	Knowledge of how hardware components interact at a low level is helpful. This includes concepts like machine instructions, addressing modes, memory management, and I/O operations.
5	Databases	Basic understanding of databases and file management systems is helpful as operating systems often interact with databases for storing and retrieving data.

2. Competencies

S/L	Competency	KSA Description
1	Operating System Fundamentals	**Knowledge**: Understanding of different operating system architectures (e.g., monolithic, microkernel, hybrid). Familiarity with system calls, file systems, memory management, process scheduling, and input/output subsystems. **Skills**: Ability to configure and install various operating systems (e.g., Windows, Linux, macOS, UNIX). Proficiency in troubleshooting OS-related issues. **Attitudes**: Ability to explain the core components of an operating system and how they interact, diagnose common OS-related performance issues, and optimize the OS for better resource utilization.
2	System Administration	**Knowledge**: Understanding of system administration tasks such as user management, system security, backup, software installation, and system configuration. **Skills**: Proficiency in managing user accounts, configuring system services, managing file systems, applying patches, and performing system backups. **Attitudes**: Ability to perform routine administrative tasks, automate repetitive tasks through scripts, and ensure that the operating system is secure and running efficiently.
3	File System Management	**Knowledge**: Understanding of different types of file systems (e.g., NTFS, ext4, APFS, FAT32). Knowledge of file system structures, data storage, permissions, and disk management tools. **Skills**: Ability to create, mount, and manage file systems. Proficiency in handling disk partitions, optimizing file system performance, and resolving file system-related issues. **Attitudes**: Ability to recover data from damaged or corrupted file systems, implements proper file access permissions, and ensure data integrity in an OS.
4	Memory Management	**Knowledge**: Understanding of memory hierarchy, paging, segmentation, and virtual memory. Knowledge of memory allocation techniques and OS strategies to handle memory (e.g., paging, swapping). **Skills**: Ability to monitor and troubleshoot memory usage in the operating system, such as detecting memory leaks, managing memory usage, and optimizing virtual memory. **Attitudes**: Ability to design efficient memory management techniques for both hardware and software, ensure that system memory is allocated properly, and minimize the occurrence of out-of-memory errors.
5	Process Management	**Knowledge**: Understanding of how processes are created, scheduled, and terminated. Familiarity with multithreading, multitasking, process synchronization, and inter-process communication (IPC). **Skills**: Ability to manage processes using command-line tools or GUI utilities. Proficiency in using OS utilities to track process states and system resource

		consumption. **Attitudes**: Ability to implement and manage process scheduling strategies, optimize resource allocation, and troubleshoot process deadlocks or race conditions.

3. Syllabus

Introduction to Operating systems **SEMESTER – VI**			
Course Code	**M23BCS604D**	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 Theory**	Total Marks	**100**
Credits	**03**	Exam Hours	**03**

Course objectives: This course will enable students to:
- Basic Understanding of Computer System Structure and Operating Systems Structure
- Analyze the main tasks carried out by the operating systems Process and thread management, CPU scheduling algorithms, memory management and deadlocks.
- To demonstrate different APIs/Commands related to processor, memory, storage and file system management.

Module -1

Introduction to operating systems: What operating systems do; Computer System organization; Computer System architecture; Operating System operations(dual-mode and multi mode);computing environments; **System structures:** Operating system services; User - Operating System interface; System calls; Types of system calls; operating system structures
textbook 1- chapter 1(1.1,1.2,1.3,1.5,1.11) chapter 2 (2.1,2.2,2.3,2.4,2.7)

Module -2

Process management: Process Concept ; Process Scheduling; Operation on Process; Inter-Process Communication. **Multithreaded programming**: Overview; Multicore programming, multithreading models, thread libraries, threading issues. **Process scheduling** - Basic Concepts, CPU I/O Burst Cycle; CPU Scheduler – Pre-emptive Scheduling, Dispatcher; Scheduling Criteria; Scheduling Algorithms – FCFS, SJF, Round-Robin, Priority.
textbook 1-chapter 3(3.1,3.2,3.3,3.4)chapter 4(4.1,4.2,4.3,4.4,4.6)chapter 6(6.1,6.2,6.3)

Module -3

Process Synchronization: Synchronization: The critical section problem; Peterson's solution; Synchronization hardware; Mutex locks; Semaphores; Classical problems of synchronization; **Deadlocks**: System model; Deadlock characterization; Methods for handling deadlocks; Deadlock prevention; Deadlock avoidance; Deadlock detection and recovery from deadlock.
textbook 1-chapter 5(5.1,5.2,5.3,5.4,5.5,5.6,5.7) chapter 7(7.1-7.7)

Module -4

Memory Management: Background; Swapping; Contiguous memory allocation; Segmentation; Paging; Structure of page table; **Virtual Memory Management**: Background; Demand paging; Page replacement; Allocation of frames; Thrashing.
textbook 1-chapter 8(8.1-8.6) chapter 9(9.1,9.2,9.4,9.5,9.6)

Module -5

File System, Implementation of File System: File concept; Access methods; Directory and Disk structure; File system mounting; File sharing; **Implementing File system**: File system structure; File system implementation; Allocation methods; Free space management. **Storage management:** overview of Mass storage structures; Disk structure; Disk attachment; Disk scheduling;
t**extbook 1-chapter 11(11.1-11.5)chapter 12(12.1-12.5)chapter 10(10.1-10.4)**

Text Books:
1. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, Operating System Concepts 9th edition, Wiley-India, 2018
2. D.M Dhamdhere, Operating Systems: A Concept Based Approach 3rd Ed, McGraw- Hill, 2013.

Reference Books:
1. P.C.P. Bhatt, An Introduction to Operating Systems: Concepts and Practice 4th Edition, PHI (EEE), 2014.
2. William Stallings Operating Systems: Internals and Design Principles, 6th Edition, Pearson.

Web links and Video Lectures (e-Resources):
https://nptel.ac.in/courses/106105214
https://www.geeksforgeeks.org/operating-systems/
https://www.youtube.com/playlist?list=PLBlnK6fEyqRiVhbXDGLXDk_OQAeuVcp2O

4. Syllabus Timeline

S/L	Syllabus Timeline	Description
1	Week 1-2: Introduction to operating systems	**Competency**: **Understanding of Operating System Concepts** **Knowledge**: how operating systems manage hardware resources efficiently. **Skills**: Understanding of basic operating system functions and objectives, knowledge of operating system history and evolution.
2	Week 3-4: Process management	**Competency**: **Problem-solving Skills** **Knowledge**: develop skills in breaking down problems and designing efficient solutions. **Skills:** Proficiency in evaluating CPU scheduling algorithms, ability to analyze performance metrics.
3	Week 5-6: Process Synchronization and deadlocks	**Competency: Concurrency and Parallelism** **Knowledge**: to design and implement concurrent programs that utilize multiple threads or processes. **Skills**: Understanding process and thread concepts, synchronization mechanisms.
4	Week 7-8: Memory Management	**Competency: Memory Management** **Knowledge:** how operating systems manage memory resources efficiently to support multiple processes. **Skills:** Understanding of virtual memory concepts, familiarity with memory allocation strategies.
5	Week 9-10: File System, Implementation of File System and storage management	**Competency: File Systems** **Knowledge**: how operating systems manage storage devices and provide a unified interface for file management.. **Skills**: Proficiency in file system organization and implementation, knowledge of disk management techniques.
6	Week 11-12: Integration and Practical Applications	Apply learned concepts and competencies to real-world scenarios. Hands-on practice with programming assignments

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 os 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) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures 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.

7. Learning Objectives

S/L	Learning Objectives	Description
1	**Understanding Operating System Fundamentals**	Students should grasp the basic concepts, components, and functions of an operating system, including process management, memory management, file systems, and device management.
2	**Process Management**	Learning how processes are created, scheduled, and managed by the operating system, including topics such as process synchronization, inter-process communication, and deadlock handling.
3	**Concurrency and Synchronization**	Learning about concurrent processes, critical sections, mutual exclusion, synchronization primitives, and techniques for ensuring thread safety and avoiding race conditions.
4	**Memory Management**	Understanding memory hierarchy, virtual memory, memory allocation strategies, and techniques for efficient memory usage, including paging, segmentation, and memory protection.
4	**File Systems**	Exploring file system organization, file operations, directory structures, file system implementation, and techniques for improving file system performance and reliability.

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

Course Outcomes (Cos)

Cos	Description
M23BCS604D.1	Understand the fundamental concepts and principles of operating systems.
M23BCS604D.2	Analyze various inter-process communication, multiprogramming mechanisms and apply different process scheduling algorithms.
M23BCS604D.3	Examine multiple mechanisms for managing deadlock situations and Implement both software and hardware solutions to address the critical-section problem
M23BCS604D.4	Implement and evaluate memory management techniques.
M23BCS604D.5	Examine the structure of file systems and the organization of secondary storage devices

CO-PO-PSO Mapping

Cos/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
M23BCS604D.1	3	-	-	-		-	-	-	-	-	-	3	3	
M23BCS604D.2	-	-	3	2	3	-	-	-	-	-	-	3	3	
M23BCS604D.3	-	-	3	2	3	-	-	-	-	-	-	3		3
M23BCS604D.4	3	-	3	2	3	-	-	-	-	-	-	3	3	
M23BCS604D.5	-	-	3	-		-	-	-	-	-	-	-	3	
M23BCS604D	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 operating systems is likely to involve several key trends and developments:

1. Continued Integration of AI: Operating systems will increasingly integrate AI and machine learning algorithms to provide more personalized and adaptive user experiences. This could involve features like predictive behavior, context-awareness, and intelligent automation.
2. Enhanced Security: With cyber threats evolving rapidly, future operating systems will place even greater emphasis on security. This might include built-in encryption, advanced authentication methods like biometrics, and more robust intrusion detection systems.
3. Interconnectivity and IoT: As the Internet of Things (IoT) expands, operating systems will need to seamlessly integrate with a wide range of devices and platforms. This could lead to more standardized communication protocols and frameworks for managing diverse IoT ecosystems.
4. Edge Computing: With the proliferation of edge computing devices, operating systems will need to support distributed computing architectures effectively. This involves optimizing resource management, latency reduction, and ensuring seamless connectivity between edge devices and centralized servers.
5. Virtualization and Containerization: Virtualization and containerization technologies will continue to play a crucial role in managing and deploying applications. Future operating systems may provide more native support for these technologies, making it easier to create and manage isolated environments for running application.

6th Semester	Project Work (PW) MAJOR PROJECT PHASE-I	M23BCA605

1. Prerequisites

S/L	Proficiency	Prerequisites
1	Understanding Research Methodology	Basic understanding of research methods, gained from prior courses in engineering mathematics and introductory project work.
2	Conducting a Literature Survey	Familiarity with academic databases, journals, and research papers; understanding of the subject matter from core courses.
3	Defining a Problem Statement	Critical thinking and analytical skills, developed through previous coursework in related engineering disciplines.
4	Multidisciplinary Collaboration	Basic knowledge of related disciplines (e.g., Mechanical students should have a basic understanding of Electronics, etc.).
5	Technical Communication	Writing technical reports and presenting technical content

2. Competencies

S/L	Competency	KSA Description
1	Research Skills	**Knowledge:** Understanding of advanced research methods and tools. **Skill:** Ability to identify, review, and synthesize relevant literature. **Attitude:** Commitment to thorough investigation and unbiased analysis.
2	Problem Identification	**Knowledge:** Deep understanding of the chosen topic area. **Skill:** Capability to define and frame a research problem effectively. **Attitude:** Critical and innovative thinking.
3	Technical Writing	**Knowledge:** Familiarity with technical writing conventions. **Skill:** Proficiency in drafting structured, clear, and concise reports. **Attitude:** Attention to detail and accuracy in documentation.
4	Presentation Techniques	**Knowledge:** Understanding of effective communication strategies. **Skill:** Ability to create and deliver engaging presentations. **Attitude:** Confidence and poise in public speaking.

