KG COLLEGE OF ARTS AND SCIENCE
Autonomous Institution | Affiliated to Bharathiar University
Accredited with A++ Grade by NAAC
ISO 9001:2015 Certified Institution
KGiSL Campus, Saravanampatti, Coimbatore – 641 035

Regulations 2024-25 for Postgraduate Programme

Learning Outcomes Based Curriculum Framework (LOCF) model with

Choice Based Credit System (CBCS)

Programme: M.Sc. Computer Science (M.Sc. CS)
Programme Code: MCS

(Applicable for the Students admitted during the Academic Year 2024-25 onwards)

Eligibility

The student should have passed B.Sc. Computer Science / BCA / B.Sc. Computer Science related Courses / B.E. / B.Tech. Computer Science related course is eligible for M.Sc. Computer Science. (As per the eligibility condition given by Bharathiar University Ref. BU/R/B3-B4/ Eligibility Condition /2024/9206 dated 24/5/2024).

Program Learning Outcomes (PLOs)

The successful completion of the M.Sc. Computer Science programme shall enable the students to:

PLO1	Develop critical analysis with creativity and problem solving skills in Computational Science to become Data Scientist and Data Analyst.
PLO2	Exhibit research skills, design and critical thinking to embellish the career of computer System Analyst, Software Engineer and Scientific Researcher to solve real world problem.
PLO3	Continue the process of life-long learning through professional activities and adapt themselves persuasively in Full Stack Development, AI and Cloud Computing.
PLO4	Enhance skills for effective leadership in IT support, Network Architect, Web Development and successful entrepreneur as well.
PLO5	Apply ethical principles through human computer interaction and contribute effectively to the welfare of the society.

M.Sc. Computer Science

Distribution of Credits and Hours for all the Semesters

Part	Course Category	No. of Courses	Hours		Credits	Total Credits		Semester
III	Core Theory (6 hrs./week)	2	2 X 6	12	4 X 2	8	84	3
	Core Theory (5 hrs./week)	2	2 X 5	10	4 X 2	8		2
	Core Theory (4 hrs./week)	5	5 X 4	20	4 X 5	20		1 – 2
	Core Lab (4 hrs./ week)	5	5 X 4	20	3 X 4	15		1 – 2
	Core Lab(Embedded (7 hrs./week))	1	1 X 7	7	5 X 1	5		3
	Elective Theory (5 hrs./ week)	1	1 X 5	5	4 X 1	4		3
	Elective Theory (4 hrs./ week)	2	2 X 4	8	4 X 2	8		1 - 2
	Skill Enhancement Course (SEC) Lab	2	2 X 2	4	3 X 2	6		2 - 3
	SEC : Internship	1	-	-	2 X 1	2		3
	Project Work	1	-	-	8 X 1	8		4
IV	Ability Enhancement Compulsory Course (AECC)	2	2 X 2	4	2 X 2	4	6	1 - 2
	Ability Enhancement Compulsory Course (AECC) – Online Course - MOOC	1	-	-	2 X 1	2		3
Total		**25**		**90**		**90**	**90**	

Consolidated Semester wise and Component wise Hours and Credits Distribution

Semester	Part III		Part IV		Total	
	Hours	Credits	Hours	Credits	**Hours**	**Credits**
1	28	26	2	2	30	**28**
2	28	25	2	2	30	**27**
3	30	25	-	2	30	**27**
4	-	8	-	-	-	**8**
Total	**86**	**84**	**4**	**6**	**90**	**90**

Curriculum

M.Sc. Computer Science

Semester – 1									
Course Code	**Part**	**Course Category**	**Course Name**	**Hrs. / week**	**Examination**				**Credits**
					Duration in hrs.	**Max Marks**			
						CIA	**ESE**	**Total**	
24MCS11C	III	Core – I	Analysis and Design of Algorithms	4	3	25	75	100	4
24MCS12C	III	Core - II	Python Programming	4	3	25	75	100	4
24MCS13P	III	Core Lab - I	**Lab :** Python Programming	4	3	40	60	100	3
24MCS14C	III	Core – III	MongoDB	4	3	25	75	100	4
24MCS15P	III	Core Lab - II	**Lab :** MongoDB	4	3	40	60	100	3
24MCS16C	III	Core - IV	Advanced Operating Systems	4	3	25	75	100	4
24MCS1AE	III	Elective - I	Exploratory Data Analysis	4	3	25	75	100	4
24MCS1BE	III		Blockchain Technology and Applications						
24MCS1CE	III		Data Preprocessing and Visualization						
24QUA1AE	IV	AECC - I	Quantitative Aptitude	2	2	-	50	50	2
Total				**30**				**750**	**28**

