SAMARTH EDUCATIONAL TRUST

ARVIND GAVALI COLLEGE OF ENGINEERING, SATARA

(AN AUTONOMOUS INSTITUTE)

Curriculum for Second Year M.C.A.

SAMARTH EDUCATIONAL TRUST
ARVIND GAVALI COLLEGE OF ENGINEERING
• ENGINEERING (B.Tech & M.Tech) • BCA • MCA • B.VOC
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Approved by AICTE, New Delhi, Recognised by Govt. Of Maha.,DTE Mumbai & Affiliated to Dr.Babasaheb Ambedkar Technological University (BATU), Lonere.
• Address : At.Panmalewadi, Post.-Varye, Tal.& Dist.-Satara.-415 015 (Maharashtra)
• Phone : 02162 - 261122 , 200100
• e-mail : agcenggsatara@gmail.com
• Website :-www.agce.edu.in
• Institute Code : Engg. DTE EN-6545
• BCA 6545, MCA 6545, B.Voc 6545

Ref No.: Date :

As per NEP Guidelines, Proposed Scheme of Credit Distribution
First Year MCA 2025-26
SEMESTER I

Sr. No.	Category	Course Code	Course Name	Teaching Scheme					Evaluation Scheme			
				L	T	P	Hrs. /Wk	Cr	Components	Max	Min for Passing	
1	PCC	25MCA1101	Advance Operating System	3	0	0	3	3	CA1	15		45
									MSE	20		
									CA2	15		
									ESE	50	20	
2	PCC	25MCA1102	Data Structure and Algorithms using python	3	0	0	3	3	CA1	15		45
									MSE	20		
									CA2	15		
									ESE	50	20	
3	PCC	25MCA1103	Data Base Management System	3	0	0	3	3	CA1	15		45
									MSE	20		
									CA2	15		
									ESE	50	20	
4	BSC	25MCA1104	Probability and Statistics	3	1	0	4	4	CA1	15		45
									CA2	20		
									ESE	15	20	
5	PCC	25MCA1105	Java Programming	3	0	0	3	3	CA1	50		45
									MSE	15		
									CA2	20		
									ESE	15	20	
6	PCC	25MCA1102L	Data Structure & Algorithms using Python Laboratory	0	0	2	2	1	CA1	25		45
									CA2	25		
									POE	50	20	
7	PCC	25MCA1103L	Data Base Management System Laboratory	0	0	2	2	1	CA1	25		45
									CA2	25		
									POE	50	20	
8	PCC	25MCA1105L	Java Programming Laboratory	0	0	2	2	1	CA1	25		45
									CA2	25		
									POE	50	20	
9	VSEC	25MCA1106L	Web Technology Laboratory	0	0	2	2	1	CA1	25		20
									CA2	25		
									POE	--	--	
			Total	**15**	**1**	**8**	**24**	**20**		**850**		
Total Contact Hours –24 Total Credits – 20												

Ref No.: Date :

SEMESTER II

Sr. No.	Category	Course Code	Course Name	Teaching Scheme					Evaluation Scheme			
				L	T	P	Hrs. / Wk	Cr	Components	Max	Min for Passing	
1	PCC	25MCA1201	Object Design & Agile Development	3	0	0	3	3	CA1	15		45
									MSE	20		
									CA2	15		
									ESE	50	20	
2	PCC	25MCA1202	Computer Networks	3	1	0	4	4	CA1	15		45
									MSE	20		
									CA2	15		
									ESE	50	20	
3	PCC	25MCA1203	Artificial Intelligence	3	0	0	3	3	CA1	15		45
									MSE	20		
									CA2	15		
									ESE	50	20	
4	PEC	25MCA1204	Program Elective I	3	0	0	3	3	CA1	15		45
									MSE	20		
									CA2	15		
									ESE	50	20	
5	OE	25MCA1205	Open Elective I	3	0	0	3	3	CA1	15		45
									MSE	20		
									CA2	15		
									ESE	50	20	
6	PCC	25MCA1201L	Object Design & Agile Development Laboratory	0	0	2	2	1	CA1	25		20
									CA2	25		
									POE	--	--	
7	VSEC	25MCA1206L	Data Analysis with Python Laboratory	0	0	2	2	1	CA1	25		45
									CA2	25		
									POE	50	20	
8	PCC	25MCA1203L	Artificial Intelligence Laboratory	0	0	2	2	1	CA1	25		45
									CA2	25	20	
									POE	50		
9	Project	25MCA1207L	Mini Project	0	0	2	2	1	CA1	25		45
									CA2	25		
									OE	50	20	
10	Internship	25MCA1208	Field Training / Internship / Industrial Training Evaluation					AU				
			Total	**15**	**1**	**8**	**24**	**20**		**850**		
Total Contact Hours – 24 Total Credits – 20												

*Students must complete a two-week internship after the semester, which will be evaluated in the following semester.

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Semester III

Sr. No.	Category	Course Code	Course Name	Teaching Scheme					Evaluation Scheme			
				L	T	P	Hrs./ Wk	Cr	Components	Max	Min for Passing	
1	PCC	25MCA2301	Full Stack Development	3	0	0	3	3	CA1	15		45
									MSE	20		
									CA2	15		
									ESE	50	20	
2	PCC	25MCA2302	Machine Learning	3	0	0	3	3	CA1	15		45
									MSE	20		
									CA2	15		
									ESE	50	20	
3	PCC	25MCA2303	Cloud Computing	3	0	0	3	3	CA1	15		45
									MSE	20		
									CA2	15		
									ESE	50	20	
4	PEC	25MCA2304	Program Elective II	3	0	0	3	3	CA1	15		45
									MSE	20		
									CA2	15		
									ESE	50	20	
5	PEC	25MCA2305	Program Elective III	3	0	0	3	3	CA1	15		45
									MSE	20		
									CA2	15		
									ESE	50	20	
6	AEC	25MCA2306L	Innovation, Business Models and Entrepreneurship	2	0	0	2	2	CA1	25		20
									MSE	--		
									CA2	25		
									ESE	--	--	
7	PCC	25MCA2301L	Full Stack Development Laboratory	0	0	4	4	2	CA1	25		45
									CA2	25		
									POE	50	20	
8	PCC	25MCA2302L	Machine Learning Laboratory	0	0	2	2	1	CA1	25		45
									CA2	25		
									POE	50	20	
10	Project	25MCA2307L	Project phase – I	0	0	2	2	1	CA1	25		45
									CA2	25		
									POE	50	20	
			Total	**17**	**0**	**8**	**25**	**21**		**850**		
Total Contact Hours –25 Total Credits – 21												

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Semester IV

Sr. No.	Category	Course Code	Course Name	Teaching Scheme					Evaluation Scheme			
				L	T	P	Hrs./ Wk	Cr	Components	Max	Min for Passing	
1	PCC	25MCA2401	Software Engineering & Project Management	3	0	0	3	3	CA1	15		45
									MSE	20		
									CA2	15		
									ESE	50	20	
2	PEC	25MCA2402	Program Elective IV	3	0	0	3	3	CA1	15		45
									MSE	20		
									CA2	15		
									ESE	50	20	
3	Internship/ OJT	25MCA2403	Internship and Project in the Industry	0	0	24	24	12	CA1	25		45
									CA2	25		
									OE	50	20	
4	Project	25MCA2404L	Project phase – II (In-house)	0	0	2	2	1	CA1	25		45
									CA2	25		
									POE	50	20	
			Total	**6**		**26**	**32**	**19**		**400**		
Total Contact Hours –32 Total Credits – 19												

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Semester III
Program Elective Course-II:

Sr. No.	Course Code	Course Name
1.	25MCA2104	Big Data Processing and Analytics
2.	25MCA2104	Distributed Computing Systems
3.	25MCA2104	Software Testing and Tools
4.	25MCA2104	Generative AI & Prompt Engineering

Program Elective Course-III:

Sr. No.	Course Code	Course Name
1.	25MCA2105	Cryptography and Network Security
2.	25MCA2105	Block Chain Technology
3.	25MCA2105	Mobile Application Development
4.	25MCA2105	Cyber Security & Ethical Hacking

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Ref No.: Date :

Semester IV
Program Elective Course-IV:

Sr. No.	Course Code	Course Name
1.	25MCA2202	Deep Learning
2.	25MCA2202	Natural Language Processing (NLP)
3.	25MCA2202	Social Networks (SN)

Semester III

Title of the Course: Full Stack Development	L	T	P	Credit
Course Code: 25MCA2301	3	-	-	3

Course Prerequisite:

Students should have basic knowledge of fundamentals of programming (C / Java / Python), basics of HTML & internet concepts and understanding of DBMS concepts, basic operating system & computer networks knowledge

Course Description:

This course introduces students to full stack web development, covering both front-end and back-end technologies. It helps students build complete web applications using modern tools and frameworks. The course also includes version control, cloud deployment, and DevOps practices. Additionally, it focuses on security and performance optimization. By the end, students can develop and deploy real-world web applications.

Course Objectives:

By the end of this course, students will be able to:

1. Understand concepts of front-end and back-end development.
2. Learn to build full-stack web applications.
3. Apply version control and collaboration tools.
4. Understand DevOps, cloud computing, and deployment.
5. Implement security practices and performance optimization.

Course Outcomes:

CO	After the completion of the course the student should be able to
CO1	Apply front-end technologies (HTML, CSS, JavaScript, frameworks) to design responsive web interfaces.
CO2	Develop back-end applications using server-side programming, APIs, and databases.
CO3	Use version control systems (Git) and collaboration tools for efficient project management.
CO4	Implement DevOps practices and cloud deployment using tools like Docker, Kubernetes, and cloud platforms.
CO5	Apply security measures and performance optimization techniques in full-stack applications.

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	3	-	3	-	-	-	2	2	-	-
CO2	3	2	3	-	3	-	-	-	2	-	-	-
CO3	-	-	-	-	2	-	-	-	3	2	2	-
CO4	-	2	2	-	3	-	2	-	2	-	2	2
CO5	2	3	2	2	3	2	2	2	-	-	-	2

Assessment Scheme:
Two components of Continuous Assessment (CA-1, CA-2), Mid Semester Examination (MSE) and End Semester Examination (ESE) having 30%, 20% and 50% weightage respectively.

Assessment Component	Marks
CA1	15
MSE	20
CA2	15
ESE	50

CA1 and **CA2** are based on Surprise test/ Assignment/ Quiz/Seminar/Group discussions presentation, etc.

MSE is based on 50% of course content.
ESE is based on 100% course content with 60-70% weightage for course content covered after MSE.