3. Project Timeline

S/L	Timeline	Description
1	**Week 1-2**	Introduction to research methods and tools; exploring literature review techniques.
2	**Week 3-4**	Initiating literature survey; identifying key research papers and sources.
3	**Week 5-6**	Analysis and synthesis of literature; identifying gaps and formulating insights.
4	**Week 7-8**	Defining the problem statement based on literature findings.
5	**Week 9-10**	Drafting the initial report; focusing on structure and content.
6	**Week 11-12**	Finalizing the report and preparing the presentation.
7	**Week 13-14**	Presentation rehearsal; peer review and feedback sessions
8	**Week 15**	Submission of the final report and formal presentation.

4. Course Objectives

- To enable students to conduct a comprehensive literature survey related to their project topic.
- To guide students in defining a clear and feasible problem statement.
- To develop skills in report writing, summarizing findings, and formal presentation.

5. Assessment Details (both CIE and SEE)

CIE procedure for Project Work Phase-I:

(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-I: There shall be no SEE.

6. Learning Objectives

S/L	Learning Objectives	Description
1	Understand the process of conducting a literature survey.	Students will gain expertise in identifying and reviewing relevant research literature.
2	To formulate a research problem statement.	Students will learn to define a research problem that is clear, concise, and researchable.
3	To enhance technical writing and presentation skills.	Students will develop the ability to draft detailed reports and present their findings effectively.

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

Course Outcomes (COs)

Cos	Description
M23BXX605.1	Conduct a comprehensive literature survey and synthesize key findings.
M23BXX605.2	Define a research problem statement based on literature review.
M23BXX605.3	Develop and present a well-structured project report.

CO-PO-PSO Mapping

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
M23BXX605.1	3	3		3		3							3	3
M23BXX605.2		3	3		3			3					3	3
M23BXX605.3	3		3	3			3		3	3	3	3	3	3
M23BXX605	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**

7. Future with this Subject

This phase equips students with essential research and analytical skills, forming the foundation for the practical work in Phase II. It also enhances their technical writing and presentation abilities, which are critical for their final year projects and professional careers.

6th Semester	Program Core Lab (PCL) ROBOTIC PROCESS AUTOMATION DESIGN & DEVELOPMENT LAB	M23BCAL606

1. Prerequisites

S/L	Proficiency	Prerequisites
1	Understanding of Automation Tools	• Familiarity with RPA Tools: Basic knowledge of RPA tools like UiPath, Blue Prism, or Automation Anywhere will give you a head start. • Experience with Automation: Experience with other types of automation, such as web automation or testing automation, can be beneficial.
2	Knowledge of Business Processes	• Understanding Workflows: Basic knowledge of how business processes work, as RPA is often used to automate repetitive tasks in business workflows. • Process Mapping: Familiarity with process mapping and how to document workflows will help in identifying tasks suitable for automation.
3	Database Management	• SQL Knowledge: Basic SQL knowledge to interact with databases, as many RPA tasks involve data extraction, manipulation, and storage. • Understanding Data Structures: Familiarity with data structures like arrays, lists, and dictionaries.
4	Basic Understanding of Web Technologies	• HTML/CSS/JavaScript: Basic knowledge of web technologies is useful, especially when automating web applications. • APIs: Understanding of how APIs work, as they are often used to integrate different systems in RPA.
5	Problem-Solving Skills	• Analytical Thinking: Strong analytical skills to identify and resolve issues that arise during automation. • Troubleshooting: Ability to troubleshoot errors and optimize processes effectively.
6	Software Development Lifecycle (SDLC)	• Knowledge of SDLC: Understanding the stages of software development, especially the testing and deployment phases, as RPA projects often follow similar cycles.

2. Competencies

S/L	Competency	KSA Description
1	RPA Fundamentals	Knowledge: Knowledge of RPA history, key concepts, and types of processes for automation. Skills: Ability to apply RPA concepts to real-world scenarios. Attitudes: Eagerness to explore RPA's potential and limitations.
2	RPA Tools and Technologies	Knowledge: Knowledge of UiPath, Blue Prism, Automation Anywhere, and other tools. Skills: Proficiency in using RPA tools for developing, testing, and deploying bots. Attitudes: Openness to learning and adapting to different RPA tools.
3	Business Processes	Knowledge: Knowledge of common business processes in finance, HR, supply chain, etc. Skills: Ability to analyze and map business processes for automation. Attitudes: Focus on optimizing business processes through automation.
4	Programming and Scripting	Knowledge: Understanding of programming languages like Python, Java, and VBScript. Skills: Skill in writing scripts to enhance automation processes. Attitudes: Attention to detail in coding and debugging scripts.
5	Workflow	Knowledge:

	Design	Knowledge of workflow design principles and best practices. Skills: Ability to create, map, and optimize workflows using RPA tools. Attitudes: Commitment to continuous improvement of workflow efficiency.

3. Syllabus

Robotic Process Automation Design & Development Lab **SEMESTER – VI**			
Course Code	**M23BCS607A**	CIE Marks	**50**
Number of Lecture Hours/Week (L: T: P: S)	**(0:0:2:0)**	SEE Marks	**50**
Total Number of Lecture Hours	**12 weeks Practical**	Total Marks	**100**
Credits	**01**	Exam Hours	**03**

Course Objectives:

1. Understand and Apply Core Web Technologies.
2. Develop and Implement Service Workers
3. Optimize Web Application Performance
4. Enhance Web Applications with Advanced Features
5. Deploy and Secure Progressive Web Apps

PART-A
Program -1
Download, Install and Activate Ui-Path Studio. Learn all the basics of RPA (Variables, arguments and Control flow etc.)
Program -2
Write a program to i) empty the trash folder in Gmail ii) ii) empty the Recycle Bin
Program -3
Write a program to perform if-activity, switch- activity. (Suggested Hint: Find the smallest and biggest numbers in an array.)
Program -4
Write a program to perform while activity, do-while activity, for-each activity. (Suggested Hint: how an integer variable will increase from 5 to 50 in increments of 5.)
Program -5
Write a program to perform Flowchart and Sequence activity on Scalar variables.
Program -6
Write a program to perform Flowchart and Sequence activity on Collection variables
Program -7
Write a program to i)build a data table(static) ii) build a data table using data scraping (Dynamically)
Program -8
Write a program to create a simple calculator using a separate workflow and arguments
Program -9
Write a program for clipboard management. (Suggested Hint: open Notepad, write some data into it, and then copy the data to the clipboard. Later extract the data from the clipboard)
Program -10
Write a program to perform the following operations on an Excel file: i)Read cell ii)Write cell iii)Read range iv)Write range v)Append range
Program -11
Write a program to implement Arithmetic operations in 2 Excel files.
Program -12
Write a program to read an Excel file and creating a data table by using data from the Excel file
Program -13

Write a program for acting on controls using mouse and keyboard activities.
Program -14
Write a program for screen scraping using OCR
Program -15
Write a program to extract Email Address
PART-B
Develop a bot for any of the following 4 applications 1. Find Unicorn Name Generators. 2. Find Movie Rating. 3. Implement Amazon Data Scraping. 4. Email Automation. 5. Supplier Management System. 6. Transferring Data from one system to another. 7. Password Generator. 8. Forms Processing 9. Connecting Robot to Orchestrator 10. Extracting data from PDFs, scanned documents and other formats 11. Generating mass emails 12. Create and deliver invoices.
Text Books: 1. Tom Taulli, The Robotic Process Automation Handbook: A Guide to Implementing RPA Systems,2020, ISBN-13 (electronic):978-7-4842-5729-6, Publisher: A press 2. Alok Mani Tripathi, Learning Robotic Process Automation, Publisher: Packt Publishing Release Date: March 2018 ISBN: 9787788470940 REFERENCE BOOKS: 1. Platform to be used is UiPath Studio. 2. Nandan Mullakara, Arun Kumar Asokan, Robotic Process Automation Projects: Build real-world RPA solutions using UiPath and Automation Anywhere, First Edition, Packt Publishing Ltd., 2020. 3. Alok Mani Tripathi, Learning Robotic Process Automation: Create Software robots and automate business processes with the leading RPA tool – UiPath, First Edition, Packt Publishing Ltd., 2018

4. Syllabus Timeline

S/L	Syllabus Timeline	Description
1	**Week 1:**	**Program -1, Program -2**
2	**Week 2:**	**Program -3, Program -4**
3	**Week 3:**	**Program -5, Program -6**
4	**Week 4:**	**Program -7**
5	**Week 5:**	**Program -8**
6	**Week 6:**	**Program -9**
7	**Week 7:**	**Program -10**
8	**Week 8:**	**Program -11**
9	**Week 9:**	**Program -12**
10	**Week 10:**	**Program -13**
11	**Week 11:**	**Program -14**
12	**Week 12:**	**Program -15**

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 data structures and algorithms live, showing step-by-step coding and debugging.
3	Lab Exercises	Design lab exercises that require students to implement and manipulate data structures.
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.

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:

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

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

7. Learning Objectives

S/L	Learning Objectives	Description
1	Understand the Core Concepts of RPA	Develop a comprehensive understanding of Robotic Process Automation, including its definition, history, types of automation, and key benefits for businesses.
2	Familiarize with RPA Tools and Platforms	Gain knowledge of various RPA tools such as UiPath, Blue Prism, and Automation Anywhere, learning their features, use cases, and how to choose the right tool for specific business needs.
3	Identify Suitable Processes for Automation	Learn to analyse business processes and identify tasks that are repetitive, rule-based, and suitable for automation, ensuring efficiency and accuracy in operations.
4	Design and Map Automated Workflows	Master the skills needed to design, document, and map out workflows for automation, including understanding process flows, dependencies, and potential bottlenecks.
5	Develop RPA Solutions Using Industry Tools	Acquire hands-on experience in developing, configuring, and deploying RPA solutions using industry-leading tools, ensuring that students can create functional and scalable bots.

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

Course Outcomes (COs)

COs	Description
M23BCI606.1	Implement basic operations on different data types.
M23BCI606.2	Apply Arithmetic operations different fields from an excel file.
M23BCI606.3	Validate different formats for input and output validations.
M23BCI606.4	Develop Bots for web scraping Applications.
M23BCI606.5	Develop bots for real time automation applications with different file formats.

CO-PO-PSO Mapping

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
M23BCI606.1	-	-	3	-	-	-	-	-	-	-	-	-	3	3
M23BCI606.2	3	-	-	-	-	-	-	-	-	-	-	-	3	3
M23BCI606.3	-	-	-	3	-	-	-	-	-	-	-	-	3	3
M23BCI606.4	-	-	3	-	-	-	-	-	-	-	-	-	3	3
M23BCI606.5	-	-	3	-	3	-	-	-	-	-	-	-	3	3
M23BCI606	3	-	3	3	3	-	-	-	-	-	-	-	3	3

9. Assessment Plan

Continuous Internal Evaluation (CIE)

	CO1	CO2	CO3	CO4	CO5	Total
Program 1 to 10	5	10	10	5	20	50
Total	5	10	10	5	20	50

Semester End Examination (SEE)

	CO1	CO2	CO3	CO4	CO5	Total
Program 1 to 10	10	20	20	10	40	100
Total	10	20	20	10	40	100

10. Future with this Subject:

❖ Increased Demand for RPA Professionals

Job Market Growth: As businesses continue to adopt RPA to streamline operations and reduce costs, the demand for skilled RPA professionals will increase, leading to more job opportunities in this field.

Specialized Roles: The course will prepare students for specialized roles such as RPA Developer, RPA Consultant, Automation Architect, and RPA Analyst, which are becoming increasingly essential in modern organizations.

❖ Expansion of RPA Use Cases

Industry Applications: The course will evolve to cover a broader range of industry-specific RPA applications, such as healthcare automation, financial services, supply chain management, and customer service.

Complex Process Automation: As RPA tools become more advanced, the course will delve into automating more complex processes, including those requiring cognitive capabilities and decision-making.

❖ Integration with Emerging Technologies

AI and Machine Learning: The course will increasingly focus on the integration of RPA with artificial intelligence (AI) and machine learning (ML) to create intelligent automation solutions that can handle unstructured data, make predictions, and continuously improve performance.

Internet of Things (IoT): As IoT devices become more prevalent, the course will explore how RPA can interact with IoT systems to automate data collection, monitoring, and response processes.