Course Contents

Unit No.	Unit Title and Contents	Hours
1	**Front-End Development** HTML5 and CSS3,JavaScriptFundamentals,Front-End Frameworks (e.g., React, Angular, Vue.js),Responsive Web Design and CSS Preprocessors (e.g., Sass, Less)	7
2	**Back-End Development** Introduction to Back-End Development, Server-Side Programming (e.g., Node.js, Python, Java),Web APIs and RESTful ServicesDatabases and SQL (e.g., MySQL, PostgreSQL), NoSQL Databases (e.g.MongoDB), Serverless Computing (e.g., AWS Lambda, Azure Functions)	7

3	**Version Control and Collaboration** Git and GitHub/GitLab,Code Reviews and Collaboration Workflows, Issue Tracking and Project Management (e.g., Jira, Trello)	7
4	**DevOps and Cloud Computing** Introduction to DevOps and CI/CD, Continuous Integration (CI) and Automated Testing, Continuous Delivery (CD) and Deployment Infrastructure as Code (IaC) with Tools like Terraform or CloudFormation, Containerization and Dockers, Orchestration with Kubernetes. Cloud Computing (e.g., AWS, Azure, Google Cloud),Cloud Deployment and Scaling Strategies, Cloud Services (e.g., AWS EC2, S3, Lambda, Azure App Service), Monitoring and Logging in the Cloud Environment	7
5	**Security & Performance Optimization** Web Application Security Fundamentals, Authentication and Authorization, Secure Coding Practices, Network Security and Encryption, DevSecOps and Security in CI/CD Pipelines. Front-End Performance Optimization, Back-End Performance Optimization, Caching Strategies, Load Balancing and Scalability.	7

Text Books

Sr. No.	Title	Author	Publisher
1	Full Stack JavaScript Development With MEAN: MongoDB, Express, AngularJS, and Node.JS	Colin Ihrig	SitePoint 1st Edition,2015

Reference Books

Sr. No.	Title	Author	Publisher
1	Learning PHP, MySQL, JavaScript, CSS & HTML5: A Step-by-Step Guide to Creating Dynamic Websites	Robin Nixon	O'Reilly Media 3rd edition, 2014
2	Web Development and Design Foundations with HTML5	Terry Felke-Morris	Pearson, 8th Edition, 2018
3	JavaScript and JQuery Interactive Front-End Web Development	Jon Duckett	Wiley, 1st Edition, 2014
4	Node.js Web Development	David Herron	Packt Publishing, 4th Edition, 2020

Title of the Course: Machine Learning Course Code: 25MCA2302	L	T	P	Credit
	3	-	-	3

Course Prerequisite:
Students should have basic knowledge of mathematics (probability, linear algebra, and statistics), fundamentals of programming (Python, Java, or C++), a basic understanding of data structures, and knowledge of DBMS concepts.

Course Description:
This course introduces the basics of machine learning and how computers learn from data. It covers different types of learning such as supervised and unsupervised learning, along with important algorithms like regression, decision trees, and clustering. Students will also learn advanced models like SVM, neural networks, and ensemble methods. The course explains how to evaluate models and apply them to real-world problems like recommendation systems.

Course Objectives:
By the end of this course, the students will be able to:

1. Understand fundamental concepts of machine learning and its types.
2. Apply supervised learning algorithms for prediction.
3. Learn probabilistic and computational learning models.
4. Explore advanced ML techniques and neural networks.
5. Implement unsupervised learning and recommendation systems.

Course Outcomes:

CO	After the completion of the course the student should be able to
CO1	Understand and apply basic concepts of machine learning, including hypothesis space, concept learning, and evaluation methods.
CO2	Apply supervised learning algorithms such as regression and decision trees with appropriate performance evaluation.
CO3	Analyze and implement Bayesian and computational learning models for solving complex problems.
CO4	Use advanced machine learning techniques including SVM, ensemble methods, and neural networks.
CO5	Apply unsupervised learning and recommendation techniques for data analysis and decision-making.

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	2	2	-	-	-	-	-	-	2
CO2	3	3	2	2	3	-	-	-	-	-	-	-
CO3	3	3	2	3	2	-	-	-	-	-	-	-
CO4	3	3	3	2	3	-	-	-	-	-	-	2
CO5	2	3	2	2	3	-	-	-	-	-	-	2

Assessment Scheme:
Two components of Continuous Assessment (CA-1, CA-2), Mid Semester Examination (MSE) and End Semester Examination (ESE) having 30%, 20% and 50% weightage respectively.

Assessment Component	Marks
CA1	15
MSE	20
CA2	15
ESE	50

CA1 and **CA2** are based on Surprise test/ Assignment/ Quiz/Seminar/Group discussions presentation, etc.

MSE is based on 50% of course content.
ESE is based on 100% course content with 60-70% weightage for course content covered after MSE.

Course Contents

Unit No.	Unit Title and Contents	Hours
1	**Foundations of Machine Learning** Well-posed learning problems, Designing a Learning System, Perspectives and Issues in Machine learning, Basic definitions, types of learning, Concept Learning and General-to-specific Ordering: A concept learning task, Concept learning as Search, Finding a maximally specific hypothesis, Version Spaces and Candidate elimination algorithm, Inductive Bias. hypothesis space and inductive bias, evaluation, cross-validation.	7
2	**Supervised Learning Techniques** Supervised Learning, Classification & Regression, Performance Metrics for Classification Problems, Performance Metrics for Regression Problems. Linear regression, Decision trees, over fitting.	7

3	**Bayesian & Computational Learning** S Bayesian Learning: Bayes theorem and concept learning, Maximum likelihood and least square error hypotheses, Minimum description length principle, Bayes optimal classifier, Gibbs algorithm, Naive Bayes classifier, Computational Learning Theory: Probably learning an approximately correct hypothesis, PAC learnability, The VC dimension, the mistake bound model for learning.	7
4	**Advanced Learning Models** Logistic Regression, Support Vector Machine, Kernel function and Kernel SVM. Ensemble Learning, Bagging, Random Forest, Boosting, AdaBoost, Stacking Perceptron, multilayer network, back propagation, introduction to deep neural network	7
5	**Unsupervised Learning & Recommendation Systems** Clustering k-means, adaptive hierarchical clustering, Gaussian mixture model. Association Rules Mining and Recommendation Systems. What are Association Rules, Association Rule Parameters, Calculating Association Rule Parameters, Recommendation Engines, Recommendation Engines working, Collaborative Filtering , content Based Filtering.	7

Text Books

Sr. No.	Title	Author	Publisher
1	Introduction to Machine Learning	Ethem Alpaydın	PHI, 3rd Edition
2	Pattern Recognition and Machine Learning	Christopher M. Bishop	Mcgraw-Hill

Reference Books

Sr. No.	Title	Author	Publisher
1	Machine Learning for Hackers	Conway, Drew and White, John Myles	O'Reilly Media, February 2012.
2	Machine Learning	Tom Mitchell	Mcgraw-Hill, First Edition.

Title of the Course: Cloud Computing Course Code: 25MCAC2303	L	T	P	Credit
	3	-	-	3

Course Prerequisite:
Students should have basic knowledge of fundamentals of computer networks, basics of operating systems, knowledge of DBMS concepts, basic understanding of virtualization & Web Technologies

Course Description:
This course introduces the fundamental concepts of cloud computing, including virtualization, cloud architecture, and service models. It covers data storage, security, and major cloud platforms such as AWS and Azure. Students will explore real-world cloud applications and deployment strategies. The course also highlights advanced topics like containers, DevOps, and IoT integration. It prepares students to design, implement, and manage scalable cloud-based solutions.

Course Objectives:
By the end of this course, students will be able to:

1. Understand fundamentals and concepts of cloud computing and virtualization.
2. Learn cloud architecture, service models, and deployment models.
3. Explore data storage, cloud security, and risk management.
4. Study cloud platforms like AWS, Azure, and real-world applications.
5. Understand advanced cloud technologies and emerging trends (IoT, DevOps, containers).

Course Outcomes:

CO	After the completion of the course the student should be able to
CO1	Understand and explain cloud computing fundamentals, virtualization, and service models.
CO2	Analyze and design cloud architecture and deployment models with scalability and fault tolerance.
CO3	Apply concepts of cloud storage, data management, and security mechanisms.
CO4	Use cloud platforms (AWS, Azure) and implement real-world cloud-based applications.
CO5	Explore and apply advanced cloud technologies such as containers, DevOps, and IoT integration.

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	2	-	-	-	-	-	-	2
CO2	3	3	3	2	3	-	2	-	-	-	-	-
CO3	2	3	2	2	3	2	2	2	-	-	-	-
CO4	2	2	3	-	3	-	-	-	2	2	2	2
CO5	2	2	2	-	3	-	2	-	2	-	2	3

Assessment Scheme:
Two components of Continuous Assessment (CA-1, CA-2), Mid Semester Examination (MSE) and End Semester Examination (ESE) having 20%, 30% and 50% weightage respectively.

Assessment Component	Marks
CA1	15
MSE	20
CA2	15
ESE	50

CA1 and **CA2** are based on Surprise test/ Assignment/ Quiz/Seminar/Group discussions presentation, etc.

MSE is based on 50% of course content.
ESE is based on 100% course content with 60-70% weightage for course content covered after MSE.

Course Contents

Unit No.	Unit Title and Contents	Hours
1	**Introduction to Cloud** Cloud Computing at a Glance, the Vision of Cloud Computing, Defining a Cloud, A Closer Look, Cloud Computing Reference Model, Characteristics and Benefits, Challenges Ahead, Historical Developments. Virtualization: Introduction, Characteristics of Virtualized Environment, Taxonomy of Virtualization Techniques, Virtualization and Cloud computing, Pros and Cons of Virtualization, Technology Examples- VMware and Microsoft Hyper-V. Before the Move into the Cloud: Know Your Software Licenses, The Shift to a Cloud Cost Model, Service Levels for Cloud Applications.	7
2	**Cloud Computing Architecture** Introduction, Cloud Reference Model, Architecture, Infrastructure / Hardware as a Service, Platform as a Service, Software as a Service,	

	Types of Clouds, Public Clouds, Private Clouds, Hybrid Clouds, Community Clouds, Economics of the Cloud, Open Challenges, Cloud Interoperability and Standards, Scalability and Fault Tolerance. Ready for the Cloud: Web Application Design, Machine Image Design, Privacy Design, Database Management, Data Security, Network Security, Host Security, Compromise Response.	7
3	**Data Storage and Security** Data Storage: Introduction to Enterprise Data Storage, Direct Attached Storage, Storage Area Network, Network Attached Storage, Data Storage Management, File System, Cloud Data Stores, Using Grids for Data Storage. Cloud Storage: Data Management, Provisioning Cloud storage, Data Intensive Technologies for Cloud Computing. Cloud Storage from LANs to WANs: Cloud Characteristics, Distributed Data Storage. Risks in Cloud Computing, Data Security in Cloud, Cloud Security Services:	7
4	**Cloud Platforms and Cloud Applications** Amazon Web Services (AWS): Amazon Web Services and Components, Amazon Simple DB, Elastic Cloud Computing (EC2), Amazon Storage System, Amazon Database services (Dynamo DB). Microsoft Cloud Services: Azure core concepts, SQL Azure, Windows Azure Platform Appliance. Cloud Computing Applications: Healthcare: ECG Analysis in the Cloud, Biology: Protein Structure Prediction, Geosciences: Satellite Image Processing, Business and Consumer Applications: CRM and ERP, Social Networking, Google Cloud Application: Google App Engine. Overview of OpenStack architecture.	7
5	**Advanced Techniques in Cloud Computing** Future Tends in cloud Computing, Mobile Cloud, Automatic Cloud Computing: Comet Cloud. Multimedia Cloud: IPTV, Energy Aware Cloud Computing, Jungle Computing, Distributed Cloud Computing Vs Edge Computing, Containers, Docker, and Kubernetes, Introduction to DevOps. IOT and Cloud Convergence: The Cloud and IoT in your Home, The IOT and cloud in your Automobile, PERSONAL: IoT in Healthcare.	7

Text Books

Sr. No.	Title	Author	Publisher
1	Cloud Computing: Principles and Paradigms	Rajkumar Buyya, James Broberg, Andrzej M. Goscinski,	Wiley, 2011.
2	Cloud Computing: A Practical Approach for Learning and Implementation	A. Srinivasan,J. Suresh	Pearson

Reference Books			
Sr. No.	**Title**	**Author**	**Publisher**
1	Cloud Computing Bible	Barrie Sosinsky	Wiley-India, 2010
2	Cloud Security: A Comprehensive Guide to Secure Cloud Computing	Ronald L. Krutz, Russell Dean Vines	Wiley-India, 2010.
3	Cloud Security: A Comprehensive Guide to Secure Cloud Computing	Ronald L. Krutz, Russell Dean Vines	Wiley-India, 2010
4	Fundamentals of Database System	Navathe	Addison-Wesley Publication, 6th edition, 2012
5	Fundamentals of Database Management System	Mark L. Gillenson	Wiley Publication,2nd edition,2011

Title of the Course: Program Elective II- A) Big Data Processing and Analytics Course Code: 25MCA2304	L	T	P	Credit
	3	-	-	3

Course Prerequisite:
Students should have basic knowledge of programming (Java / Python),data structures and algorithms, Database Management Systems (DBMS),computer networks basics

Course Description:
This course introduces the concepts and technologies of Big Data, including its characteristics, challenges, and applications. It covers platforms such as Hadoop, Spark, and streaming systems like Kafka. Students will explore big data processing, machine learning techniques, and modern databases like MongoDB. The course also focuses on real-time data processing and scalable data solutions. It prepares students to analyze and manage large-scale data efficiently.

Course Objectives:
By the end of this course, the students will be able to:

1. To understand the fundamentals of Big Data, its characteristics, challenges, and enabling technologies used in modern data-driven environments.
2. To explore Big Data platforms and frameworks such as Hadoop, Spark, HDFS, and NoSQL databases for efficient data storage and processing.
3. To learn real-time data processing and streaming techniques using tools like Spark Streaming and Kafka.
4. To apply Big Data analytics and machine learning techniques using frameworks like Mahout and Spark MLlib for solving real-world problems.
5. To understand modern database systems such as MongoDB and their role in handling large-scale, unstructured data in web applications.

Course Outcomes:

CO	After the completion of the course the student should be able to
CO1	Understand fundamental concepts of Big Data, its characteristics, challenges, and Technologies.
CO2	Analyze and use Big Data platforms such as Hadoop, Spark, and NoSQL databases
CO3	Apply streaming technologies and real-time data processing systems.
CO4	Implement machine learning and graph processing techniques on Big Data platforms.
CO5	Use modern databases (MongoDB) for designing and querying large-scale web Applications.

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	2	-	-	-	-	-	-	2
CO2	3	3	2	2	3	-	-	-	-	-	-	
CO3	2	3	2	2	3	-	-	-	-	-	-	2
CO4	3	3	3	3	3	-	-	-	-	-	-	2
CO5	2	2	3		3	-	-	-	2	2	2	2

Assessment Scheme:
Two components of Continuous Assessment (CA-1, CA-2), Mid Semester Examination (MSE) and End Semester Examination (ESE) having 30%, 20% and 50% weightage respectively.

Assessment Component	Marks
CA1	15
MSE	20
CA2	15
ESE	50

CA1 and **CA2** are based on Surprise test/ Assignment/ Quiz/Seminar/Group discussions presentation, etc.

MSE is based on 50% of course content.
ESE is based on 100% course content with 60-70% weightage for course content covered after MSE.

Course Contents

Unit No.	Unit Title and Contents	Hours
1	**Introduction to Big Data** Why Big Data and Where did it come from?, Characteristics of Big, Challenges and applications of Big Data,Enabling Technologies for Big Data, Big Data Stack, Big Data distribution packages	7
2	**Big Data Platforms** Overview of Apache Spark, HDFS, YARN, MapReduce, MapReduce Programming Model with Spark, MapReduce Example: Word Count, Page Rank etc, CAP Theorem, Eventual Consistency, Consistency TradeO-s, ACID and BASE, Zookeeper and Paxos, Cassandra, Cassandra Internals, HBase, HBase Internals.	7
3	**Big Data Streaming Platforms** Big Data Streaming Platforms for Fast Data, Streaming Systems, Big Data Pipelines for RealTime computing, Spark Streaming, Kafka, Streaming Ecosystem.	7

4	**Big Data Applications** Overview of Big Data Machine Learning, Mahout, Big Data Machine learning Algorithms in Mahoutkmeans, Naive Bayes etc. Machine learning with Spark, Machine Learning Algorithms in Spark, SparkMLlib, Deep Learning for Big Data, Graph Processing: Pregel, Giraph, Spark GraphX.	7
5	**Database for the Modern Web** Introduction to mongoDB key features, Core server tools, MongoDB through the JavaScript_sshell, Creating and querying through Indexes, Document-oriented, principles of schema design, Constructing queries ondatabases, collections and documents, MongoDB query language.	7

Text Books

Sr. No.	Title	Author	Publisher
1	Analytics in a Big Data World: The Essential Guide to Data Science and its Applications	Bart Baesens	Wiley and SAS Business Series

Reference Books

Sr. No.	Title	Author	Publisher
1	Big Data Principals and Paradiagram	RajkumarBuyya, Rodrigo N. Calheiros, Amir M VahidDastjerdi, Morgan Kaufmann	Elsevier
2	MongoDB in Action	Kyle Banker, Peter Bakkum and Shaun Verch	2nd Edition Dreamtech Press
3	BIG Data and Analytics	Sima Acharya, Subhashini Chhellappan,	Willey publication.

Title of the Course: Program Elective II-(B) Distributed Computing Systems Course Code: 25MCA2304	L	T	P	Credit
	3	-	-	3

Course Prerequisite:

Students should have basic knowledge of operating systems concepts,computer networks, programming (C / Java / Python),basic understanding of data structures.

Course Description:

This course introduces the fundamental concepts and design issues of distributed systems, including system models, communication mechanisms, and synchronization. It covers key topics such as inter-process communication, Remote Procedure Calls (RPC), and Distributed Shared Memory (DSM). Students will learn about scheduling, load balancing, and distributed file systems. The course also emphasizes fault tolerance, security, and performance in distributed environments. It prepares students to design and analyze scalable distributed applications.

Course Objectives:

By the end of this course, students will be able to:

1. To understand the basic concepts of distributed systems and how they work.
2. To learn how different systems communicate with each other using message passing.
3. To understand how remote services (RPC) work in distributed environments.
4. To study how data and memory are shared and managed across systems.
5. To learn how tasks are managed, balanced, and handled in distributed systems with fault tolerance.

Course Outcomes:

CO	After the completion of the course the student should be able to
CO1	Understand fundamental concepts, models, and design issues of distributed systems.
CO2	Apply inter-process communication and synchronization techniques in distributed environments.
CO3	Analyze and implement Remote Procedure Call (RPC) mechanisms and communication protocols.
CO4	Understand and apply Distributed Shared Memory (DSM), clock synchronization, and mutual exclusion.
CO5	Design and evaluate distributed scheduling, load balancing, and distributed file systems.

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	2	-	-	-	-	-	-	2
CO2	3	3	2	2	3	-	-	-	-	-	-	-
CO3	2	3	2	2	3	-	-	-	-	-	-	-
CO4	3	3	2	3	2	-	-	-	-	-	-	2
CO5	2	3	3	2	3	-	-	-	2	2	2	2

Assessment Scheme:
Two components of Continuous Assessment (CA-1, CA-2), Mid Semester Examination (MSE) and End Semester Examination (ESE) having 30%, 20% and 50% weightage respectively.

Assessment Component	Marks
CA1	15
MSE	20
CA2	15
ESE	50

CA1 and **CA2** are based on Surprise test/ Assignment/ Quiz/Seminar/Group discussions presentation, etc.

MSE is based on 50% of course content.
ESE is based on 100% course content with 60-70% weightage for course content covered after MSE.

Course Contents

Unit No.	Unit Title and Contents	Hours
1	**Introduction to Distributed Systems** Evolution of Distributed Computing Systems, System models, issues in design of Distributed Computing environment, web based distributed model, computer networks related to distributed systems and web based protocols.	7
2	**Inter-Process Communication** Inter process Communication, Desirable Features of Good Message-Passing Systems, Issues in IPC by Message, Synchronization, Buffering, Multidatagram Messages, Encoding and Decoding of Message Data, Process Addressing, Failure Handling, Group Communication	7

3	**Remote Procedure Calls** The RPC Model, Transparency of RPC, Implementing RPC Mechanism, Stub Generation, RPC Messages, Marshaling Arguments and Results, Server Management, Communication Protocols for RPCs, Complicated RPCs, Complicated RPCs, ClientServer Binding, Exception Handling, Security, Some Special Types of RPCs, Lightweight RPC, Optimization for Better Performance	7
4	**Distributed Memory & Synchronization** Design and Implementation Issues of DSM, Granularity, Structure of shared memory space, Consistency Models, replacement Strategy, Thrashing, Other Approaches to DSM, Advantages of DSM , Clock Synchronization, Event Ordering, Mutual Exclusion, Election Algorithms.	7
5	**Distributed System Management** Desirable Features of a good global scheduling algorithm, Task assignment approach, Load Balancing approach, Load sharing approach, Process Migration, Desirable Features of a good Distributed File Systems, File Models, File-Accessing Models, File-sharing Semantics, File caching schemes, File Replication, Fault Tolerance.	7

Text Books

Sr. No.	Title	Author	Publisher
1	Distributed Operating Systems	Andrew S. Tanenbaum, Prentice Hall	Prentice Hall,1995
2	Distributed Systems: Concepts and Design	George Coulouris, Jean Dollimore, Tim Kindberg	Pearson

Reference Books

Sr. No.	Title	Author	Publisher
1	Distributed OS	Pradeep K. Sinha	PHI Learning,2008

Title of the Course: Program Elective II (C) Software Testing and Tools Course Code: 25MCA2304	L	T	P	Credit
	3	-	-	3

Course Prerequisite:
Students should have basic knowledge of software engineering concepts, programming (Java / C / Python),basic understanding of SDLC models, fundamentals of data structures

Course Description:
This course introduces the principles and practices of software testing and quality assurance. It covers testing techniques such as black-box, white-box, and gray-box testing along with test planning and management. Students will learn static and dynamic testing methods, test metrics, and debugging strategies. The course also explores test automation, tools, and object-oriented testing concepts. It prepares students to ensure software reliability, quality, and performance.

Course Objectives:
By the end of this course, the students will be able to:

1. To understand the fundamentals of software testing, including testing principles, test processes, and the role of testing in ensuring software quality.
2. To study various software development and testing models, and understand the impact of methodologies like Agile on testing practices.
3. To apply different testing techniques such as black-box, white-box, and gray-box testing for effective defect detection.
4. To learn test management practices, including test planning, test strategies, risk management, and test process monitoring.
5. To explore test automation concepts and tools, and understand their role in improving efficiency and effectiveness of software testing.

Course Outcomes:

CO	After the completion of the course the student should be able to
CO1	Understand fundamentals of software testing, quality assurance, and testing principles.
CO2	Analyze and apply testing levels, software development models, and static testing techniques.
CO3	Apply dynamic testing techniques including black-box, white-box, and gray-box testing.
CO4	Plan and manage testing processes, strategies, and specialized testing methods.
CO5	Use test automation tools and object-oriented testing concepts for improving software quality.

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	2	-	-	2	-	-	-	2
CO2	3	3	2	2	2	-	-	-	-	-	-	-
CO3	2	3	2	3	3	-	-	-	-	-	-	-
CO4	2	2	3	-	2	2	-	2	2	2	3	-
CO5	2	2	2	-	3	-	-	-	2	2	2	2

Assessment Scheme:
Two components of Continuous Assessment (CA-1, CA-2), Mid Semester Examination (MSE) and End Semester Examination (ESE) having 30%, 20% and 50% weightage respectively.

Assessment Component	Marks
CA1	15
MSE	20
CA2	15
ESE	50

CA1 and **CA2** are based on Surprise test/ Assignment/ Quiz/Seminar/Group discussions presentation, etc.

MSE is based on 50% of course content.
ESE is based on 100% course content with 60-70% weightage for course content covered after MSE.