❖ Focus on Hyper automation

End-to-End Automation: The future of the course will include a focus on hyper automation, which involves automating as many business processes as possible using a combination of RPA, AI, ML, and other advanced technologies.

Workflow Automation Platforms: The course will teach students how to work with integrated platforms that support hyper automation, enabling them to design and manage complex automated workflows.

❖ Emphasis on Compliance and Ethical Automation

Regulatory Compliance: With growing concerns over data privacy and security, the course will place greater emphasis on teaching students how to implement RPA solutions that comply with legal and regulatory requirements.

Ethical Considerations: The future curriculum will likely include more content on the ethical implications of automation, ensuring that students are equipped to develop RPA solutions that are socially responsible and align with organizational values.

❖ Continual Evolution of RPA Tools

Tool Updates and New Features: The course will keep pace with the continual evolution of RPA tools, incorporating the latest updates, features, and best practices to ensure students are trained on cutting-edge technology.

Low-Code/No-Code Platforms: As low-code and no-code RPA platforms become more popular, the course will provide training on how to leverage these tools to develop automation solutions quickly and efficiently.

6th Semester	Ability Enhancement-V(AE) Tensorflow And Torch For Developer	M23BCA607A

1. Prerequisites

S/L	Proficiency	Prerequisites
1	**Proficiency in Python Programming**	Solid understanding of Python programming, including control structures, functions, and object-oriented programming.
2	**Basic Knowledge of Linear Algebra**	Understanding of vectors, matrices, matrix multiplication, and other fundamental linear algebra concepts.
3	**Fundamentals of Machine Learning**	Familiarity with basic machine learning concepts, including supervised and unsupervised learning, and common algorithms such as linear regression and decision trees.
4	**Experience with Data Preprocessing**	Understanding of data preprocessing techniques, including data cleaning, normalization, and feature engineering.
5	**Familiarity with Jupyter Notebooks**	Ability to use Jupyter Notebooks or similar development environments for writing and running Python code.

2. Competencies

S/L	Competency	KSA Description
1	**TensorFlow and PyTorch Proficiency:**	**Knowledge:** • Deep understanding of TensorFlow and PyTorch libraries and their respective APIs. • Familiarity with TensorFlow Keras for building and training models. **Skills:** • Ability to implement neural networks using TensorFlow and PyTorch. • Debugging and optimizing model performance. **Abilities:** • Adapt to updates and changes in both frameworks. • Integrate TensorFlow and PyTorch models into existing projects.
2	**Model Deployment:**	**Knowledge:** • Understanding of model deployment concepts and frameworks like TensorFlow Serving and TorchServe. • Awareness of cloud platforms (AWS, Google Cloud, Azure) for deploying models. **Skills:** • Setting up and configuring TensorFlow Serving and TorchServe. • Creating REST APIs for serving models. **Abilities:** • Troubleshoot deployment issues. • Scale deployed models to handle increased load.
3	**Data Handling and Preprocessing:**	**Data Handling and Preprocessing:** **Knowledge:** • Understanding of data preprocessing techniques such as normalization, augmentation, and transformation. • Familiarity with data formats (CSV, JSON, images). **Skills:** • Implementing data pipelines using TensorFlow Data API and PyTorch DataLoader. • Cleaning and preprocessing raw data for model training. **Abilities:** • Handle large datasets efficiently. • Adapt preprocessing techniques to different data types.
4	**Model Optimization:**	**Knowledge:** • Understanding of hyperparameter tuning methods (grid search, random search, Bayesian optimization). • Knowledge of optimization algorithms (Adam, SGD, RMSprop). **Skills:** • Tuning hyperparameters to improve model performance.

		• Using TensorBoard and other visualization tools to monitor training. **Abilities:** • Identify and address overfitting and underfitting. • Optimize models for speed and memory efficiency.
5	**Building Advanced Neural Networks:**	**Knowledge:** • Deep understanding of advanced neural network architectures like CNNs, RNNs, and their variants. • Familiarity with architectures for specific tasks (e.g., object detection, text generation). **Skills:** • Designing and implementing complex neural networks. • Using TensorFlow and PyTorch to build and train advanced models. **Abilities:** • Adapt architectures to new problems and datasets. • Innovate and experiment with new network designs.

3. Syllabus

TENSORFLOW AND TORCH FOR DEVELOPER SEMESTER – VI			
Course Code	**M23BCA607A**	CIE Marks	**25**
Number of Lecture Hours/Week(L: T: P: S)	**(1:0:0:0)**	SEE Marks	**25**
Total Number of Lecture Hours	**15**	Total Marks	**50**
Credits	**01**	Exam Hours	**01**
Module -1			
Introduction to Tensor Flow: Installation and Setup, TensorFlow Basics: Tensors, Operations, and Graphs, Basic Tensor Flow Syntax **Building Neural Networks with Tensor Flow**: Creating and Training Neural Networks, Using TensorFlow's Keras API, Model Evaluation and Validation **Advanced Tensor Flow Concepts**: Custom Training Loops, TensorFlow Data Pipelines, TensorFlow Extended (TFX) and Serving			
Module -2			
Introduction to PyTorch: Installation and Setup, PyTorch Basics: Tensors and Auto grad, Basic PyTorch Syntax **Building Neural Networks with PyTorch**: Creating and Training Neural Networks, Using PyTorch' snn. Module, Model Evaluation and Validation **Advanced PyTorch Concepts**: Custom Training Loops ,PyTorch Data Loaders and Dataset, Deploying PyTorch Models			
Module -3			
Convolutional Neural Networks (CNNs):Basics of CNNs, Building CNNs with TensorFlow and **PyTorch, Applications**: Image Classification, Object Detection Recurrent Neural Networks (RNNs):Basics of RNNs, Building RNNs with TensorFlow and **PyTorch, Applications**: Natural Language Processing, Time Series Analysis **Transfer Learning and Pre-trained Models**: Concept of Transfer Learning, Using Pre-trained Models in TensorFlow and PyTorch, Fine-tuning Pre-trained Models			
Module -4			
Generative Adversarial Networks (GANs):Basics of GANs, Building GANs with TensorFlow and **PyTorch, Applications**: Image Generation, Data Augmentation **Hyperparameter Tuning and Optimization**: Techniques for Hyperparameter Tuning, Tools: Tensor Board, Optuna, Best Practices for Model Optimization			
Module -5			
Model Deployment: Deploying TensorFlow Models with TensorFlow Serving, Deploying PyTorch Models with Torch Serve ,REST APIs and Cloud Deployment			
TEXTBOOKS: 1. "Deep Learning with Python" by François Chollet 2. "Deep Learning with PyTorch" by Eli Stevens, Luca Antiga, and Thomas Viehmann.			

4. Syllabus Timeline

S/L	Syllabus Timeline	Description
1	Week 1-3:	Introduction to Tensor Flow: Installation and Setup, TensorFlow Basics: Tensors, Operations, and Graphs, Basic Tensor Flow Syntax Building Neural Networks with Tensor Flow: Creating and Training Neural Networks, Using Tensor Flow's Keras API, Model Evaluation and Validation Advanced Tensor Flow Concepts: Custom Training Loops, TensorFlow Data Pipelines, TensorFlow Extended (TFX) and Serving
2	Week 4-6:	Introduction to PyTorch: Installation and Setup, PyTorch Basics: Tensors and Auto grad, Basic PyTorch Syntax Building Neural Networks with PyTorch: Creating and Training Neural Networks, Using PyTorch' snn. Module, Model Evaluation and Validation Advanced PyTorch Concepts: Custom Training Loops, PyTorch Data Loaders and Dataset, Deploying PyTorch Models
3	Week 7-8:	Convolutional Neural Networks (CNNs):Basics of CNNs, Building CNNs with TensorFlow and PyTorch, Applications: Image Classification, Object Detection Recurrent Neural Networks (RNNs):Basics of RNNs ,Building RNNs with TensorFlow and PyTorch, Applications: Natural Language Processing, Time Series Analysis Transfer Learning and Pre-trained Models: Concept of Transfer Learning, Using Pre-trained Models in TensorFlow and PyTorch, Fine-tuning Pre-trained Models
4	Week 9-11:	Generative Adversarial Networks (GANs):Basics of GANs, Building GANs with TensorFlow and PyTorch, Applications: Image Generation, Data Augmentation Hyperparameter Tuning and Optimization: Techniques for Hyperparameter Tuning, Tools: Tensor Board, Optuna, Best Practices for Model Optimization
5	Week 12-13 :	Model Deployment: Deploying TensorFlow Models with TensorFlow Serving, Deploying PyTorch Models with TorchServe, REST APIs and Cloud Deployment

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	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)**

Continuous Internal Evaluation (CIE):

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 (A+B)			**50**	**20**

The CIE question paper shall have MCQ set for 25 questions, each carrying one mark.
Average internal assessment shall be the average of the 2 test marks conducted.

Semester End Exam (SEE)

The SEE question paper shall have MCQ set for 50 questions, each carrying one mark. The time duration for SEE is one hour

7. Learning Objectives

S/L	Learning Objectives	Description
1	Understand Deep Learning Fundamentals	Comprehend the core concepts of deep learning, including neural networks, activation functions, loss functions, and optimization algorithms.
2	Proficiently Use TensorFlow and PyTorch	Develop, train, and evaluate neural network models using both TensorFlow and PyTorch frameworks, leveraging their respective APIs and tools.
3	Implement Advanced Neural Network Architectures	Design and build advanced neural network architectures such as Convolutional Neural Networks (CNNs) for image processing and Recurrent Neural Networks (RNNs) for sequence data.
4	Pre-process and Augment Data	Efficiently pre-process and augment data, implementing robust data pipelines using TensorFlow Data API and PyTorch Data Loader to handle large and complex datasets.
5	Perform Model Optimization and Tuning	Conduct hyper parameter tuning and optimization techniques to enhance model performance and ensure models are efficient and effective.
6	Deploy Machine Learning Models	Deploy trained models into production environments using tools like TensorFlow Serving and TorchServe, creating REST APIs for real-time model serving.

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

Course Outcomes (COs)

COs	Description
M23BCA607A.1	Understand the fundamental concepts of deep learning frameworks, including TensorFlow and PyTorch, and their core functionalities.
M23BCA607A.2	Applying and train basic neural network models (e.g., feed forward, convolutional, and recurrent) using TensorFlow and PyTorch, applying appropriate data pre-processing techniques.
M23BCA607A.3	Analyse and interpret the performance of models developed using TensorFlow and PyTorch, utilizing evaluation metrics and visualization tools to assess their effectiveness.
M23BCA607A.4	Evaluate different model optimization techniques, such as hyperparameter tuning and regularization, and assess their impact on model performance and computational efficiency.

CO-PO-PSO Mapping

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
M23BCA607A.1	3	-	-	-	-	-	-	-	-	-	-	-	3	-
M23BCA607A.2	-	3	-	-	-	-	-	-	-	-	-	-	-	3
M23BCA607A.3	-	-	3	3	-	-	-	-	-	-	-	-	3	-
M23BCA607A.4	-	-	-	3	-	-	-	-	-	-	-	-	-	3
M23BCA607A	3	3	3	3									3	3

9. Assessment Plan

Continuous Internal Evaluation (CIE)

	CO1	CO2	CO3	CO4	Total
Module 1	**5**				**5**
Module 2		**5**			**5**
Module 3			**5**		**5**
Module 4				**5**	**5**
Module 5				**5**	**5**
Total	**5**	**5**	**5**	**10**	**25**

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**	**4 0**	**100**

10. Future with this Subject:

- Career Advancement in AI and ML:

  Machine Learning Engineer: Design, build, and deploy machine learning models for various applications.

  Data Scientist: Analyze complex data sets to derive actionable insights and build predictive models.

  AI Researcher: Conduct research to develop new AI algorithms and enhance existing models.
- Industry Applications:

  Healthcare: Develop models for medical imaging analysis, predictive healthcare analytics, and personalized medicine.

  Finance: Implement AI for fraud detection, algorithmic trading, and risk management.

  Retail and E-commerce: Create recommendation systems, customer sentiment analysis, and inventory management solutions.