Course Contents

Unit No.	Unit Title and Contents	Hours
1	**Fundamentals of Software Testing** Human and errors, Testing and Debugging, Software Quality, Requirement Behavior and Correctness, Fundamentals of Test Process, Psychology of Testing, General Principles of Testing, Test Metrics.	7
2	**Testing Models and Static Testing** Review of software development models (Waterfall Models, Spiral Model, W Model, V Model) Agile Methodology and Its Impact on testing, Test Levels (Unit, Component, Module, Integration, System, Acceptance, Generic)Static Testing Structured Group Examinations Static Analysis Control flow & Data flow, Determining Metrics	7

3	**Testing Techniques (Black Box & White Box)** Dynamic Testing Black Box Testing Equivalence Class Partitioning, Boundary Value Analysis, State Transition Test, Cause Effect Graphing and Decision Table Technique and Used Case Testing and Advanced black box techniques White Box Testing Statement Coverage, Branch Coverage, Test of Conditions, Path Coverage, Advanced White Box Techniques, Instrumentation and Tool Support Gray Box Testing, Intuitive and Experience Based Testing	7
4	**Test Management and Specialized Testing** Test Organization Test teams, tasks and Qualifications Test Planning Quality Assurance Plan, Test Plan, Prioritization Plan, Test Exit Criteria Cost and economy Aspects Test Strategies Preventive versus Reactive Approach, Analytical versus heuristic Approach Test Activity Management, Incident Management, Configuration Management Test Progress Monitoring and Control Specialized Testing: Performance, Load, Stress & Security Testing.	7
5	**Test Automation and Tools** Automation of Test Execution, Requirement tracker, High Level Review Types of test Tools for test management and Control, Test Specification, Static Testing, Dynamic Testing, Nonfunctional testing Selection and Introduction of Test Tools Tool Selection and Introduction, Cost Effectiveness of Tool . Introduction to OO testing concepts, Differences in OO testing	7

Text Books

Sr. No.	Title	Author	Publisher
1	Software Testing Principles and Practices	Srinivasan Desikan , Gopalaswamy Ramesh	Pearson Education

Reference Books

Sr. No.	Title	Author	Publisher
1	Software Testing Foundations	Andreas Spillner, Tilo Linz, Hans Schaefer	Shoff Publishers and Distributors
2	Software Testing: Principles and Practices	Srinivasan D and Gopalswamy R	PearsonEd, 2006
3	Foundations of Software Testing	Aditya P. Mathur	Pearson Education custom edition 2000
4	Testing Object Oriented Systems: models, patterns and tools	Robert V Binder, Addison Wesley	1996

Title of the Course: Program Elective II (D) Generative AI & Prompt Engineering Course Code: 25MCA2304	L	T	P	Credit
	3	-	-	3

Course Prerequisite:

Basic knowledge of programming (preferably Python), fundamental understanding of Artificial Intelligence and Machine Learning concepts, and familiarity with basic mathematics (linear algebra and probability).

Course Description:

This course provides a comprehensive introduction to Generative Artificial Intelligence (GenAI) and the emerging field of Prompt Engineering. It begins with the foundational concepts of Artificial Intelligence, Machine Learning, and Deep Learning, followed by an in-depth exploration of generative models such as GANs, VAEs, Transformers, and Large Language Models (LLMs) like GPT and BERT.

Course Objectives

By the end of this course, the students will be able to:

1. To introduce the fundamental concepts of Artificial Intelligence, Machine Learning, Deep Learning, and Generative AI.
2. To understand the architecture and working of generative models such as GANs, VAEs, Transformers, and Large Language Models (LLMs).
3. To develop skills in designing effective prompts using appropriate structure, clarity, and constraints.
4. To apply various prompt engineering techniques such as zero-shot, few-shot, and Chain-of-Thought for improving AI outputs.
5. To explore real-world applications of generative AI in text, image, audio, and code generation.

Course Outcomes:

CO	After the completion of the course the student should be able to
CO1	Understand AI, ML, DL, and Generative AI basics.
CO2	Learn generative models and LLMs
CO3	Design effective prompts
CO4	Apply advanced prompting techniques
CO5	Build real-world GenAI applications

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	-	-	-	-	-	-	-	-	-	2
CO2	3	2	1		1	-	-	-	-	-	-	2
CO3	3	3	2		2	-	-	-	-	1	-	2
CO4	2	3	2	1	2	-	-	-	1	1	-	2
CO5	2	2	3	2	3	1	-	-	1	1	1	2

Assessment Scheme:

Two components of Continuous Assessment (CA-1, CA-2), Mid Semester Examination (MSE) and End Semester Examination (ESE) having 30%, 20% and 50% weightage respectively.

Assessment Component	Marks
CA1	15
MSE	20
CA2	15
ESE	50

CA1 and **CA2** are based on Surprise test/ Assignment/ Quiz/Seminar/Group discussions presentation, etc.

MSE is based on 50% of course content.

ESE is based on 100% course content with 60-70% weightage for course content covered after MSE.

Course Contents

Unit No.	Unit Title and Contents	Hours
1	**Introduction to Generative AI** Basics of Artificial Intelligence, Machine Learning, Deep Learning Concept of Generative AI and its evolution Types of generative models: GANs, VAEs, Transformers Large Language Models (LLMs) – GPT, BERT Applications: text, image, code, audio generation Limitations and challenges of generative models	7
2	**Fundamentals of Prompt Engineering** Definition and importance of prompt engineering Structure of prompts: instruction, context, input-output format Prompt components and design principles Understanding model behavior and tokenization Prompt clarity, specificity, and constraints Common mistakes in prompt design	7

3	**Prompt Engineering Techniques** Zero-shot, One-shot, Few-shot prompting Chain-of-Thought (CoT) and Tree-of-Thought (ToT) Role-based prompting and instruction tuning Prompt templates and reusable patterns Iterative prompt refinement and testing Evaluation metrics for prompt effectiveness	7
4	**Applications of Generative AI & Prompting** Text generation (chatbots, summarization, translation) Code generation and automation Image/video/audio generation tools Domain-specific applications (education, healthcare, business) Integration with tools: APIs, LangChain, Hugging Face Building simple GenAI applications	7
5	**Ethics & Security** Fine-tuning and prompt optimization Retrieval-Augmented Generation (RAG) Prompt injection and adversarial attacks AI ethics: bias, fairness, accountability Responsible AI and governance	7

Text Books			
Sr. No.	**Title**	**Author**	**Publisher**
1	Generative Deep Learning	David Foster	O'Reilly Media

Reference Books			
Sr. No.	**Title**	**Author**	**Publisher**
1	Prompt Engineering for Generative AI	James Phoenix	O'Reilly Media
2	Deep Learning	Ian Goodfellow, Yoshua Bengio, Aaron Courville	MIT Press
3	NLP with Transformers	Tunstall et al	O'Reilly

Title of the Course: Program Elective III-(A) Cryptography and Network Security Course Code: 25MCA2305	L	T	P	Credit
	3	-	-	3

Course Prerequisite:
Students should have basic knowledge of Mathematics (number theory, probability), fundamentals of computer networks, basic understanding of data structures, operating systems concepts.

Course Description:
This course provides a comprehensive understanding of cryptographic techniques and network security principles used to secure information systems. It covers classical and modern cryptosystems, symmetric and asymmetric encryption algorithms, hash functions, digital signatures, and key exchange mechanisms. The course also introduces network security protocols such as SSL, Kerberos, and PGP, along with concepts like firewalls, intrusions, and malware. Emphasis is given to both theoretical foundations and practical applications in securing communication systems.

Course Objectives:
By the end of this course, students will be able to:

1. To understand the mathematical foundations of cryptography
2. To learn symmetric and asymmetric encryption techniques
3. To study hash functions, MACs, and digital signatures
4. To analyze cryptographic attacks and security mechanisms
5. To understand network security protocols and system protection techniques

Course Outcomes:

CO	After the completion of the course the student should be able to
CO1	Understand cryptographic principles, classical ciphers, and mathematical foundations
CO2	Apply symmetric key cryptographic techniques and analyze their security
CO3	Implement hash functions, MACs, and stream ciphers for data integrity
CO4	Analyze asymmetric cryptosystems and key exchange algorithms
CO5	Evaluate digital signatures and network security protocols for secure communication

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	2	-	-	-	-	1	1	2
CO2	3	3	3	3	3	-	-	-	1	2	2	2
CO3	3	3	3	3	3	1	-	-	1	2	2	2
CO4	3	3	3	3	3	2	-	-	2	2	2	3
CO5	3	3	3	3	3	2	1	1	2	3	3	3

Assessment Scheme:
Two components of Continuous Assessment (CA-1, CA-2), Mid Semester Examination (MSE) and End Semester Examination (ESE) having 30%, 20% and 50% weightage respectively.

Assessment Component	Marks
CA1	15
MSE	20
CA2	15
ESE	50

CA1 and **CA2** are based on Surprise test/ Assignment/ Quiz/Seminar/Group discussions presentation, etc.

MSE is based on 50% of course content.
ESE is based on 100% course content with 60-70% weightage for course content covered after MSE.

Course Contents

Unit No.	Unit Title and Contents	Hours
1	**Introduction to Cryptography & Mathematical Foundations** Introduction to Cryptography & Mathematical Foundations Introduction, Overview on Modern Cryptography, Number Theory, Probability and Information Theory. Classical Cryptosystems: Classical Cryptosystems, Crypt-analysis of Classical Cryptosystems, Shannon_s Theory.	7
2	**Symmetric Key Ciphers** Symmetric Key Ciphers, Modern Block Ciphers (DES), Modern Block Cipher (AES).Crypt-analysis of Symmetric Key Ciphers: Linear Crypt-analysis, Differential Crypt-analysis, other Crypt-analytic Techniques, Overview on S-Box Design Principles, Modes of operation of Block Ciphers	7

3	**Stream Ciphers and Pseudo-randomness** Stream Ciphers, Pseudo-random functions. Hash Functions and MACs: Hash functions: The MerkleDamgard Construction, Message Authentication Codes (MACs).	7
4	**Asymmetric Key Ciphers** Construction and Crypt-analysis: More Number Theoretic Results, The RSA Cryptosystem, Primality Testing, Factoring Algorithms, Other attacks on RSA and Semantic Security of RSA, The Discrete Logarithm Problem (DLP) and the Diffie-Hellman Key Exchange algorithm, The ElGamal Encryption Algorithm, Crypt-analysis of DLP.	7
5	**Digital Signatures** Signature schemes: I, Signature schemes: II. Modern Trends in Asymmetric Key Cryptography: Elliptic curve based cryptography: I, Elliptic curve based cryptography: II. Network Security: Secret Sharing Schemes, A Tutorial on Network Protocols, Kerberos, Pretty Good Privacy (PGP), Secure Socket Layer (SSL), Intruders and Viruses, Firewalls.	7

Text Books

Sr. No.	Title	Author	Publisher
1	Cryptography Theory and Practice	Douglas Stinson	2nd Edition, Chapman & Hall/CRC.

Reference Books

Sr. No.	Title	Author	Publisher
1	Cryptography & Network Security	B. A. Forouzan	McGraw- Hill Publication
2	Modern Cryptography, Theory & Practice	Wenbo Mao	Pearson Education.
3	Computer Security and Cryptography	Alang.Konheim	Wiley Publication.

Title of the Course: Program Elective III-(B) Block Chain Technology Course Code: 25MCA2305	L	T	P	Credit
	3	-	-	3

Course Prerequisite:

Student should have basic understanding of Computer Networks and Internet concepts, fundamentals of, Cryptography (hashing, encryption, digital signatures), basic knowledge of data structures, understanding of database systems, basic programming knowledge (Python / Java)

Course Description:

This course introduces the fundamentals of blockchain technology and its applications in modern systems. It covers core concepts such as cryptography, hashing, mining, and distributed ledgers. Students will learn about cryptocurrencies like Bitcoin and Ethereum, along with smart contracts and real-world use cases. The course also explores blockchain architecture, security, and regulatory aspects. It prepares students to understand and develop blockchain-based solutions.

Course Objectives:

By the end of this course, the students will be able to:

1. Understand the basic concepts and working of blockchain technology
2. Learn about blockchain architecture, cryptocurrencies, and applications
3. Analyze concepts like hashing, mining, and double spending prevention
4. Explore Bitcoin and Ethereum platforms and their functionalities
5. Understand smart contracts, legal issues, and real-world use cases

Course Outcomes:

CO	After the completion of the course the student should be able to
CO1	Understand and explain fundamental concepts of blockchain, cryptography, and distributed systems.
CO2	Analyze blockchain architecture, types, and applications including cryptocurrencies.
CO3	Apply concepts such as hashing, mining, proof of work, and transaction verification.
CO4	Understand and use Bitcoin concepts, wallets, and transaction mechanisms.
CO5	Explore Ethereum, smart contracts, and legal/regulatory aspects of blockchain technology.

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	2	-	-	-	-	2	-	2
CO2	3	3	3	2	3	2	2	-	2	2	2	-
CO3	3	3	3	3	3	2	2	2	2	-	2	-
CO4	2	3	3	2	3	2	-	-	2	-	2	2
CO5	2	3	3	3	3	2	2	2	2	2	3	3

Assessment Scheme:
Two components of Continuous Assessment (CA-1, CA-2), Mid Semester Examination (MSE) and End Semester Examination (ESE) having 30%, 20% and 50% weightage respectively.

Assessment Component	Marks
CA1	15
MSE	20
CA2	15
ESE	50

CA1 and **CA2** are based on Surprise test/ Assignment/ Quiz/Seminar/Group discussions presentation, etc.

MSE is based on 50% of course content.
ESE is based on 100% course content with 60-70% weightage for course content covered after MSE.

Course Contents

Unit No.	Unit Title and Contents	Hours
1	**Introduction** Introduction to Blockchain, How Blockchain works, Blockchain vs Bitcoin, Practical applications, public and private key basics, pros and cons of Blockchain, Myths about Bitcoin.	7
2	**Blockchain** Architecture, versions, variants , use cases, Life use cases of blockchain, Blockchain vs. shared Database, Introduction to cryptocurrencies, Types, Applications.	7
3	**Concept of Double Spending** Concept of Double Spending, Hashing, Mining, Proof of work. Introduction to Merkel tree, Privacy, payment verification, Resolving Conflicts, Creation of Blocks.	7

4	**Introduction to Bitcoin** Introduction to Bitcoin, key concepts of Bitcoin, Merits and De Merits Fork and Segwits, Sending and Receiving bitcoins, choosing bitcoin wallet, Converting Bitcoins to Fiat Currency.	7
5	**Introduction to Ethereum** Introduction to Ethereum, Advantages and Disadvantages, Ethereum vs. Bitcoin, Introduction to Smart contracts, usage, application, working principle, Law and Regulations. Case Study.	7

Text Books

Sr. No.	Title	Author	Publisher
1	Beginning Blockchain: A Beginner's Guide to Building Blockchain Solutions	Arshdeep Bikramaditya, Gautam Dhameja	PriyansuSekhar Panda., APress
2	Blockchain Applications	Bahga, Vijay Madisetti	
3	Blockchain	Melanie Swan	OReilly

Reference Books

Sr. No.	Title	Author	Publisher
1	Bitcoin and Cryptocurrency Technologies	by Aravind Narayan Joseph Bonneau,	T Books.
2	Bitcoin and Blockchain Basics: A non-technical introduction for beginners	Arthu.	T Books.
3	Java Server Programming Java EE 7 (J2EE 1.7) -Black Book	Kogent, Dreamtech Press Senn, LA.,	Laxmi Publication,2nd edition 2009.

Title of the Course: Program Elective III-(C) Mobile Application Development Course Code: 25MCA2305	L	T	P	Credit
	3	-	-	3

Course Prerequisite:

Students should have basic knowledge of programming concepts (Java or Kotlin preferred), understanding of object-oriented programming (OOP)**,** and familiarity with database concepts (SQL/SQLite)**.** Basic knowledge of web technologies (HTML, CSS) and general understanding of computer fundamentals will be helpful.

Course Description:

This course introduces students to the fundamentals of developing mobile applications using the Android platform. It covers the Android architecture, development environment setup, and the structure of Android applications. Students learn essential components such as activities, services, intents, and permissions, along with user interface design using layouts and animations. The course also focuses on application testing, resource management, and deployment processes. Additionally, it provides hands-on experience with Android APIs for data storage, networking, web services, and device features such as telephony. By the end of the course, students will be able to design, develop, and deploy functional Android applications for real-world use.

Course Objectives:

By the end of this course, the students will be able to:

1. Understand the Android platform, architecture, and application components
2. Learn to design and develop Android applications using activities, services, and intents
3. Develop user interfaces and animations for mobile applications
4. Test, manage, and deploy Android applications effectively
5. Use Android APIs for data storage, networking, and communication

Course Outcomes:

CO	After the completion of the course the student should be able to
CO1	Understand and explain Android architecture, SDK, and application structure.
CO2	Design and develop Android applications using core components like activities, services, and intents.
CO3	Create interactive user interfaces and animations for mobile applications
CO4	Test, manage resources, and deploy Android applications
CO5	Apply Android APIs for data storage, networking, and communication in real-world applications.

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	-	2	-	-	-	-	-	-	2
CO2	3	3	3	1	3	-	-	-	2	1	-	-
CO3	2	2	3		3	-	-	-	2	2	1	-
CO4	2	3	2	3	3	-	-	1	2	2	2	2
CO5	3	3	3	2	3	1	-	1	2	2	2	2

Assessment Scheme:
Two components of Continuous Assessment (CA-1, CA-2), Mid Semester Examination (MSE) and End Semester Examination (ESE) having 30%, 20% and 50% weightage respectively.

Assessment Component	Marks
CA1	15
MSE	20
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ESE	50

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ESE is based on 100% course content with 60-70% weightage for course content covered after MSE.

Course Contents

Unit No.	Unit Title and Contents	Hours
1	**Introduction to Android** The Android Platform, Android SDK, Eclipse Installation, Android Installation, Building you First Android application, Understanding Anatomy of Android Application, Android Manifest file	7
2	**Android Application Design Essentials** Anatomy of an Android applications, Android terminologies, Application Context, Activities, Services, Intents, Receiving and Broadcasting Intents, Android Manifest File and its common settings, Using Intent Filter, Permissions.	7

3	**Android User Interface Design Essentials** User Interface Screen elements, Designing User Interfaces with Layouts, Drawing and Working with Animation.	7
4	**Testing Android applications** Publishing Android application, Using Android preferences, Managing Application resources in a hierarchy, working with different types of resources.	7
5	**Using Common Android APIs** Using Android Data and Storage APIs, Managing data using Sqlite, Sharing Data between Applications with Content Providers, Using Android Networking APIs, Using Android Web APIs, Using Android Telephony APIs, Deploying Android Application to the World	7

Text Books

Sr. No.	Title	Author	Publisher
1	Android Wireless Application Development‖	T1. Lauren Darcey and Shane Conder	Pearson Education, 2nd ed. (2011)

Reference Books

Sr. No.	Title	Author	Publisher
1	Professional Android 2 Application Development	R1. Reto Meier	Wiley India Pvt Ltd
2	Beginning Android	Mark L Murphy	Wiley India Pvt Ltd
3	Android Application Development All in one for Dummies	Barry Burd	Edition: I Dr. Babasaheb Ambedkar Technological

Title of the Course: Program Elective III-(D) Cyber Security & Ethical Hacking Course Code: 25MCA2305	L	T	P	Credit
	3	-	-	3

Course Prerequisite:

Basic knowledge of computers, networking concepts, operating systems, and fundamental programming skills.

Course Description:

This course provides a comprehensive introduction to Cyber Security and Ethical Hacking, focusing on protecting computer systems, networks, and data from cyber threats. It begins with the fundamentals of cyber security, information security principles, and the CIA triad—confidentiality, integrity, and availability—along with an overview of different types of hackers and ethical considerations in hacking practices.

Course Objective

By the end of this course, the students will be able to:

1. To introduce the fundamental concepts of Cyber Security and Information Security, including the CIA triad and types of hackers.
2. To understand networking and system fundamentals such as computer networks, IP addressing, protocols, and operating systems (Windows/Linux).
3. To learn the phases of ethical hacking, including footprinting, scanning, and enumeration techniques for information gathering and vulnerability identification.
4. To analyze various system hacking techniques and common security attacks such as password cracking, malware, DoS/DDoS, and social engineering.
5. To understand web application security, cryptography basics, and wireless network security concepts.

Course Outcomes:

CO	After the completion of the course the student should be able to
CO1	Understand the fundamental concepts of cyber security, information security, CIA triad, and types of hackers.
CO2	Explain networking and system fundamentals including computer networks, IP addressing, protocols, and operating systems.
CO3	Apply information gathering, footprinting, scanning, and enumeration techniques to identify system vulnerabilities.
CO4	Analyze various system hacking methods and security attacks such as password cracking, malware, DoS/DDoS, and social engineering.
CO5	Evaluate web application security risks, cryptography techniques, and wireless network security mechanisms.

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	-	1	-	2	-	-	-	2
CO2	3	2	1		2	-	-	-	-	-	-	2
CO3	2	3	2	2	3	-	-	-	-	1	-	2
CO4	2	3	2	2	2	1	-	1	1	1	-	2
CO5	2	2	3	3	2	2	1	2	1	1	-	2

Assessment Scheme:

Two components of Continuous Assessment (CA-1, CA-2), Mid Semester Examination (MSE) and End Semester Examination (ESE) having 30%, 20% and 50% weightage respectively.

Assessment Component	Marks
CA1	15
MSE	20
CA2	15
ESE	50

CA1 and **CA2** are based on Surprise test/ Assignment/ Quiz/Seminar/Group discussions presentation, etc.

MSE is based on 50% of course content.

ESE is based on 100% course content with 60-70% weightage for course content covered after MSE.

Course Contents

Unit No.	Unit Title and Contents	Hours
1	**Introduction to Cyber Security & Ethical Hacking** Basics of Cyber Security and Information Security CIA Triad (Confidentiality, Integrity, Availability) Types of Hackers (White, Black, Grey) Ethical vs Malicious Hacking Phases of Ethical Hacking Legal & Ethical Issues in Cyber Security, Overview of IT Act 2000 and Cyber Laws in India, Cyber Crimes and Penalties under IT Act 2000	7
2	**Networking & System Fundamentals** Basics of Computer Networks (LAN, WAN, OSI, TCP/IP) IP Addressing & Subnetting Network Devices & Protocols Operating Systems (Windows/Linux basics) Virtual Machines & Lab Setup	7

3	**Footprinting, Scanning & Enumeration** Information Gathering (Footprinting techniques) WHOIS, DNS, Google Dorking, OSINT Network Scanning (Nmap, tools) Enumeration techniques (users, services, ports) Vulnerability Identification	7
4	**System Hacking & Security Attacks** Password Cracking Techniques Malware (Virus, Worms, Trojans, Spyware) Sniffing & Session Hijacking Denial of Service (DoS/DDoS) Social Engineering Attacks Privilege Escalation	7
5	**Web Security, Cryptography & Countermeasures** Web Application Attacks (SQL Injection, XSS) Wireless Network Security Cryptography Basics (Encryption, Hashing) Firewalls, IDS/IPS Penetration Testing & Vulnerability Assessment Report Writing & Security Best Practices	7

Text Books			
Sr. No.	**Title**	**Author**	**Publisher**
1	Cyber Security and Cyber Laws	Nina Godbole, Sunit Belapure	Wiley India
2	Ethical Hacking and Penetration Testing Guide	Rafay Baloch	CRC Press

Reference Books			
Sr. No.	**Title**	**Author**	**Publisher**
1	Web Application Hacker's Handbook	Stuttard & Pinto	Wiley
2	Cryptography & Network Security	William Stallings	Pearson
3	Hacking: Art of Exploitation	Jon Erickson	No Starch Press

Title of the Course: Innovation, Business Models and Entrepreneurship laboratory Course Code: 25MCA2306	L	T	P	Credit
	-	-	2	2

Course Prerequisite:

Students should have basic understanding of business concepts and entrepreneurship**,** along with general knowledge of market trends and consumer behavior**.** Basic communication and presentation skills are required. Familiarity with basic computer tools (MS Word, Excel, PowerPoint) and simple data analysis will be helpful.