  Automotive: Contribute to the development of autonomous driving systems and smart vehicle technologies.
- Entrepreneurial Ventures:

  Start-ups: Leverage AI and ML to create innovative products and services, potentially founding your own tech start up.

  Consulting: Offer expertise to help businesses integrate AI and ML into their operations.
- Academic and Research Opportunities:

  Advanced Degrees: Pursue further studies in AI, ML, or data science, leading to advanced degrees (Master's, PhD).

6th Semester	Ability Enhancement(AE) DevOps	M23BCS607B

1. Prerequisites

S/L	Proficiency	Prerequisites
1	**Basic Understanding of Programming and Scripting Languages**	• Knowledge of programming fundamentals and experience with at least one scripting language (e.g., Python, JavaScript) is required to create automation scripts, work with Selenium WebdriverIO, and write scripts for Maven and Docker.
2	**Familiarity with Command Line Interfaces (CLI)**	• Proficiency in using command-line tools like GitBash or terminal commands is essential for interacting with Git, executing Docker commands, and managing CI/CD pipelines..
3	**Introduction to Software Development Life Cycle (SDLC)**	• A foundational understanding of the software development life cycle and its various stages will help students grasp the context of continuous integration, continuous deployment, and Agile methodologies used in DevOps practices.
4	**Basic Knowledge of Web Development and HTML/CSS**	• Familiarity with web technologies such as HTML and CSS is necessary for creating and understanding XPath expressions for locating elements in web applications during automation testing.
5	**Experience with Integrated Development Environments (IDEs) and Build Tools**	• Prior experience working with IDEs (e.g., IntelliJ IDEA, Eclipse) and build tools like Maven will be beneficial for managing project dependencies, building projects, and integrating with Jenkins for CI/CD.

2. Competencies

S/L	Competency	KSA Description
1	Proficient Use of Version Control Systems	**Knowledge:** Understand the principles and best practices of version control, including branching, merging, and conflict resolution.. **Skills:** Ability to create, manage, and collaborate on projects using Git, GitHub, and GitBash, including advanced operations like rebasing and resolving merge conflicts. **Attitudes:** Cultivate a disciplined approach to version control, emphasizing the importance of clear commit messages, regular updates, and collaborative workflows.
2	Mastery of Continuous Integration and Automation Tools	**Knowledge:** Understand the fundamentals of continuous integration, continuous deployment, and automation in a DevOps environment. **Skills:** Ability to configure and manage Jenkins pipelines, automate project execution, and apply various scheduling techniques within a CI/CD framework. **Attitudes:** Develop a proactive mindset towards automation, recognizing its role in improving efficiency, reducing errors, and ensuring consistent project delivery.
3	Advanced Automation and Testing Techniques	**Knowledge:** Comprehend the role of automated testing in software development, including the use of Selenium WebdriverIO and XPath. **Skills:** Ability to write and execute test scripts using Selenium WebdriverIO, effectively locate elements in web applications using different XPath strategies, and integrate with reporting tools for comprehensive test coverage. **Attitudes:** Foster an attention to detail and thoroughness in testing, emphasizing the importance of accuracy and reliability in automated testing processes.
4	Integration of Build and Deployment	**Knowledge:** Understand the lifecycle of software builds and deployments, including the use of Maven, Docker, and Jenkins.

	Technologies	**Skills:** Ability to apply Maven lifecycle commands, create Docker containers, and integrate these tools with Jenkins to streamline the build and deployment processes. **Attitudes:** Embrace a continuous improvement mindset, focusing on optimizing build and deployment processes for speed, efficiency, and reliability.
5	Effective Application of Agile and DevOps Practices	**Knowledge:** Grasp the principles of Agile methodologies and DevOps practices, including backlog management, sprint planning, and the integration of various DevOps tools. **Skills:** Ability to create and manage project backlogs, sprints, and tasks using Agile techniques, retrieve and manipulate data using JQuery, and integrate multiple DevOps tools into a cohesive framework. **Attitudes:** Develop a collaborative and adaptable approach to project management, valuing teamwork, continuous feedback, and the iterative nature of Agile and DevOps practices.

3. Syllabus

DEVOPS **SEMESTER – VI**			
Course Code	M23BCS607B	CIE Marks	**50**
Number of Lecture Hours/Week(L: T: P: S)	**(0:0:2:0)**	SEE Marks	**50**
Total Number of Lecture Hours	**2hrs/week Practical**	Total Marks	**100**
Credits	**01**	Exam Hours	**03**

Course Objectives:

1. Understanding and Application of Version Control Systems.
2. Mastering Continuous Integration and Automation.
3. Proficient Use of Automation Tools for Web Application Testing.
4. Integration and Management of Build and Deployment Pipelines
5. Implementation of Agile and DevOps Practices in Project Management.

Program -1
Demonstrate and Create project in local and remote repository using git and GitBash.
Program -2
Demonstrate and apply fork, merge, conflict and rebase concepts on repo using GitHub.
Program -3
Demonstrate the process of interfacing the repo using Jenkins to automate the project execution.
Program -4
Create a repository and apply different types of scheduling using continuous integration tool
Program -5
Create a script to automate the operation using selenium WebdriverIO and integrate with reporting tools.
Program -6
Create a script using different types of Xpath and locate elements in an application.
Program-7
Apply maven life cycle commands on project and integrate with Jenkins tools
Program-8
Apply basic commands for Dockers and integrate with other tools.
Program-9
Create and apply backlogs, sprints, tasks for project and retrieve data using J-query.
Program-10
Create a Framework and integrate different DevOps tools for an application.

TEXTBOOKS:

1. "Pro Git" by Scott Chacon and Ben StraubAvailable for free online.
2. "Continuous Delivery: Reliable Software Releases through Build, Test, and Deployment Automation" by Jez Humble and David Farley

REFERENCE BOOKS:

1. "Selenium WebDriver 3 Practical Guide" by Unmesh Gundecha

2. "Docker: Up & Running: Shipping Reliable Containers in Production" by Karl Matthias and Sean P. Kane **VIDEO LINKS:** 1.https://www.youtube.com/watch?v=RGOj5yH7evk 2.https://www.youtube.com/watch?v=6YZvp2GwT0A

4. Syllabus Timeline

S/L	Syllabus Timeline	Description
1	**Week 1:** Introduction to Version Control and Git	Demonstrate and Create Project in Local and Remote Repository Using Git and GitBash Introduction to Git, setting up GitBash, creating local repositories, initializing remote repositories, and pushing code. Lab/Practice: Set up a Git repository, commit changes, and push them to GitHub.
2	**Week 2**: Advanced Git Concepts	Demonstrate and Apply Fork, Merge, Conflict, and Rebase Concepts on Repo Using GitHub Forking repositories, branching, merging, handling conflicts, and rebasing. Lab/Practice: Fork a repository, create a branch, make changes, merge, and resolve conflicts.
3	**Week 3:** Introduction to Jenkins and CI/CD	Demonstrate the Process of Interfacing the Repo Using Jenkins to Automate the Project Introduction to Jenkins, setting up a Jenkins server, and creating a basic CI/CD pipeline. Lab/Practice: Set up Jenkins, integrate it with a GitHub repository, and create an automated build.
4	**Week 4:** Advanced Jenkins and Scheduling	Create a Repository and Apply Different Types of Scheduling Using Continuous Integration Tools. Jenkins scheduling, cron jobs, and different scheduling strategies in CI/CD pipelines. Lab/Practice: Implement scheduling in Jenkins pipelines, using cron expressions for various tasks.
5	**Week 5:** Introduction to Selenium and Automation Scripting	Create a Script to Automate the Operation Using Selenium WebdriverIO and Integrate with Reporting Tools Introduction to Selenium WebdriverIO, writing basic test scripts, and integrating with reporting tools Lab/Practice: Write Selenium scripts using WebdriverIO, automate a basic web operation, and generate reports.
6	**Week 6:** XPath Strategies in Web Automation	Create a Script Using Different Types of XPath and Locate Elements in an Application Understanding XPath, types of XPath, and strategies for locating web elements. Lab/Practice: Create and run test scripts using different XPath strategies in a sample web application.
7	**Week 7:** Build Management with Maven	Apply Maven Life Cycle Commands on Project and Integrate with Jenkins Tools Introduction to Maven, Maven lifecycle phases, and integrating Maven with Jenkins. Lab/Practice: Create a Maven project, execute Maven lifecycle commands, and integrate with Jenkins for builds.
8	**Week 8:** Containerization with Docker	Apply Basic Commands for Docker and Integrate with Other Tools Introduction to Docker, Docker commands, containerization, and integration with CI/CD tools. Lab/Practice: Create and manage Docker containers, and integrate Docker with Jenkins in a CI/CD pipeline.
9	**Week 9:** Agile Methodologies and Project Management	Create and Apply Backlogs, Sprints, Tasks for Project and Retrieve Data Using JQuery. Agile methodologies, managing backlogs and sprints, using JIRA or similar tools, and using JQuery for data manipulation. Lab/Practice: Set up a project in an Agile tool, create and manage sprints and tasks, and retrieve data using JQuery.
10	**Week 10:**	Create a Framework and Integrate Different DevOps Tools for an Application

	DevOps Framework and Tool Integration	Overview of DevOps frameworks, integrating tools like Jenkins, Docker, Maven, and Selenium into a cohesive CI/CD pipeline. Lab/Practice: Develop and demonstrate a full CI/CD pipeline integrating multiple DevOps tools in a project framework.

5. Teaching-Learning Process Strategies

S/L	TLP Strategies:	Description
1	Project-Based Learning (PBL)	Integrate hands-on projects that align with each week's topics.Integrate hands-on projects that align with each week's topics.
2	Collaborative Learning and Peer Reviews	Encourage collaboration among students through pair programming, group tasks, and peer reviews. Organize students into small teams to work on projects, and incorporate peer review sessions where students evaluate each other's code, Git workflows, and automation scripts.
3	Flipped Classroom	Use the flipped classroom model, where students study theoretical content through videos and readings before class, and spend in-class time engaging in hands-on activities, discussions, and problem-solving.
4	Incremental and Iterative Learning	Teach concepts incrementally, building complexity over time. Start with foundational concepts like Git basics and gradually introduce more advanced topics like Jenkins integration, Docker commands, and full DevOps toolchain integration.
5	Continuous Assessment and Feedback	Implement continuous assessment methods that include quizzes, coding challenges, and mini-projects.Conduct regular assessments such as short quizzes on Git commands, Jenkins pipelines, and Docker basics.

6. Assessment Details (both CIE and SEE)

Class Work:-A

CIE Split up for Laboratory based Ability Enhancement Course

SL. No.	Description	% of Marks	In Marks
1	Write-up, Conduction, result and Procedure	60%	30
2	Viva-Voce	40%	20
Total		**100%**	**50**

The Test marks should be scaled down to 30marks (60% of the maximum Marks)

Laboratory Test: -B

CIE Split up for Test in Laboratory based Ability Enhancement Course

SL. No.	Description	% of Marks	In Marks
1	Write-up, Conduction, result and Procedure	60%	30
2	Viva-Voce	40%	20
Total		**100%**	**50**

The Test marks should be scaled down to 20marks (40% of the maximum Marks)

Final CIE for Laboratory based Ability Enhancement Course

SL. No.	Description	% of Marks	In Marks
1	Scaled Down marks of record/journal-A	60% of the maximum	30
2	Scaled Down marks of test-B	40% of the maximum	20
Total		**100%**	**50**

Final CIE Marks =(A) + (B)

SEE for practical Course:

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**

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

7. Learning Objectives

S/L	Learning Objectives	Description
1	Master the Fundamentals of Version Control with Git	Students will be able to create, manage, and collaborate on projects using Git and GitHub, including setting up local and remote repositories, and executing advanced version control operations like branching, merging, rebasing, and resolving conflicts.
2	Implement Continuous Integration and Delivery Pipelines Using Jenkins	Students will learn to configure Jenkins for automating project builds, tests, and deployments, integrating it with GitHub repositories and other CI/CD tools, and applying various scheduling techniques to optimize workflow efficiency..
3	Analysis of Stress and StrainAutomate Web Application Testing Using Selenium WebdriverIO	Students will be able to write and execute automated test scripts using Selenium WebdriverIO, utilize different XPath strategies to locate web elements, and integrate these scripts with reporting tools for comprehensive test automation.
4	Apply Containerization and Build Management Techniques Using Docker and Maven	Students will gain proficiency in using Docker to containerize applications, apply Maven lifecycle commands for build management, and integrate these tools with Jenkins to streamline the build, test, and deployment processes..
5	Manage Agile Project Workflows and Retrieve Data Using JQuery	Students will learn to implement Agile methodologies, including creating and managing backlogs, sprints, and tasks in a project, and effectively use JQuery for data retrieval and manipulation within web applications..
6	Develop and Integrate a Comprehensive DevOps Toolchain Framework	Students will be able to design, develop, and implement a cohesive DevOps toolchain framework that integrates multiple tools such as Git, Jenkins, Docker, Maven, Selenium, and Agile project management practices to automate and manage the software development lifecycle efficiently.