Course Description:

This course introduces the concepts of innovation, entrepreneurship, and business model design. It focuses on idea generation, startup development, and value creation. Students will learn tools like Business Model Canvas, design thinking, and market validation. The course is activity-based and encourages practical learning through case studies and projects. It prepares students to develop entrepreneurial mindset and startup skills.

Course Objectives:

By the end of this course, the students will be able to:

1. Understand fundamentals of innovation and entrepreneurship.
2. Learn to develop business ideas and startup models.
3. Apply tools like Business Model Canvas.
4. Analyze real-world startups and case studies.
5. Develop entrepreneurial and problem-solving skills.

Course Outcomes:

CO	After the completion of the course the student should be able to
CO1	Understand concepts of innovation and entrepreneurship**.**
CO2	Identify and analyze business opportunities and ideas**.**
CO3	Develop business models using structured tools**.**
CO4	Conduct market analysis and validate business ideas**.**
CO5	Present and pitch startup ideas effectively**.**

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	-	-	-	2	-	2	-	-	-	2
CO2	-	3	2	-	-	2	-	-	-	-	-	-
CO3	-	2	3	-	2	-	-	-	-	-	3	-
CO4	-	3	2	2		2	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	2	3	2	2

Assessment Scheme:

Two components of in Semester Evaluation (CA1 and CA2), having 50% weightage respectively.

Assessment Component	Marks
CA1	25
CA2	25
POE	--

CA1 and CA2 are based on practical performance.

Course Contents

Practical No.	List of Experiments	Hours
1	Identifying Innovation Select a real-life product/service, identify type of innovation (product/process/disruptive)	02
2	Problem Identification Identify a real-world problem (college/local area) ,write problem statement	02
3	Idea Generation Generate 3–5 startup ideas, select best idea with justification	02
4	Customer Segmentation Identify target customers for your idea, create customer profile (age, needs, behavior)	02
5	Value Proposition Design Define value your product/service provides ,write unique selling proposition (USP)	02
6	Business Model Canvas (BMC) Prepare full BMC including: Key partners ,Activities Revenue streams	02
7	Market Survey Conduct survey (10–20 people) **,** analyze responses (charts/summary)	02
8	Competitor Analysis Identify 2–3 competitors, compare features, price, strengths	02
9	Revenue Model & Costing Decide pricing strategy ,estimate cost and profit	02

10	Startup Pitch Presentation Prepare PPT (5–10 slides),present idea with: Problem Solution Market Revenue	02

Text Books			
Sr. No.	**Title**	**Author**	**Publisher**
1	Entrepreneurship Development	S. S. Khanka	S. Chand & Company Ltd.
2	Entrepreneurship Development and Small Business Enterprises	Poornima M. Charantimath	Pearson Education

Reference Books			
Sr. No.	**Title**	**Author**	**Publisher**
1	Business Model Generation	Alexander Osterwalder, Yves Pigneur	Wiley
2	The Lean Startup	Eric Ries	Crown Business
3	Value Proposition Design	Alexander Osterwalder, Yves Pigneur	Wiley

Title of the Course: Full Stack Development Laboratory Course Code: 25MCA2301L	L	T	P	Credit
	-	--	4	2

Course Prerequisite:
Students shuld have basic knowledge of HTML, CSS, JavaScript, programming fundamentals, and database concepts.

Course Description:
This lab course focuses on developing full-stack web applications using modern technologies like HTML, CSS, JavaScript, ReactJS, NodeJS, and databases. Students will gain hands-on experience in frontend and backend development, API integration, and deployment. The course also introduces server-side programming, authentication, and containerization using Docker. It enables students to build complete, scalable, and real-world web applications.

Course Objectives:
By the end of this course, the students will be able to:

1. To understand and apply frontend technologies like HTML, CSS, JavaScript, and ReactJS
2. To develop backend applications using NodeJS and Express
3. To implement database operations using MySQL/MongoDB
4. To design and develop full-stack web applications
5. To understand deployment and containerization using Docker

Course Outcomes:

CO	After the completion of the course the student should be able to
CO1	Design and develop interactive web pages using HTML, CSS, and JavaScript.
CO2	Implement server-side applications using NodeJS and Express.
CO3	Perform database operations and integrate backend with frontend.
CO4	Develop dynamic web applications using ReactJS and APIs.
CO5	Build and deploy full-stack applications with authentication and containerization.

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	P011	P012
CO1	2	2	3	-	3	-	-	-	2	2	-	1
CO2	3	3	3	-	3	-	-	-	2	1	-	-
CO3	3	3	3	2	3	-	-	-	2	-	1	-
CO4	2	2	3	-	3	-	-	-	2	2	-	1
CO5	3	3	3	2	3	1		1	2	2	2	2

Assessment Scheme:

Two components of Continuous Assessment (CA-1, CA-2), End Semester Practical Oral Examination (POE), have 25%, 25% and 50% weightage, respectively.

Assessment Component	Marks
CA1	25
CA2	25
POE	50

CA1 and CA2 are based on 50% practical assignment.

POE is based on 100% Experiments.

Course Contents

Practical No.	List of Experiments	Hours
1	Create a form and validate the contents of the form using JavaScript.	02
2	Get data using Fetch API from an open-source endpoint and display the contents in the form of cards.	02
3	Create a NodeJS server that serves static HTML and CSS files to the user without using Express.	02
4	Create a NodeJS server using Express that stores data from a form as a JSON file and displays it on another page using Handlebars.	02
5	Create a NodeJS server that performs CRUD operations (Create, Read, Update, Delete) on event details stored in a MySQL database.	02
6	Create a counter application using ReactJS.	02
7	Create a Todo application using ReactJS and store/retrieve data using a NodeJS server withJSON.	02
8	Create a signup and login system using NodeJS and Express with authentication using cookies and database (MongoDB/MySQL).	02
9	Create a Docker container to deploy a NodeJS ping server using a NodeJS image.	02

10	Develop a full-stack mini project combining frontend (ReactJS) and backend (NodeJS +Express) with database integration (MongoDB/MySQL), implementing features like: User authentication,Data storage & retrieval, API integration	02

Text Books			
Sr. No.	**Title**	**Author**	**Publisher**
1	Full Stack JavaScript Development With MEAN: MongoDB, Express, AngularJS, and Node.JS	Colin Ihrig	SitePoint 1st Edition,2015

Reference Books			
Sr. No.	**Title**	**Author**	**Publisher**
1	Learning PHP, MySQL, JavaScript, CSS & HTML5: A Step-by-Step Guide to Creating Dynamic Websites	Robin Nixon	O'Reilly Media 3rd edition, 2014
2	Web Development and Design Foundations with HTML5	Terry Felke-Morris	Pearson, 8th Edition, 2018
3	JavaScript and JQuery Interactive Front-End Web Development	Jon Duckett	Wiley, 1st Edition, 2014
4	Node.js Web Development	David Herron	Packt Publishing, 4th Edition, 2020

Title of the Course: Machine Learning Laboratory Course Code: 25MCA2302L	L	T	P	Credit
	-	-	2	1

Course Prerequisite:
Students should have basic knowledge of Python, statistics, linear algebra, and fundamentals of data analysis and machine learning.

Course Description:
This lab course provides hands-on experience in applying machine learning techniques using Python. Students will perform data preprocessing, exploratory data analysis, and visualization on real-world datasets. The course covers implementation of supervised and unsupervised learning algorithms such as regression, classification, and clustering. It also focuses on model evaluation and comparison. The lab enables students to build practical solutions for real-life data-driven problems.

Course Objectives:
By the end of this course, the students will be able to:

1. To understand and apply data preprocessing and visualization techniques.
2. To implement machine learning algorithms for classification and regression.
3. To perform clustering and pattern recognition.
4. To evaluate and compare different machine learning models.
5. To develop practical skills for solving real-world problems using ML.

Course Outcomes:

CO	After the completion of the course the student should be able to
CO1	Apply data preprocessing and exploratory data analysis techniques using Python.
CO2	Implement supervised learning algorithms such as regression and classification.
CO3	Apply unsupervised learning techniques like clustering for pattern discovery.
CO4	Evaluate and compare machine learning models using performance metrics.
CO5	Develop end-to-end machine learning solutions for real-world problems.

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2		2	3	-	-	-	-	-	-	2
CO2	3	3	2	2	3	-	-	-	-	-	-	
CO3	2	3	2	2	3	-	-	-	-	-	-	2
CO4	2	3	2	3	3	-	-	-	-	-	-	2
CO5	3	3	3	2	3	1		1	2	2	2	2

Assessment Scheme:

Two components of Continuous Assessment (CA-1, CA-2), End Semester Practical Oral Examination (POE), have 25%, 25% and 50% weightage, respectively.

Assessment Component	Marks
CA1	25
CA2	25
POE	50

CA1 and CA2 are based on 50% practical assignment.

POE is based on 100% Experiments.

Course Contents

Practical No.	List of Experiments	Hours
1	EDA & Data Visualization Perform Exploratory Data Analysis (EDA),use libraries: Pandas, Matplotlib, Seaborn, visualize patterns, trends, missing values	02
2	Data Preprocessing Handle missing values, feature scaling, encoding, apply feature engineering techniques	02
3	Linear Regression Implement Simple &amp, multiple Linear Regression, train model using CSV dataset, evaluate accuracy and visualize results	02
4	Decision Tree (ID3) Build classification model using decision tree, train on dataset and classify new data, visualize decision tree	02
5	K-Nearest Neighbors (KNN) Implement KNN on Iris dataset, compute accuracy, visualize classification	02
6	Naive Bayes Classifier Apply Naïve Bayes on dataset, train and test model, valuate accuracy	02

7	Support Vector Machine (SVM) Implement Kernel SVM, train and test model, visualize decision boundary	02
8	Random Forest Algorithm Implement Random Forest classifier,compare performance with other models	02
9	K-Means Clustering Perform clustering on dataset, visualize clusters, analyze grouping	02
10	Model Evaluation & Comparison Apply multiple ML models on real dataset, compare accuracy (KNN, SVM, RF etc.),select best model.	02

Text Books			
Sr. No.	**Title**	**Author**	**Publisher**
1	Introduction to Machine Learning,	Ethem Alpaydın,	PHI, ISBN No. 978-81-203- 5078-6
2	Machine Learning,	Tom Mitchell,	Mcgraw-Hill, First Edition, ISBN No. 0-07-115467-1.
3	Pattern Recognition and Machine Learning,	Christopher M. Bishop,	Mcgraw-Hill, ISBN No. 0- 07- 115467-1

Reference Books			
Sr. No.	**Title**	**Author**	**Publisher**
1	Machine Learning Algorithms	Giuseppe Bonaccorso,	Packt Publishing Limited, ISBN10: 1785889621, ISBN-13: 978-1785889622
2	An Introduction to Machine Learning,	Miroslav, Kubat.	Springer Publishing.
3	Machine Learning for Hackers‖,	Conway, Drew and White, John Myles,	O'Reilly Media, February 2012.

Title of the Course: Project phase–I Course Code: 25MCA2307L	L	T	P	Credit
	-	-	2	1

Project Guidelines

The project helps students apply theory and practical knowledge together.

Students should work in a group of 3–4 members.

The project can be:

Software-based

Industry problem

Research-based

Students should:

Do literature survey (books, journals, internet)

Select proper tools and technologies

Plan and divide work among team members

The **project** should develop:

Teamwork skills

Problem-solving ability

Planning and execution skills

Technical report writing

Project Work Activity

Students should meet their project guide regularly

Weekly progress discussion is required

Guide will:

Monitor progress

Give suggestions

Maintain continuous assessment record

Students must:

Maintain project diary/logbook

Show regular progress

Follow guide instructions

Phase – I Activities

Project Abstract Submission

Write short description of project

Include:

Problem idea

Objective

Applications

Required tools

Approximate cost (if needed)

Problem Definition

Explain the problem clearly in detail

Describe existing system (if any)

Explain need for new system

Literature Survey

Study related work from:

Research papers

Websites

Books

Compare existing solutions

Requirement Analysis

Identify:

Functional requirements

Non-functional requirements

System Analysis

Draw DFD (up to Level 2)

Perform feasibility study

System Design

Prepare:

System architecture

Database design

Interface design

Coding / Implementation

Develop 30% to 50% of project

Basic modules should be working.

Assessment Scheme:

Two components of Continuous Assessment (CA-1, CA-2), End Semester Practical Oral Examination (POE), have 25%, 25% and 50% weightage, respectively.

Assessment Component	Marks
CA1	25
CA2	25
POE	50

CA1 and CA2 are based on 50% practical assignment.

POE is based on 100% project presentation.

Semester IV

Title of the Course: Software Engineering & Project Management Course Code: 25MCA2401	L	T	P	Credit
	3	-	-	3

Course Prerequisite:
Students should have basic knowledge of programming (C / Java / Python) , fundamentals of computer systems ,basic understanding of databases

Course Description:
This course introduces students to the fundamental concepts of software engineering and project management. It covers software development life cycle models, requirement engineering, system design, project planning, estimation, scheduling, quality assurance, and team management. The course aims to equip students with practical knowledge to develop high-quality software and manage projects effectively using modern tools and methodologies such as Agile.

Course Objectives:
By the end of this course, students will be able to:

1. To understand fundamental concepts of Software Engineering and the importance of systematic software development along with project management principles.
2. To study various Software Process Models including traditional (Waterfall, Spiral) and modern Agile methodologies (Scrum, XP) for effective software development.
3. To learn Requirements Engineering and System Design techniques, including requirement analysis, SRS preparation, feasibility study, and basic modeling using DFD and UML.
4. To understand project monitoring and quality assurance practices, including testing methods, risk management, configuration management, and change control.
5. To apply project planning, estimation, and scheduling techniques such as WBS, COCOMO model, Gantt charts, PERT, and CPM for efficient project execution.

Course Outcomes:

CO	After the completion of the course the student should be able to
CO1	Understand software engineering concepts, SDLC, and project management basics
CO2	Analyze and compare different software process models and Agile practices
CO3	Apply requirement engineering techniques and system design principles
CO4	Develop project plans including estimation, scheduling, and risk management
CO5	Evaluate software quality, testing methods, and manage teams effectively.

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	2	-	-	-	-	-	-	2
CO2	2	3	2	-	2	-	-	-	2	-	-	2
CO3	3	3	3	2	2	-	-	-	2	-	-	-
CO4	2	3	2	-	2	-	-	-	3	2	3	2
CO5	2	3	2	2	3	-	-	2	3	2	3	2

Assessment Scheme:

Two components of Continuous Assessment (CA-1, CA-2), Mid Semester Examination (MSE) and End Semester Examination (ESE) having 30%, 20% and 50% weightage respectively.

Assessment Component	Marks
CA1	15
MSE	20
CA2	15
ESE	50

CA1 and **CA2** are based on Surprise test/ Assignment/ Quiz/Seminar/Group discussions presentation, etc.

MSE is based on 50% of course content.

ESE is based on 100% course content with 60-70% weightage for course content covered after MSE.

Course Contents

Unit No.	Unit Title and Contents	Hours
1	**Introduction to Software Engineering & Project Management** Software engineering concepts and importance ,Software characteristics and quality attributes ,Software Development Life Cycle (SDLC) ,Project management basics ,Role of project manager ,Project life cycle and stakeholders	7
2	**Software Process Models & Agile Development** Waterfall, Incremental, Spiral, Prototype models ,Agile methodologies (Scrum, XP) ,Plan-driven vs Agile development ,Process activities and framework ,Agile project management	7

3	**Requirements Engineering & System Design** Requirement types (functional, non-functional),Requirement elicitation techniques ,SRS (Software Requirement Specification),Feasibility study ,System modeling (DFD, UML basics) ,Software architecture and design concepts	8
4	**Project Planning, Estimation & Scheduling** Project planning and scope management ,Work Breakdown Structure (WBS) ,Cost estimation (COCOMO model basics) ,Scheduling techniques (Gantt chart, PERT, CPM, Resource allocation ,Risk management	8
5	**Project Monitoring, Quality & Team Management** Project monitoring and control ,Software quality assurance (SQA) ,Testing basics (black-box, white-box) ,Configuration and change management ,Team management and leadership, Communication and ethics in projects	9

Text Books

Sr. No.	Title	Author	Publisher
1	Software Engineering: A Practitioner's Approach	Roger S. Pressman, Bruce R. Maxim	McGraw-Hill 9th Edition, 2023
2	Software Engineering	Ian Sommerville	Pearson, 10th Edition, 2025.

Reference Books

Sr. No.	Title	Author	Publisher
1	Fundamentals of Software Engineering	Rajib Mall	PHI (Prentice Hall of India) 5th Edition, 2018
2	Software Engineering Principles and Practice	Waman S. Jawadekar	McGraw-Hill, 2004
3	An Integrated Approach to Software Engineering	Pankaj Jalote	Springer / Narosa, 3rd Edition, 2005

Title of the Course: Program Elective IV- (A) Deep Learning Course Code: 25MCA2402	L	T	P	Credit
	3	-	-	3

Course Prerequisite:

Students should have knowledge about basics of Linear Algebra (matrices, vectors), fundamentals of Probability & Statistics, Programming knowledge (Python preferred) ,basic understanding of Machine Learning

Course Description:

This course introduces the fundamental concepts and techniques of deep learning. It covers neural networks, optimization methods, feedforward and recurrent networks, convolutional neural networks, and auto encoders. Students will learn how deep learning models are designed, trained, and applied to solve real-world problems such as image recognition, sequence prediction, and representation learning.

Course Objectives:

By the end of this course, the students will be able to:

1. To understand the fundamentals of neural networks and deep learning
2. To learn different optimization techniques used in training models
3. To study feedforward neural networks and backpropagation
4. To explore CNNs, RNNs, and advanced architectures
5. To understand representation learning using autoencoders

Course Outcomes:

CO	After the completion of the course the student should be able to
CO1	Understand neural networks, activation functions, and optimization techniques
CO2	Apply feedforward neural networks and backpropagation algorithms.
CO3	Analyze and improve neural networks using regularization and optimization methods.
CO4	Design and implement CNNs and RNNs for real-world applications
CO5	Apply auto encoders for feature learning and dimensionality reduction

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	3	-	-	-	-	2	2	-
CO2	3	3	3	2	3	-	-	-	1	2	2	-
CO3	3	3	2	3	3	1	-	-	1	2	2	-
CO4	3	3	3	3	3	2	1	-	2	3	3	3
CO5	3	3	3	3	3	1	1	-	2	2	2	-

Assessment Scheme:
Two components of Continuous Assessment (CA-1, CA-2), Mid Semester Examination (MSE) and End Semester Examination (ESE) having 30%, 20% and 50% weightage respectively.

Assessment Component	Marks
CA1	15
MSE	20
CA2	15
ESE	50

CA1 and **CA2** are based on Surprise test/ Assignment/ Quiz/Seminar/Group discussions presentation, etc.

MSE is based on 50% of course content.

ESE is based on 100% course content with 60-70% weightage for course content covered after MSE.

Course Contents

Unit No.	Unit Title and Contents	Hours
1	**Neural Network Brief introduction to neural networks.** Error Cost Function, Mean-Square Error, Cross-Entropy. Linear vs Non-linear functions: Activation Function – Linear, Sigmoid, Softmax, Relu. Optimization: Gradient Descent Algorithm, Momentum Based Gradient Descent Algorithm and Nesterov Accelerated Gradient Descent Algorithm. .	7

2	**Feed forward Neural Networks** Basic concept and terminology, Representing networks, Perceptron rule, Delta rule, From logistic regression to Backpropagation, Backpropagation, Complete Feedforward NNs.	8
3	**Modifications & Extensions of FF Neural Nets** Regularization, L1 & L2 regularization, Learning Rate, Momentum and Dropout, Stochastic Gradient Descent and Online Learning, Problems with multiple hidden layers, Vanishing and exploding gradients.	8
4	**Convolution & Recurrent Neural Networks** Logistic Regression, Support Vector Machine, Kernel function and Kernel SVM. Ensemble Learning, Bagging, Random Forest, Boosting, AdaBoost, Stacking Perceptron, multilayer network, back propagation, introduction to deep neural network	9
5	**Auto encoders** Learning Representations, Different Auto encoder Architectures, Stacking Auto encoders.	7

Text Books

Sr. No.	Title	Author	Publisher
1	Deep Learning	Ian Goodfellow, Yoshua Bengio, Aaron Courville	MIT Press,2016
2	Neural Networks and Deep Learning: A Textbook	Charu C. Aggarwal	Springer Year: 2018

Reference Books

Sr. No.	Title	Author	Publisher
1	Pattern Recognition and Machine Learning	Christopher M. Bishop	Springer Year: 2006
2	Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow	Aurélien Géron	2022 (3rd Edition)

Title of the Course Program Elective IV-(B) Natural Language Processing (NLP) Course Code: 25MCA2402	L	T	P	Credit
	3	-	-	3

Course Prerequisite:

Students should have knowledge about basic knowledge of Programming (Python), fundamentals of Data Structures, basic understanding of Machine Learning concepts, knowledge of Probability and Statistics.

Course Description:

This course provides a comprehensive understanding of Natural Language Processing (NLP), focusing on both foundational and advanced techniques used to process and analyze human language. It covers linguistic challenges, text preprocessing, word representation, deep learning approaches, and modern transformer-based models. The course also emphasizes real-world applications such as sentiment analysis, machine translation, text summarization, and question-answering systems, enabling students to build intelligent language-based solutions.

Course Objectives:

By the end of this course, students will be able to:

1. To understand the fundamental concepts and challenges in NLP.
2. To learn text preprocessing and word representation techniques.
3. To apply deep learning models for NLP tasks.
4. To explore advanced NLP techniques including language generation.
5. To understand modern transformer-based models and applications.

Course Outcomes:

CO	After the completion of the course the student should be able to
CO1	Understand NLP concepts, challenges, and basic text processing techniques
CO2	Apply text representation methods and word embedding techniques
CO3	Implement deep learning models for NLP tasks.
CO4	Analyze and apply advanced NLP techniques including language generation
CO5	Analyze and apply advanced NLP techniques including language generation

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	2	-	-	-	-	2	1	2
CO2	3	3	3	2	3	-	-	-	1	2	2	3
CO3	3	3	3	3	3	1	-	-	2	2	2	3
CO4	3	3	3	3	3	2	1	-	-	3	3	3
CO5	3	3	3	3	3	2	1	-	3	3	3	3

Assessment Scheme:
Two components of Continuous Assessment (CA-1, CA-2), Mid Semester Examination (MSE) and End Semester Examination (ESE) having 30%, 20% and 50% weightage respectively.