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

Course Outcomes (COs)

COs	Description
M23BCS607B.1	Apply Version Control Techniques Demonstrate the ability to create, manage, and maintain local and remote repositories using Git and GitBash
M23BCS607B.2	Implement Continuous Integration and Automation Utilize Jenkins to automate the integration, testing, and deployment processes by creating and scheduling CI/CD pipelines.
M23BCS607B.3	Develop Automation Scripts for Web Applications
M23BCS607B.4	Integrate Development Tools with Docker and Maven
M23BCS607B.5	Design Agile and DevOps Practices**.**

CO-PO-PSO Mapping

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
M23BCS607B.1	3	3	-	-	3	-	-	-	-	-	-	-	3	-
M23BCS607B.2	3	3	3	-	3	-	-	-	-	-	-	-	-	3
M23BCS607B.3	3	-	3	-	3	3	-	-	-	-	-	-	3	-
M23BCS607B.4	3	3	3	3	3	-	-	-	-	-	-	-	-	3
M23BCS607B.5	**3**	**3**	3	3	3	3	-	-	3	-	-	-	3	3
M23BCS607B	**3**	**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:

- **High Demand for DevOps Professionals:** Proficiency in tools like Git, Jenkins, Docker, and Selenium, coupled with Agile and DevOps methodologies, will make graduates highly sought after in industries ranging from tech startups to large enterprises.
- **Cloud-Native and Microservices Architectures**: Skills in containerization (e.g., Docker) and CI/CD pipelines will be critical for managing complex, distributed applications in cloud environments. Students trained in these areas will be well-prepared for roles in cloud engineering and site reliability engineering (SRE)
- **Automation and Artificial Intelligence in DevOps**: Knowledge in automation scripting and tool integration will be a foundational skill as AI-driven tools become standard in CI/CD pipelines and infrastructure management. This subject will prepare students to innovate in these areas.
- **Expansion of Agile and DevOps Beyond IT**: A deep understanding of Agile and DevOps practices will be valuable not just in tech roles but also in broader organizational contexts, allowing graduates to contribute to the digital transformation of various industries.
- **Continuous Learning and Adaptability**: A deep understanding of Agile and DevOps practices will be valuable not just in tech roles but also in broader organizational contexts, allowing graduates to contribute to the digital transformation of various industries.

6th Semester	Ability Enhancement-V Project Management with Git	M23BCA607C

1. Prerequisites

S/L	Proficiency	Prerequisites
1	**Initialize and Configure a Git Repository**	•Basic understanding of version control concepts •Familiarity with command-line interfaces • Knowledge of directory structure and file management
2	**Create and Manage Git Branches**	•Proficiency in initializing repositories •Basic Git commands like add and commit • Understanding of branch creation and merging processes
3	**Stash Changes and Manage Branches**	•Knowledge of basic branching commands •Experience with initial Git repository setup • Understanding of stashing operations and branch management
4	**Clone Remote Git Repositories**	•Understanding of remote repositories •Basic network knowledge • Proficiency in using git clone and handling remote URLs
5	**Fetch and Rebase Remote Changes**	• Proficiency in cloning repositories • Knowledge of basic git fetch commands • Understanding of rebasing and resolving conflicts
6	**Merge Branches with Custom Commit Messages**	• Familiarity with creating and switching branches • Understanding of merge operations • Knowledge of writing and formatting commit messages
7	**Analyze and Modify Git History**	• Knowledge of Git commits and history • Understanding of tagging concepts • Familiarity with basic Git commands like git tag

2. Competencies

S/L	Competency	KSA Description
1	Initialize and Use Basic Git Commands	**Knowledge:** Grasp of Git initialization commands, staging area, and commit operations. **Skills:** Ability to initializing a Git repository, creating files, staging them, and committing changes. **Attitudes:** Precision and diligence in setting up and documenting changes to ensure accurate version control.
2	Create and Manage Git Branches	**Knowledge:** Familiarity with Git branch creation, switching, and merging operations. **Skills:** Skill in creating, switching, and merging branches in a Git repository. **Attitudes:** Adaptability and responsibility in managing different development branches and integration.
3	Stash Changes and Manage Branches	**Knowledge:** Understanding of stashing changes, branch switching, and applying stashed changes. **Skills:** Ability in using commands to stash changes, switch branches, and reapply stashed changes. **Attitudes:** Organization and resilience in handling workflow interruptions and maintaining productivity.
4	Collaborate with Remote Repositories	**Knowledge:** Comprehensive understanding of cloning repositories, fetching updates, and rebasing branches. **Skills:** Capability to cloning remote repositories, fetching changes, and rebasing local branches onto updated remote branches.

		Attitudes: Openness and effective communication in collaborating and synchronizing with remote teams.
5	Analyze and Modify Git History	**Knowledge:** In-depth knowledge of viewing commit details, filtering commits by author/date, and reverting changes. **Skills:** Competence in analyzing commit history, listing commits by specific criteria, and undoing changes. **Attitudes:** Thoroughness and problem-solving in understanding and correcting commit history.

3. Syllabus

Ability Enhancement –V

Project Management with Git

SEMESTER – VI

Course Code	**M23BCA607C**	CIE Marks	**50**
Number of Lecture Hours/Week(L: T: P: S)	**(0: 0 : 2: 0)**	SEE Marks	**50**
Total Number of Lecture Hours	**20 Hours**	Total Marks	**100**
Credits	**01**	Exam Hours	**03**

Course Objectives:

1. To familiar with basic command of Git
2. To create and manage branches
3. To understand how to collaborate and work with Remote Repositories
4. To familiar with vision controlling commands

Sl.NO	Experiments
1	**Setting Up and Basic Commands** Initialize a new Git repository in a directory. Create a new file and add it to the staging area and commit the changes with an appropriate commit message.
2	**Creating and Managing Branches** Create a new branch named "feature-branch." Switch to the "master" branch. Merge the "feature-branch" into "master."
3	**Creating and Managing Branches** Write the commands to stash your changes, switch branches, and then apply the stashed changes.
4	**Collaboration and Remote Repositories** Clone a remote Git repository to your local machine.
5	**Collaboration and Remote Repositories** Fetch the latest changes from a remote repository and rebase your local branch onto the updated remote branch.
6	**Collaboration and Remote Repositories** Write the command to merge "feature-branch" into "master" while providing a custom commit message for the merge.
7	**Git Tags and Releases** Write the command to create a lightweight Git tag named "v1.0" for a commit in your local repository.
8	**Advanced Git Operations** Write the command to cherry-pick a range of commits from "source-branch" to the current branch.
9	**Analyzing and Changing Git History** Given a commit ID, how would you use Git to view the details of that specific commit, including the author, date, and commit message?
10	**Analyzing and Changing Git History** Write the command to list all commits made by the author "JohnDoe" between "2023-01-01" and "2023-12-31."
11	**Analyzing and Changing Git History** Write the command to display the last five commits in the repository's history.
12	**Analyzing and Changing Git History** Write the command to undo the changes introduced by the commit with the ID "abc123".

Suggested Learning Resources:
● Version Control with Git, 3rd Edition, by Prem Kumar Ponuthorai, Jon Loeliger Released October 2022, Publisher(s): O'Reilly Media, Inc.
● Pro Git book, written by Scott Chacon and Ben Straub and published by Apress, https://gitscm.com/book/en/v2
●https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_013094443347369984278 2_shared/overview
●https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_013301347121774592119 26_shared/overview
Software/Platform Needed
Git (Command Line Interface) or Git GUI Clients (e.g., Source tree, GitKraken)

4. Syllabus Timeline

S/L	Syllabus Timeline	Description
1	Week 1-3: Introduction to Git and Basic Commands and Branch Creation and Management	Overview of Git. Initialize a new Git repository, create a file, add it to the staging area, and commit changes with appropriate commit messages. Learn to create a new branch (e.g., "feature-branch"), switch between branches, and merge branches into "master."
2	Week 4-5: Advanced Branch Management and Remote Repositories: Cloning and Fetching	Clone a remote Git repository to your local machine and understand the basic operations to work with remote repositories. Fetch the latest changes from a remote repository and rebase your local branch onto the updated remote branch to synchronize your local work with remote developments.
3	Week 5-6: Merging with Custom Messages and Git Tags and Releases	Write commands to merge branches (e.g., merge "feature-branch" into "master") and provide custom commit messages for the merges. Write commands to create a lightweight Git tag (e.g., "v1.0") for a commit in your local repository to manage versioning and releases.
4	Week 7-8: Advanced Git Operations: Cherry-Picking and Listing Commits by Author and Date Range	Learn to cherry-pick a range of commits from one branch to another, selecting specific changes to apply to the current branch. Write commands to list all commits made by a specific author (e.g., "JohnDoe") within a given date range (e.g., "2023-01-01" to "2023-12-31").
5	Week 9-12: Viewing Recent Commit History and Undoing Changes in Git History	Write the command to display the last five commits in the repository's history to quickly review recent changes and updates. Write the command to undo changes introduced by a specific commit ID (e.g., "abc123") to correct errors or revert unwanted changes.

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 probability concepts.
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)
Class Work:-A

CIE Split up for Laboratory based Ability Enhancement Course

SL. No.	Description	% of Marks	In Marks
1	Write-up, Conduction, result and Procedure	60%	30
2	Viva-Voce	40%	20
Total		**100%**	**50**

The Test marks should be scaled down to 30marks (60% of the maximum Marks)

Laboratory Test: -B

CIE Split up for Test in Laboratory based Ability Enhancement Course

SL. No.	Description	% of Marks	In Marks
1	Write-up, Conduction, result and Procedure	60%	30
2	Viva-Voce	40%	20
Total		**100%**	**50**

The Test marks should be scaled down to 20marks (40% of the maximum Marks)

Final CIE for Laboratory based Ability Enhancement Course

SL. No.	Description	% of Marks	In Marks
1	Scaled Down marks of record/journal-A	60% of the maximum	30
2	Scaled Down marks of test-B	40% of the maximum	20
Total		**100%**	**50**

FinalCIE Marks =(A) + (B)

SEE for practical Course:

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**

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

7. Learning Objectives

S/L	Learning Objectives	Description
1	Initialize a Git Repository and Perform Basic Commands	Students will be able to initialize a new Git repository, create a file, stage it, and commit the changes with a meaningful commit message, demonstrating fundamental knowledge of Git operations.
2	Create and Manage Git Branches	Students will gain the ability to create a new branch, switch between branches, and merge branches effectively, enabling them to manage different lines of development within a Git repository.
3	Use Branch Management Commands	Students will learn to stash changes, switch branches, and apply stashed changes, which enhances their capability to handle interrupted workflows and manage changes across different branches.
4	Clone and Collaborate with Remote Repositories	Students will be able to clone a remote Git repository, fetch updates, and rebase their local branches, facilitating collaboration and synchronization with remote project developments.
5	Manage Git Tags and Advanced Operations	Students will develop skills to create lightweight Git tags and execute advanced operations such as cherry-picking commits, enabling them to handle versioning and selective application of changes in a repository.
6	Analyze and Modify Git History	Students will be proficient in using Git to view specific commit details, list commits by author and date, and undo changes introduced by specific commits, which supports effective version control and history management.

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

Course Outcomes (COs)

COs	Description
M23BCA607C.1	Apply fundamental Git commands to manage and interact with a Git repository effectively

M23BCA607C.2	Utilize strategies to understand and systematically arrange branches within a Git repository.
M23BCA607C.3	Apply commands related to Collaboration and Remote Repositories.
M23BCA607C.4	Analyze and change the Git history.
M23BCA607C.5	Design commands related to Git Tags, Releases, and advanced Git operations.

CO-PO-PSO Mapping

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
M23BCA607C.1	3	-	-	-	-	-	-	-	-	-	-	-	3	3
M23BCA607C.2	-	3	-	-	-	-	-	-	-	-	-	-	3	3
M23BCA607C.3	-	-	3	3	-	-	-	-	-	-	-	-	3	3
M23BCA607C.4	-	-	-	3	-	-	-	-	-	-	-	-	3	3
M23BCA607C.5	-	-	3	-	3	-	-	-	-	-	-	-	3	3
M23BCA607C	**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**

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:

1. **Enhanced Version Control Proficiency:** Understanding and applying basic Git commands, including initialization, staging, and committing, will enable students to manage code changes effectively in any development environment, supporting robust version control practices.
2. **Advanced Branch Management Skills:** Mastery of creating, switching, and merging branches equips students to manage complex development workflows, collaborate on feature development, and integrate changes from multiple sources efficiently, essential for modern software development and team collaboration.
3. **Efficient Workflow Management:** Skills in stashing, switching branches, and applying stashed changes will help students manage interrupted workflows and maintain productivity, crucial for dealing with real-world development challenges where tasks are frequently shifted.
4. **Collaborative Development and Remote Synchronization:** Proficiency in cloning remote repositories, fetching updates, and rebasing ensures that students can contribute to collaborative projects, synchronize their work with the latest developments, and resolve conflicts, which is vital in distributed team environments.
5. **Versioning and Release Management**: Knowledge of creating Git tags and performing advanced operations like cherry-picking commits allows students to manage software releases and apply specific changes selectively, supporting structured versioning and maintaining a clean project history.
6. **Historical Analysis and Error Correction**: Ability to analyze and modify Git history by viewing commit details, listing commits by author, and undoing changes enables students to troubleshoot issues, track project evolution, and correct mistakes, which is important for maintaining high-quality code and ensuring project integrity.

6thSemester	Ability Enhancement (AE) GOLANG PROGRAMMING	M23BCS607D

1. Prerequisites

S/L	Proficiency	Prerequisites
1	Basic Programming Knowledge	Understanding of programming concepts: Familiarity with basic concepts like variables, loops, conditionals, functions, and data structures (e.g., arrays, slices, maps) is helpful. Experience with another programming language: Prior experience with languages like Python, Java, or C can be beneficial, as it helps you understand Go's syntax and structure more easily.
2	Development Environment	Operating System: Go is cross-platform, so you can use it on Windows, macOS, or Linux. Text Editor or IDE: You can use any text editor like VS Code, Sublime Text, or a Go-specific IDE like GoLand. VS Code with the Go extension is highly recommended for Go development.
3	Go Compiler and Tools	**Git:** Familiarity with Git is helpful for version control, especially when working on larger projects or contributing to open source.
4	Command Line Interface (CLI)	Basic command-line knowledge: Understanding how to navigate your file system, execute commands, and manage packages using the CLI will be useful. Go often interacts with the terminal, especially when running or building programs.
5	Internet Connection	Access to documentation and packages: Go has extensive online documentation and a package ecosystem. You'll need an internet connection to access the Go documentation and to download third-party packages.
6	Familiarity with Go Conventions	Go coding standards: Go has specific coding conventions, like using tabs for indentation and organizing code in specific directory structures. Familiarizing yourself with these early on will help you write idiomatic Go code.

2. Competencies

S/L	Competency	KSA Description
1	Concurrency and Parallelism in Go	**Knowledge:** Understand Go's concurrency model, including go routines, channels, and the Go scheduler. Familiarity with parallel processing and how Go manages concurrent tasks. **Skills:** Ability to design and implement concurrent applications that efficiently utilize multiple CPU cores. Proficiency in managing synchronization issues, avoiding race conditions, and ensuring thread safety. **Abilities:** Capable of analyzing and optimizing the performance of concurrent Go programs, ensuring that they are both efficient and scalable. Ability to debug complex concurrency-related issues.
2	Go Language Proficiency	**Knowledge:** Comprehensive understanding of Go's syntax, data types, control structures, and standard libraries. Familiarity with Go's memory management, garbage collection, and type system. **Skills:** Proficiency in writing clean, idiomatic Go code. Skilled in leveraging Go's built-in functions and packages to solve common programming tasks efficiently. **Abilities:** Able to apply Go's features to develop high-performance applications. Capable of mentoring others in Go's best practices and contributing to open-source Go projects.
3	Backend Development with Go	**Knowledge:** Understanding of backend architecture, RESTful API design, and database integration (both SQL and NoSQL) within the context of Go programming. Familiarity with web frameworks like Gin, Echo, or Fiber. **Skills:** Expertise in building and maintaining robust backend services and APIs using Go. Skilled in handling HTTP requests, routing, middleware, and integrating third-party services. **Abilities:** Capable of designing and implementing scalable backend systems, optimizing them for performance, and ensuring they can handle high loads. Ability to troubleshoot and resolve backend issues effectively.
4	Testing and	**Knowledge:** In-depth knowledge of Go's testing framework, including testing

	Debugging in Go	package, benchmarking, and mock testing. Familiarity with Go's debugging tools and techniques. **Skills:** Proficient in writing unit tests, integration tests, and benchmarks to ensure code quality and performance. Skilled in debugging Go applications to identify and fix issues efficiently. **Abilities:** Able to design comprehensive test suites that cover all critical aspects of the application. Capable of using profiling tools to identify performance bottlenecks and optimize code accordingly.
5	Dependency Management and Project Structuring	**Knowledge:** Understanding of Go modules for dependency management, including versioning, package distribution, and workspace organization. Familiarity with Go's project structure and best practices. **Skills:** Ability to manage project dependencies effectively using Go modules. Skilled in organizing code into packages, managing external dependencies, and ensuring reproducible builds. **Abilities:** Capable of structuring large-scale Go projects in a way that promotes maintainability and scalability. Ability to resolve dependency conflicts and ensure smooth project collaboration.
6	Performance Optimization in Go	**Knowledge:** Deep understanding of Go's performance characteristics, including memory management, garbage collection, and CPU usage. Familiarity with tools for profiling and performance analysis. **Skills:** Expertise in identifying and optimizing performance bottlenecks in Go applications. Skilled in writing efficient code that minimizes memory usage and maximizes execution speed. **Abilities:** Able to conduct thorough performance audits and implement optimizations that improve the overall efficiency of Go applications. Ability to scale applications to meet increasing demands while maintaining performance.

3. Teaching-Learning Process Strategies

S/L	TLP Strategies:	Description
1	**Hands-on Coding Sessions**	Conduct regular coding exercises and labs where students actively write and run Go programs, reinforcing concepts learned in lectures. Provide practical projects that require the application of Go's concurrency model, standard libraries, and tools.
2	**Interactive Lectures and Discussions**	Use interactive lectures to introduce and explain Go's core concepts, such as go routines, channels, and Go modules. Encourage class discussions and Q&A sessions to clarify doubts and deepen understanding of complex topics.
3	**Problem-Based Learning (PBL)**	Present real-world scenarios and problems that require students to design and develop solutions using Go. Assign group projects that foster collaboration and peer learning, simulating professional Go development environments.
4	**Code Reviews and Pair Programming**	Implement code review sessions where students evaluate each other's code, learning best practices and improving their coding style. Utilize pair programming to enhance collaboration, allowing students to work together to solve coding challenges.
5	**Quizzes and Assessments**	Use regular quizzes and assessments to gauge understanding of key Go concepts and reinforce learning. Include both theoretical questions and practical coding tasks in assessments to ensure comprehensive evaluation.
6	**Advanced Topics**	State Management: Introduce advanced topics like state management and how to handle complex data flows in larger applications.
7	**Continuous Feedback and Support**	Offer timely feedback on assignments and projects, guiding students in improving their Go programming skills. Provide additional support through office hours, online forums, or study groups to address individual learning needs.

4. Syllabus Timeline

S/L	Syllabus Timeline	Description
1	Week 1-2:	**Program 1:** Design and Implement a Go program to print the name of the months and number of days based on user input number. Apply switch statement to implement the same. **Program 2:** Implement a calculator program that displays a menu with options

		1. Add 2. Sub 3. Mul 4. Div Read 2 numbers and perform the relevant operation. After performing the operation, the program should ask the user if he wants to continue. If the user press Yes or Y, then the program should continue displaying the menu else the program should terminate.
2	Week 3-4:	**Program 3:** Accept a n array of 5 positive integers. Create a program to find the smallest positive integer in the user input array which cannot be formed from the sum of 2 numbers in the array. **Program 4:** Develop a Go Program to check whether the user given matrix is a sparse or not.
3	Week 5-6:	**Program 5:** Design and develop a simple Go function to find the longest substring without repeating characters in a given String. **Program 6:** Illustrate the different types of recursion in Go with suitable programs. Direct, Indirect, Tail and Head Recursion
4	Week 7-8:	**Program 7:** Design a structure Employee with name and salary as its filed. Create three employee instances. Print the details and computer the average salary. **Program 8**: Create a program to swap two numbers using pointers in Go.
5	Week 9-10:	**Program 9:** Apply pointer to structure concept to print the details of 3 student records. Assume Student record to contain USN, name and marks. **Program 10:** Develop a program to illustrate how to create an anonymous Go routine.
6	Week 11-12:	**Program 11:** Develop a program to illustrate how to start multiple Go routines. **Program 12:** Solve Producer Consumer concurrency issue using Go concurrency concept.

5. Syllabus

GOLANG PROGRAMMING SEMESTER – VI			
Course Code	**M23BCS607D**	CIE Marks	**50**
Number of Lecture Hours/Week(L: T: P: S)	**(0:0:2:0)**	SEE Marks	**50**
Total Number of Lecture Hours	**20 hours**	Total Marks	**100**
Credits	**01**	Exam Hours	**03**

Course objectives: This course will enable students:

1. To learn the basics of Golang Programming.
2. To understand and develop Go applications using syntax, data structures, and standard libraries.
3. To Debug and analyze Go code for logic, performance, and concurrency issues.
4. To Design and optimize scalable backend services and APIs using Go best practices.

Pgm. No.	**List of Programs**
	PART-A
1	Design and Implement a Go program to print the name of the months and number of days based on user input number. Apply switch statement to implement the same.
2	Implement a calculator program that displays a menu with options 1. Add 2. Sub 3. Mul 4. Div Read 2 numbers and perform the relevant operation. After performing the operation, the program should ask the user if he wants to continue. If the user press Yes or Y, then the program should continue displaying the menu else the program should terminate.
3	Accept a n array of 5 positive integers. Create a program to find the smallest positive integer in the user input array which cannot be formed from the sum of 2 numbers in the array.
4	Develop a Go Program to check whether the user given matrix is a sparse or not.
5	Design and develop a simple Go function to find the longest substring without repeating characters in a given String.
6	Illustrate the different types of recursion in Go with suitable programs. Direct, Indirect, Tail and Head Recursion
	PART-B

7	Design a structure Employee with name and salary as its filed. Create three employee instances. Print the details and computer the average salary.
8	Create a program to swap two numbers using pointers in Go.
9	Apply pointer to structure concept to print the details of 3 student records. Assume Student record to contain USN, name and marks.
10	Develop a program to illustrate how to create an anonymous Goroutine.
11	Develop a program to illustrate how to start multiple Go routines.
12	Solve Producer Consumer concurrency issue using Go concurrency concept.