Assessment Component	Marks
CA1	15
MSE	20
CA2	15
ESE	50

CA1 and **CA2** are based on Surprise test/ Assignment/ Quiz/Seminar/Group discussions presentation, etc.

MSE is based on 50% of course content.
ESE is based on 100% course content with 60-70% weightage for course content covered after MSE.

Course Contents

Unit No.	Unit Title and Contents	Hours
1	**Introduction to NLP & Linguistic Challenges** This unit introduces the need, applications, and industry demand for Natural Language Processing (NLP). It covers key challenges such as ambiguity in language, contextual meaning of words and phrases, homonyms, coreference resolution, domain-specific language issues, and low-resource languages. Basic text preprocessing techniques including segmentation, tokenization, stemming, Lemmatization, spelling correction, stop words removal, and N-grams are discussed. The unit also includes concepts like synsets, hypernyms, WordNet and WordNet similarity, language corpus, N-gram language models, and Hidden Markov Models.	7
2	**Text Processing & Word Representation** This unit focuses on text processing techniques and representation methods. It includes iNLTK for Indic languages, text normalization, script normalization, and handling parallel corpora. Students will learn techniques for handling code-mixed text and cross-lingual information retrieval. The unit covers vector space models, term frequency (TF), TF-IDF representation, and distributional representations. It also introduces word embedding such as Word2Vec (CBOW), GloVe, document-to-vector approaches, and word embedding techniques for regional languages.	9

3	**Deep Learning for NLP** This unit covers the application of deep learning techniques in NLP. Topics include neural networks for text processing, recurrent neural networks (RNNs), vanishing and exploding gradient problems, Long Short-Term Memory (LSTM), and Gated Recurrent Units (GRU). It also includes sequence-to-sequence (Seq2Seq) modeling, bidirectional models, contextual word representations, and transformer architectures such as BERT. Concepts like multilingual embedding, transfer learning in embedding (MUSE), and NLP tasks such as part-of-speech tagging, named entity recognition, sentiment analysis, and text clustering are also covered.	8
4	**Advanced NLP & Language Generation** This unit focuses on advanced NLP techniques and language generation. It includes topic modeling, latent semantic analysis, statistical machine translation, and neural machine translation. Students will learn attention mechanisms, self-attention models, and their role in generative models. The unit also covers natural language generation, question-answering systems, the use of 1D convolutional neural networks (CNNs) in NLP, and sub-word modeling techniques.	9
5	**Modern NLP Models & Applications** This unit introduces modern transformer-based models and their applications. It covers advanced models such as GPT, ALBERT, ULMFiT, and RoBERTa. The unit also focuses on text summarization techniques including extractive and abstractive methods, along with transformer-based approaches for automatic text summarization.	9

Text Books

Sr. No.	Title	Author	Publisher
1	Speech and Language Processing	Daniel Jurafsky, James H. Martin,	Pearson, 3rd Edition (Draft widely used) Year: 2023
2	Natural Language Processing with Python	Steven Bird, Ewan Klein, Edward Loper	O'Reilly Media, 2009

Reference Books			
Sr. No.	**Title**	**Author**	**Publisher**
1	Foundations of Statistical Natural Language Processing	Christopher D. Manning, Hinrich Schütze	MIT Press, 1999
2	Neural Network Methods in Natural Language Processing	Yoav Goldberg	Morgan & Claypool,2017
3	Transformers for Natural Language Processing	Denis Rothman Publisher	Packt Publishing,2021
4	Applied Natural Language Processing in the Enterprise	Ankur A. Patel, Ajay Uppili Arasanipalai	O'Reilly Media, 2021

Title of the Course: Program Elective IV-(C) Social Networks (SN) Course Code: 25MCA2402	L	T	P	Credit
	3	-	-	3

Course Prerequisite:

Students should have knowledge about Mathematics (graphs and matrices), fundamentals of Data Structures, basic understanding of statistics and data analysis, familiarity with computers and data handling tools.

Course Description:

This course introduces the concepts, methods, and tools used in social network analysis. It focuses on understanding social network data, graph-based representations, matrix-based analysis, and structural properties of networks such as connectivity, distance, and clustering. The course also covers ego networks, centrality measures, and power dynamics within networks.

Students will learn to analyze and visualize network data using tools like UCINET and NetDraw, enabling them to interpret complex relationships in social, organizational, and technological systems.

Course Objectives:

By the end of this course, the students will be able to:

1. To understand social network data and its unique characteristics.
2. To learn graph-based and matrix-based representations of networks.
3. To analyze structural properties such as connectivity and distance.
4. To explore ego networks and centrality measures.
5. To use tools for visualization and analysis of network data.

Course Outcomes:

CO	After the completion of the course the student should be able to
CO1	Understand social network concepts, data types, and relations
CO2	Represent and visualize networks using graphs and tools
CO3	Apply matrix operations and analyze network data structures
CO4	Evaluate network properties such as connectivity, clustering, and distance.
CO5	Analyze ego networks and centrality measures to interpret influence and power

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	2	-	-	-	-	1	1	2
CO2	3	3	3	2	3	-	-	-	1	2	2	2
CO3	3	3	3	3	3	1		-	1	2	2	3
CO4	3	3	3	3	3	2	1	-	2	2	2	3
CO5	3	3	3	3	3	2	1	-	3	3	3	3

Assessment Scheme:
Two components of Continuous Assessment (CA-1, CA-2), Mid Semester Examination (MSE) and End Semester Examination (ESE) having 30%, 20% and 50% weightage respectively.

Assessment Component	Marks
CA1	15
MSE	20
CA2	15
ESE	50

CA1 and **CA2** are based on Surprise test/ Assignment/ Quiz/Seminar/Group discussions presentation, etc.

MSE is based on 50% of course content.

ESE is based on 100% course content with 60-70% weightage for course content covered after MSE.

Course Contents

Unit No.	Unit Title and Contents	Hours
1	**Social network data:** What's different about social network data?, Nodes, Populations, samples, and boundaries, Modality and levels of analysis, Relations Sampling ties, Multiple relations, Scales of measurement. Formal Methods: Efficiency, Using computers, Seeing patterns.	7
2	**Graphs to represent social relations:** Representing networks with graphs and sociograms, Kinds of graphs: Levels of measurement: Binary, signed, and valued graphs, Directed or "bonded" Ties in the graph, Simplex or multiplex relations in the graph. Working with NetDraw to visualize graphs: Node attributes, Relation properties, Location, location, location Highlighting parts of the network, A few hints on data handling with NetDraw.	7

3	**Using matrices to represent social relations:** What is a matrix?, The "adjacency" matrix, Matrix permutation, blocks, and images, Doing mathematical operations on matrices, Transposing a matrix, Taking the inverse of a matrix, Matrix addition and matrix subtraction, Matrix multiplication and Boolean matrix multiplication. Working with network data: Manipulating network data structures, Making UCINET datasets, Transforming data values, File handling tools, Selecting sub-sets of the data, Making new kinds of graphs from existing graphs.	7
4	**Connection and distance: Networks and actors:** An example: Knoke's information exchange, Connection: Basic demographics, Density, Reachability Connectivity, Distance: Walks, Geodesic distance, eccentricity, and diameter Flow. Embedding: Density, Reciprocity, Transitivity, Clustering, Group-external and group-internal ties, Krackhardt's Graph Theoretical Dimensions of Hierarchy.	7
5	**Ego networks:** Ego network data, Ego network density, Structural holes Brokerage. Centrality and power: Degree centrality: Degree: Freeman's approach, Degree: Bonacich's approach, Closeness centrality: Closeness: Path distances Closeness: Reach, Closeness: Eigenvector of geodesic distances, Closeness: Hubbell, Katz, Taylor, Stephenson and Zelen influence, Betweenness Centrality: Betweenness: Freeman's approach to binary relations, Betweenness: Flow centrality	7

Text Books

Sr. No.	Title	Author	Publisher
1	Analyzing Social Networks	Stephen P. Borgatti, Martin G. Everett, Jeffrey C. Johnson	SAGE Publications, 2nd Edition Year: 2018

Reference Books

Sr. No.	Title	Author	Publisher
1	Networks, Crowds, and Markets: Reasoning About a Highly Connected World	David Easley, Jon Kleinberg	Cambridge University Press, 2010
2	Social Network Analysis for Startups	Maximilian Schich	O'Reilly Media Year: 2011
3	Graph Theory with Applications	J.A.Bondy, U.S.R. Murty	Elsevier, 1976

Title of the Course: Internship and Project in the Industry Course Code: 25MCA2403	L	T	P	Credit
	-	-	24	12

In this course, it is expected that students will go to industry for internship for one semester and do industry-based project in that period. Student will be assigned one dept. one Industry guide to monitor
progress of the student. After, completion of the Internship student will submit project report to the dept. and project examination will be conducted in consultation with the industry guide. In case, if student not opting / not doing Internship in the Industry, such students can do project work in the dept.

Assessment Scheme:

Two components of Continuous Assessment (CA-1, CA-2), End Semester Oral Examination (OE), have 25%, 25% and 50% weightage, respectively.

Assessment Component	Marks
CA1	25
CA2	25
OE	50

CA1 and CA2 are based on 50% practical assignment. OE is based on 100% industry based project presentation.

Title of the Course: Project phase – II (In-house) Course Code: 25MCA2404L	L	T	P	Credit
	-	-	2	1

Project Guidelines

The project continues Phase I work with focus on completion, testing, and deployment.
Students should continue in the same group (3–4 members).
The **project** should be:
Software-based / Industry problem / Research-based.
Students should:
Enhance and complete implementation.
Use appropriate tools and technologies.
Perform testing and validation.
Document results properly.
The project should develop:
Advanced technical skills
Testing and debugging ability.
Project completion and deployment skills.
Documentation and presentation skills.

Project Work Activity

Students should meet their project guide regularly.
Weekly progress discussion is require.
Guide will:
Monitor development progress.
Suggest improvements and corrections.
Evaluate testing and final outcomes.
Maintain continuous assessment record.
Students must:
Maintain project diary/logbook.
Show working modules regularly.
Fix errors and improve system.
Follow guide instructions.

Phase – II Activities

Implementation Completion

Complete remaining modules (100% implementation).
Integrate all modules into one system.
Ensure proper functionality of the system.
Testing & Validation
Perform different types of testing:
Unit Testing.
Integration Testing.
System Testing.
Identify and fix bugs/errors.
Validate system with sample inputs.

Result Analysis

Show output/screenshots of the system.

Compare expected vs actual results.

Analyze performance of the system.

System Optimization (if required)

Improve performance and efficiency.

Enhance UI/UX design.

Optimize database and code.

Documentation (Final Report)

Prepare complete project report including:

Introduction

Problem definition

Literature survey

System analysis & design

Implementation details

Testing and results

Conclusion and future scope

Project Presentation

Prepare PPT (10–15 slides) including:

Problem statement

Solution approach

System design

Screenshots/demo

Results

Demonstrate working project.

Project Deployment (if applicable)

Deploy project (local/server/cloud).

Make system usable for end us.

Assessment Scheme:

Two components of Continuous Assessment (CA-1, CA-2), End Semester Oral Examination (POE), have 25%, 25% and 50% weightage, respectively.

Assessment Component	Marks
CA1	25
CA2	25
POE	50

CA1 and CA2 are based on 50% practical assignment.

POE is based on 100% project presentation.