PART-C

Beyond Syllabus Virtual Lab Content (To be done during Lab but not to be included for CIE or SEE)

• Develop a Golang program to replace all occurrences of a word with another word in the given string. https://www.youtube.com/watch?v=vFqjpJfCG6Q

• Develop a calculator program using switch cases in Golang. https://www.youtube.com/watch?v=ca8xBxKWXsM

• Develop bubble sort implementation in Golang. https://www.youtube.com/watch?v=98yDJ5vao5Q

Suggested Learning resources

Reference Books:

1) A Donovan, Brain W.Keringhan, " The Go Programming Language", Addison-Wesley Professional Computing Series,2016(Reprint)

E-Reference Books:

1) www.tutorialgateway.org/go-programs
2) https://gobyexample.com

6. **Assessment Details (both CIE and SEE)**

Class Work:-A

CIE Split up for Laboratory based Ability Enhancement Course

SL. No.	Description	% of Marks	In Marks
1	Write-up, Conduction, result and Procedure	60%	30
2	Viva-Voce	40%	20
Total		**100%**	**50**

The Test marks should be scaled down to 30marks (60% of the maximum Marks)

Laboratory Test: -B

CIE Split up for Test in Laboratory based Ability Enhancement Course

SL. No.	Description	% of Marks	In Marks
1	Write-up, Conduction, result and Procedure	60%	30
2	Viva-Voce	40%	20
Total		**100%**	**50**

The Test marks should be scaled down to 20marks (40% of the maximum Marks)

Final CIE for Laboratory based Ability Enhancement Course

SL. No.	Description	% of Marks	In Marks
1	Scaled Down marks of record/journal-A	60% of the maximum	30
2	Scaled Down marks of test-B	40% of the maximum	20
Total		**100%**	**50**

FinalCIE Marks =(A) + (B)

SEE for practical Course:

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**

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

7. Learning Objectives

S/L	Learning Objectives	Description
1	Understand Go Syntax and Structure	Students will be able to identify and use Go's syntax, data types, and control structures to write basic programs
2	Implement Concurrency in Go	Students will understand Go's concurrency model and be able to create and manage goroutines and channels to develop concurrent applications.
3	Utilize Go's Standard Library	Students will learn to effectively use Go's standard library for tasks such as file handling, error management, and networking.
4	Develop and Test Go Applications	Students will be able to write, build, and run Go applications, and utilize Go's testing framework to create and run unit tests.
5	Design and Optimize Go-based Systems	Students will gain the ability to design, implement, and optimize scalable backend services and APIs using Go, focusing on performance and maintainability.
6	Apply Best Practices in Go Programming	Students will understand and apply Go programming best practices, including code organization, documentation, and code reviews.

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

Course Outcomes (COs)

COs	Description
M23BCS607D.1	Apply the basic programming Go Lang constructs to develop standalone applications.
M23BCS607D.2	Apply the concept of functions and recursive functions in GoLang programming
M23BCS607D.3	Develop applications using Go Routines and channels
M23BCS607D.4	Solve the real-world concurrency issues using concurrency with go concepts.

CO-PO-PSO Mapping

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
M23BCS607D.1	**3**												**2**	
M23BCS607D.2		**3**											**2**	
M23BCS607D.3			**3**											**2**
M23BCS607D.4				**3**	**3**									**2**
M23BCS607D	**3**	**3**	**3**	**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**		**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**	**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 with Go (Golang) programming language looks promising, driven by its strengths and growing adoption in various industries. Here are some key trends and potential future developments:

1. **Increased Adoption in Cloud and Microservices:**

Go's efficiency and concurrency model make it ideal for cloud-native development and microservices. As more organizations move towards microservices architectures, Go's role in building scalable, high-performance services is likely to expand.

Companies like Google, Uber, and Dropbox have already integrated Go into their systems, and this trend is expected to grow, especially in cloud platforms like Kubernetes, which is itself written in Go.

2. **Growing Ecosystem and Tooling:**

The Go ecosystem is continuously evolving, with a growing number of libraries, frameworks, and tools. The introduction of modules for dependency management has made Go even more robust.

Tools like GoLand (IDE), Go's built-in testing suite, and profiling tools continue to improve, making Go development more accessible and efficient.

3. **Continued Focus on Simplicity and Performance:**

Go's design philosophy emphasizes simplicity and minimalism, which resonates with developers seeking to build maintainable and efficient systems. As the demand for performant and scalable software grows, Go's straightforward approach will remain attractive.

The language's performance characteristics, particularly in networked applications and large-scale systems, will keep it relevant in performance-critical environments.

4. **Expansion in DevOps and Site Reliability Engineering (SRE):**

Go's quick compilation times, static binaries, and cross-platform capabilities make it a preferred choice for developing DevOps tools and SRE applications. Its growing popularity in this area is likely to continue as infrastructure-as-code and automation become more prevalent.

5. **Broader Application in Emerging Technologies**:

As technologies like blockchain, AI, and IoT continue to grow, Go's reliability and performance could see it being adopted in these fields. For example, Go is already being used in blockchain platforms like Ethereum and Hyperledger Fabric.

The language's ease of deployment and low overhead make it suitable for resource-constrained environments like IoT devices.

6. **Enhanced Support for Web Development:**

Although not traditionally seen as a web development language, Go's use in backend web services and APIs is on the rise. Frameworks like Gin and Echo are helping Go gain traction in the web development community.

As web applications continue to evolve, Go could see increased use in performance-critical web backends and real-time services.

7. **Active Community and Language Evolution:**

The Go community is active and continues to drive the language forward with regular updates and proposals for new features. The community's focus on keeping Go simple yet powerful ensures that the language will continue to evolve to meet the needs of developers.

Future versions of Go are likely to introduce features that address current limitations while maintaining the language's core simplicity.

8. **Learning and Career Opportunities:**

As Go's popularity increases, there will be more opportunities for learning and career advancement in this field. Developers proficient in Go are already in demand, particularly in industries focused on cloud computing, backend development, and distributed systems.

Educational resources, both online and in academic settings, are likely to expand, further driving the language's adoption.

6thSemester	Non-Credit Mandatory Course(NCMC) National Service Scheme(NSS)	M23BNSK608

National Service Scheme (NSS)			
Course Code	**M23BNSK608**		
Number of Lecture Hours/Week(L: T: P: S)	0:0:2:0	CIE Marks	100
Total Number of Lecture Hours		SEE Marks	-
Credits	**0**	Total Marks	100
Activities Report Evaluation by College NSS Officer at the end of every semester (3rd to 6th semester)			

Course objectives:

National Service Scheme (NSS) will enable students to:

1. Understand the community in general in which they work.
2. Identify the needs and problems of the community and involve them in problem –solving.
3. Develop among themselves a sense of social & civic responsibility & utilize their knowledgein finding practical solutions to individual and community problems.
4. Develop competence required for group-living and sharing of responsibilities & gain skills inmobilizing community participation to acquire leadership qualities and democratic attitudes.
5. Develop capacity to meet emergencies and natural disasters & practice national integration andsocial harmony in general.

General Instructions - Pedagogy :

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. In addition to the traditional lecture method, different types of innovative teaching methods may be adopted sothat the activities will develop students' theoretical and applied social and cultural skills.
2. State the need for NSS activities and its present relevance in the society and Provide real-life examples.
3. Support and guide the students for self-planned activities.
4. You will also be responsible for assigning homework, grading assignments and quizzes, and documentingstudents' progress in real activities in the field.
5. Encourage the students for group work to improve their creative and analytical skills.

Contents :

1. Organic farming, Indian Agriculture (Past, Present and Future) Connectivity for marketing.
2. Waste management– Public, Private and Govt organization, 5 R's.
3. Setting of the information imparting club for women leading to contribution in social and economic issues.
4. Water conservation techniques – Role of different stakeholders– Implementation.
5. Preparing an actionable business proposal for enhancing the village income and approach for implementation.
6. Helping local schools to achieve good results and enhance their enrolment in Higher/ technical/ vocationaleducation.
7. Developing Sustainable Water management system for rural areas and implementation approaches.
8. Contribution to any national level initiative of Government of India. For eg. Digital India, Skill India, Swatch Bharat, Atmanirbhar Bharath, Make in India, Mudra scheme, Skill development programs etc.
9. Spreading public awareness under rural outreach programs.(minimum5 programs).
10. Social connect and responsibilities.
11. Plantation and adoption of plants. Know your plants.
12. Organize National integration and social harmony events /workshops /seminars. (Minimum 02 programs).

Govt. school Rejuvenation and helping them to achieve good infrastructure.

NOTE:
1. Student/s in individual or in a group Should select any one activity in the beginning of each semester till end of that respective semester for successful completion as per the instructions of NSS officer with the consent ofHOD of the department.
2. At the end of every semester, activity report should be submitted for evaluation.

Distribution of Activities - Semester wise from 3rd to 6th semester

Sem	Topics / Activities to be Covered
3rd Sem for 25 Marks	1. Organic farming, Indian Agriculture (Past, Present, and Future) Connectivity for marketing. 2. Waste management– Public, Private and Govt organization, 5 R's. 3. Setting of the information imparting club for women leading to contribution in social andeconomic issues.
4th Sem for 25 Marks	Water conservation techniques – Role of different stakeholders– Implementation. Preparing an actionable business proposal for enhancing the village income and approach forimplementation. Helping local schools to achieve good results and enhance their enrolment in Higher/ technical/vocational education.
5th Sem for 25 Marks	1. Developing Sustainable Water management systems for rural areas and implementationapproaches. 2. Contribution to any national-level initiative of the Government of India. Foreg. Digital India,Skill India, Swachh Bharat, Atmanirbhar Bharath, Make in India, Mudra scheme, Skill developmentprograms etc. 3. Spreading public awareness under rural outreach programs.(minimum 5 programs). 4. Social connect and responsibilities.
6th Sem for 25 Marks	1. Plantation and adoption of plants. Know your plants. 2. Organize National integration and social harmony events /workshops /seminars. (Minimum 02programs). 3. Govt. school Rejuvenation and helping them to achieve good infrastructure.

Course outcomes (Course Skill Set):
At the end of the course, the student will be able to:
CO1. Understand the importance of his / her responsibilities towards society.
CO2. Analyse the environmental and societal problems/issues and will be able to design solutions for the same.
CO3. Evaluate the existing system and to propose practical solutions for the same for sustainable development.
CO4. Implement government or self-driven projects effectively in the field.
CO5. Develop capacity to meet emergencies and natural disasters & practice national integration and social harmony in general.

Pedagogy – Guidelines:

It may differ depending on local resources available for the study as well as environment and climatic differences, location, and time of execution.

Sl No	Topic	Group size	Location	Activity execution	Reporting	Evaluation of the Topic
1.	Organic farming, Indian Agriculture (Past, Present, and Future) Connectivity for marketing.	May be individual or team	Farmers land/ Villages/ roadside/ community area /College campus etc	Site selection / proper consultation/ Continuous monitoring/ Information board	Report should be submitted by an individual to the concerned evaluation authority	Evaluation as per the rubrics ofthe scheme and syllabus by NSS officer

2.	Waste management– Public, Private organization, 5 R's.	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/ Government Schemes officers / campus etc…	Site selection / proper consultation/ Continuous monitoring/ Information board	Report should be submitted by an individual to the concerned evaluation authority	Evaluation as per the rubrics of the scheme and syllabus by NSS officer
3.	Setting of the information imparting club for women leading to contribution in social and economic issues.	May be individual or team	Women empowerment groups/ Consulting NGOs & Govt Teams / College campus etc…	Group selection / proper consultation / Continuous monitoring / Information board	Report should be submitted by an individual to the concerned evaluation authority	Evaluation as per the rubrics of the scheme and syllabus by NSS officer
4.	Water conservation techniques – Role of different stakeholders– Implementation.	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/ Government Schemes officers / campus etc…	Site selection / Proper consultation/ Continuous monitoring/ Information board	Report should be submitted by an individual to the concerned evaluation authority	Evaluation as per the rubrics of the scheme and syllabus by NSS officer
5.	Preparing an actionable business proposal for enhancing the village income and approach for implementation.	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/ Government Schemes officers / campus etc…	Group selection / proper consultation / Continuous monitoring / Information board	Report should be submitted by an individual to the concerned evaluation authority	Evaluation as per the rubrics of the scheme and syllabus by NSS officer
6.	Helping local schools to achieve good results and enhance their enrolment in Higher/ technical/ vocational education.	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/ Government Schemes officers / campus etc…	School selection / proper consultation / Continuous monitoring / Information board	Report should be submitted by an individual to the concerned evaluation authority	Evaluation as per the rubrics of the scheme and syllabus by NSS officer
7.	Developing Sustainable Water management system for rural areas and implementation approaches.	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/ Government Schemes officers / campus etc…	Site selection / proper consultation / Continuous monitoring / Information board	Report should be submitted by an individual to the concerned evaluation authority	Evaluation as per the rubrics of the scheme and syllabus by NSS officer

8.	Contribution to any national-level initiative of the Government of India. For eg. Digital India, Skill India, Swachh Bharat, Atmanirbhar Bharath, Make in India, Mudra scheme, Skill development programs etc.	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/ Government Schemes officers / campus etc…	Group selection / proper consultation / Continuous monitoring / Information board	Report should be submitted by an individual to the concerned evaluation authority	Evaluation as per the rubrics of the scheme and syllabus by NSS officer
9.	Spreading public awareness under rural outreach programs.(minimum5 programs). ///// Social connect and responsibilities.	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/ Government Schemes officers / campus etc…	Group selection / proper consultation / Continuous monitoring / Information board	Report should be submitted by an individual to the concerned evaluation authority	Evaluation as per the rubrics of the scheme and syllabus by NSS officer
10.	Plantation and adoption of plants. Know your plants.	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/ Government Schemes officers / campus etc…	Place selection / proper consultation / Continuous monitoring / Information board	Report should be submitted by an individual to the concerned evaluation authority	Evaluation as per the rubrics of the scheme and syllabus by NSS officer
11.	Organize National integration and social harmony events /workshops /seminars. (Minimum 02 programs).	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/ Government Schemes officers / campus etc…	Place selection / proper consultation / Continuous monitoring / Information board	Report should be submitted by an individual to the concerned evaluation authority	Evaluation as per the rubrics of the scheme and syllabus by NSS officer
12.	Govt. school Rejuvenation and helping them to achieve good infrastructure.	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/ Government Schemes officers / campus etc…	Place selection / proper consultation / Continuous monitoring / Information board	Report should be submitted by an individual to the concerned evaluation authority	Evaluation as per the rubrics of the scheme and syllabus by NSS officer

Plan of Action ((Execution of Activities For Each Semester)

Sl.No	Practice Session Description
1.	Lecture session by NSS Officer
2.	Students' Presentation on Topics
3.	Presentation - 1 , Selection of topic, PHASE - 1
4.	Commencement of activity and its progress - PHASE - 2
5.	Execution of Activity
6.	Execution of Activity
7.	Execution of Activity
8.	Execution of Activity
9.	Execution of Activity
10.	Case study-based Assessment, Individual performance
11.	Sectorwise study and its consolidation
12.	Video-based seminar for 10 minutes by each student At the end of the semester with a Report.

- In every semester from 3rd semester to 6th semester, Each student should do activities according to thescheme and syllabus.
- At the end of every semester student performance has to be evaluated by the NSS officer for the assignedactivity progress and its completion.
- At last in 6th semester consolidated report of all activities from 3rd to 6th semester, compiled report should besubmitted as per the instructions.

Assessment Details:

Weightage	CIE 100%
Presentation - 1 Selection of topic, PHASE - 1	**10 Marks**
Commencement of activity and its progress PHASE - 2	**10 Marks**
Case Study-based Assessment Individual Performance with Report	**10 Marks**
Sector-wise study & its consolidation	**10 Marks**
Video based seminar for 10 minutes by each student At the end of semester with Report. Activities.	**10 Marks**
Total marks for the course in each semester	**50 Marks**

- Implementation strategies of the project (NSSwork).
- The last Report should be signed by the NSS Officer, the HOD, and the principal.
- At last Report should be evaluated by the NSSofficer of the institute.
- Finally, the consolidated marks sheet should be sent to the university and made available atthe LIC visit.

Marks scored for 50 by the students should be Scale down to 25 marks In each semester for CIE entry in theVTU portal.

25 marks CIE entry will be entered in University IA marks portal at the end of each semester 3rd to 6th sem,Report and assessment copy should be made available in the department semester wise

Students should present the progress of the activities as per the schedule in the prescribed practical session in thefield.
There should be positive progress in the vertical order for the benefit of society in general.

Suggested Learning Resources:
Books :
1. NSS Course Manual, Published by NSS Cell, VTU Belagavi.
2. Government of Karnataka, NSS cell, activities reports and manual.
3. Government of India, NSS cell, Activities reports and manual.

PHYSICAL EDUCATION (SPORTS & ATHLETIC

Course Code	**M23BPEK608**	CIE Marks	**100**
Number of Lecture Hours/Week(L: T: P: S)		SEE Marks	
Total Number of Lecture Hours		Total Marks	100
Credits	**0**	Exam Hours	**-**

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

CO1.Understand the fundamental concepts and skills of Physical Education, Health, Nutrition and Fitness.
CO2.Familiarization of health-related Exercises, Sports for overall growth and development.
CO3.Create a foundation for the professionals in Physical Education and Sports. CO4.Participate in the competition at regional/state / national / international levels.
CO5.Create consciousness among the students on Health, Fitness and Wellness in developing and maintaining a healthy lifestyle.

Module-1

Orientation **(5 hours)**

A. Lifestyle
B. Fitness
C. Food & Nutrition
D. Health & Wellness
E. Pre-Fitness test.

Module-2

General Fitness & Components of Fitness: **(15hours)**

A. Warming up (Free Hand exercises)
B. Strength — Push-up / Pull-ups
C. Speed — 30 Mtr Dash
D. Agility — Shuttle Run
E. Flexibility — Sit and Reach
F. Cardiovascular Endurance — Harvard step Test

Module-3

Recreational Activities: **(10 hours)**

A. Postural deformities.
B. Stress management.
C. Aerobics.
D. Traditional Games.

Scheme and Assessment for auditing the course and Grades:

Sl. No.	Activity	Marks
1.	Participation of student in all the modules	20
2.	Quizzes — 2, each of 15 marks	30
3.	Final presentation/exhibition / Participation in competitions/practical on specific tasks assigned to the students	50
Total		100

6th Semester	Non-Credit Mandatory Courses(NCMC) PHYSICAL EDUCATION (SPORTS & ATHLETICS) - III	M23BPEK608

Non-Credit Mandatory Course (NCMC) PHYSICAL EDUCATION (SPORTS & ATHLETICS) -III			
Course Code	**M23BPEK608**	CIE Marks	**100**
Number of Lecture Hours/Week(L:T:P:S)	**(0:0:2:0)**	SEE Marks	-
Total Number of Lecture Hours	**-**	Total Marks	**100**
Credits	**0**	Exam Hours	**-**

Semester-V

PHYSICAL EDUCATION (SPORTS & ATHLETICS)—III

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

COs	Description
M23BPEK608.1	Understand the ethics and moral values in sports and athletics.
M23BPEK608.2	Perform in the selected sports or athletics of the student's choice.
M23BPEK608.3	Understand the roles and responsibilities of organization and administration of sports and games.

Module-1

Ethics and Moral Values **(5hours)**

A. Ethics in Sports
B. Moral Values in Sports and Games

Module-2

Specific Games(Anyone to be selected by the student) **(20hours)**

A. Volley ball—Attack,Block,Service,Upper Hand Pass and Lower hand Pass.
B. Throwball—Service,Receive,Spinattack,NetDrop & Jumpthrow.
C. Kabaddi—Handtouch,ToeTouch,ThighHold,Anklehold and Bonus.
D. Kho-Kho—Giving Kho,SingleChain,Pole dive,Pole turning,3-6Up.
E. TableTennis—Service(ForeHand&BackHand),Receive(ForeHand&BackHand),Smash.
F. Athletics(Track/FieldEvents)—Any event as per availability of Ground.

Module-3

Role of Organisation and administration (5 hours)

Sl. No.	Activity
1.	Participation of student in all the modules
2.	Quizzes—2,each of 15 marks
3.	Final presentation/exhibition/Participation in competitions/practical on specific tasks assigned to the students

6thSemester	Non-Credit Mandatory Course(NCMC) Yoga	M23BYOK609

Non-Credit Mandatory Courses(NCMC) Yoga			
Course Code	**M23BYOK609**		
Number of Lecture Hours/Week(L: T: P: S)	**0:0:2:0**	CIE Marks	**100**
Total Number of Lecture Hours	-	SEE Marks	**-**
Credits	**0**	Total Marks	**100**
Evaluation Method: Objective type Theory / Practical / Viva-Voce			

Course objectives:

1. To enable the student to have good Health.
2. To practice mental hygiene.
3. To possess emotional stability.
4. To integrate moral values.
5. To attain a higher level of consciousness.

The Health Benefits of Yoga

The benefits of various yoga techniques have been supposed to improve

- body flexibility,
- performance,
- stress reduction,
- attainment of inner peace, and
- self-realization.

The system has been advocated as a complementary treatment to aid the healing of severalailments such as

- coronary heart disease,
- depression,
- anxiety disorders,
- asthma, and
- extensive rehabilitation for disorders including musculoskeletal problems and traumatic brain injury.

The system has also been suggested as behavioral therapy for smoking cessation and substance abuse (including alcohol abuse).

If you practice yoga, you may receive these physical, mental, and spiritual benefits:

- Physical
  1. Improved body flexibility and balance
  2. Improved cardiovascular endurance (stronger heart)
  3. Improved digestion
  4. Improved abdominal strength
  5. Enhanced overall muscular strength
  6. Relaxation of muscular strains
  7. Weight control
  8. Increased energy levels
  9. Enhanced immune system
- Mental
  1. Relief of stress resulting from the control of emotions
  2. Prevention and relief from stress-related disorders
  3. Intellectual enhancement, leading to improved decision-making skills
- Spiritual
  4. Life with meaning, purpose, and direction
  5. Inner peace and tranquility
  6. Contentment

Yoga Syllabus

Semester V

- Patanjali's Ashtanga Yoga its need and importance.
- Ashtanga Yoga

1. Asana
2. Pranayama
3. Pratyahara

- Asana its meaning by name, technique, precautionary measures and benefits of each asana
- Different types of Asanas

a. Sitting 1. Ardha Ushtrasana 2. Vakrasana 3. Yogamudra in Padmasana
b. Standing 1. UrdhvaHastothanasana 2. Hastapadasana 3. ParivrittaTrikonasana 4. Utkatasana
c. Prone line 1. Padangushtha Dhanurasana 2. Poorna Bhujangasana / Rajakapotasana
d. Supine line 1. Sarvangasana 2. Chakraasana 3. Navasana/Noukasana 4. Pavanamuktasana

- Revision of practice 60 strokes/min 3 rounds
- Meaning by name, technique, precautionary measures and benefits of each Pranayama 1. Ujjayi 2. Sheetali 3. Sheektari

Course outcomes (Course Skill Set):
At the end of the course, the student will be able to:

COs	Description
M23BYOK609.1	Understand the meaning, aim and objectives of Yoga.
M23BYOK609.2	Perform Suryanamaskar and able toTeach its benefits.
M23BYOK609.3	Understand and teach different Asanasbyname,its importance,methods and benefits.
M23BYOK609.4	Instruct Kapalabhati and its need and importance.
M23BYOK609.5	Teach different types of Pranayamaby its name,precautions,procedure and uses
M23BYOK609.6	Coach different types of Kriyas, method to follow and usefulness.

Assessment Details (both CIE and SEE)

- Students will be assessed with internal test by a. Multiple choice questions b. Descriptive type questions (Twointernal assessment tests with 25 marks/test)
- Final test shall be conducted for whole syllabus for 50 marks.
- Continuous Internal Evaluation shall be for 100 marks (including IA test)

Suggested Learning Resources:
Books:

1. Yogapravesha in Kannada by Ajitkumar
2. Light on Yoga by BKS Iyengar
3. Teaching Methods for Yogic practices by Dr. M L Gharote & Dr. S K Ganguly
4. Yoga Instructor Course hand book published by SVYASA University, Bengaluru
5. Yoga for Children –step by step – by Yamini Muthanna

Web links and Video Lectures (e-Resources):Refer links
1. https://youtu.be/KB-TYlgd1wE
2. https://youtu.be/aa-TG0Wg1Ls