Semester – 2									
Course Code	**Part**	**Course Category**	**Course Name**	**Hrs. / week**	**Examination**				**Credits**
					Duration in hrs.	**Max Marks**			
						CIA	**ESE**	**Total**	
24MCS21C	III	Core - V	Advanced Java Programming	5	3	25	75	100	4
24MCS22P	III	Core Lab- III	**Lab :** Advanced Java Programming	4	3	40	60	100	3
24MCS23C	III	Core - VI	Artificial Intelligence and Machine Learning	5	3	25	75	100	4
24MCS24P	III	Core Lab- IV	**Lab :** Artificial Intelligence and Machine Learning	4	3	40	60	100	3
24MCS25C	III	Core - VII	Data Mining	4	3	25	75	100	4
24MCS2AE	III	Elective - II	Big Data Analytics	4	3	25	75	100	4
24MCS2BE	III		Ethical Hacking						
24MCS2CE	III		Neural Networks and Deep Learning						
24MCS26P	III	SEC Lab - I	**Lab :** Data Mining	2	3	40	60	100	3
24SOF2AE	IV	AECC - II	Soft Skills	2	2	-	50	50	2
Total				**30**				**750**	**27**

Semester – 3									
Course Code	**Part**	**Course Category**	**Course Name**	**Hours / Week**	**Examination**				**Credits**
					Duration in hrs.	**Max Marks**			
						CIA	**ESE**	**Total**	
24MCS31C	III	Core – VIII	Digital Image Processing	6	3	25	75	100	4
24MCS32C	III	Core – IX	Network Security and Cryptography	6	3	25	75	100	4
24MCS33P	III	Core Lab - V	**(Embedded) Lab:** Cloud Computing	7	3	40	60	100	5
24MCS34P	III	Core Lab- VI	**Lab:** Web Application Development and Hosting	4	3	40	60	100	3
24MCS3AE	III	Elective - III	Social Network Analytics	5	3	25	75	100	4
24MCS3BE	III		Digital and Mobile Forensics						
24MCS3CE	III		Generative AI and Prompt Engineering						
24MCS35P	III	SEC Lab - II	**Lab:** Digital Image Processing	2	3	40	60	100	3
24MCS37I	III	SEC	**SEC:**Internship	-	-	50	-	50	2
24MOO3AE	IV	AECC – III	Online Course MOOC	-	-	50	-	50	2
Total				**30**				**700**	**27**

Semester 1

Course Code	Course Name	Category	Hours / Week	Credits
24MCS11C	Analysis and Design of Algorithms	Core - I	4	4

Course Objectives

This course intends to cover

- Elementary data structures.
- Various techniques such as divide and conquer, dynamic programming, backtracking.

Course Learning Outcomes

On the successful completion of the course, students will be able to

CLO	CLO Statements	Knowledge Level
CLO1	Recite the elementary data structures.	K1
CLO2	Understand the traversal and search techniques.	K2
CLO3	Apply the Greedy method in various applications.	K3
CLO4	Analyze the dynamic programming techniques.	K4
CLO5	Evaluate the concept of backtracking, branch and bound techniques.	K5
K1 – Remember; **K2** - Understand; **K3** - Apply; **K4** – Analyze; **K5** – Evaluate		

CLO – PLO Mapping

CLOs/PLOs	PLO1	PLO2	PLO3	PLO4	PLO5
CLO1	2	3	2	3	3
CLO2	2	2	2	3	2
CLO3	2	2	2	2	2
CLO4	3	3	2	2	2
CLO5	3	3	3	3	2
3 - Substantial (high)		2 - Moderate (medium)		1 - Slight (low)	

Core I: Analysis and Design of Algorithms

Unit	Content	No. of Hours
I	**Introduction:** Algorithm Definition and Specification – Space complexity- Time Complexity- Asymptotic Notations - Elementary Data Structure: Stacks and Queues – Binary Tree - Binary Search Tree - Heap – Heap sort- Graph.	12
II	**Traversal and search techniques:** Basics of Traversal and Search Techniques- Techniques for Binary Trees-Techniques for Graphs -Divide and Conquer: - General Method – Binary Search – Merge Sort – Quick Sort.	13
III	**Greedy method:** General Method –Knapsack Problem – Minimum Cost Spanning Tree – Single Source Shortest Path.	11
IV	**Dynamic Programming:** General Method –Multistage Graphs – All Pair Shortest Path–Optimal Binary Search Trees – 0/1 Knapsacks – Traveling Salesman Problem – Flow Shop Scheduling.	13
V	**Backtracking:** General Method–8-QueensProblem–Sum of Subsets – Graph Coloring– Hamiltonian Cycles – Branch and Bound: The Method – Traveling Salesperson.	11
	Total Hours	**60**
Text Books		
1.	Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman (2013), Data Structures and Algorithms, Pearson Education Limited.	
2.	Ellis Horowitz (2008), Computer Algorithms, Galgotia Publications.	
Reference Books		
1.	Goodrich (2022), Data Structures and Algorithms in Java, 6th Edition, Wiley.	
2.	Skiena (2008), The Algorithm Design Manual, 2nd Edition, Springer.	
3.	Anany Levith (2003), Introduction to the Design and Analysis of algorithm, Pearson Education Asia.	
4.	Robert Sedgewick, Phillipe Flajolet (1996), An Introduction to the Analysis of Algorithms, Addison-Wesley Publishing Company.	
Web Resources (Swayam / NPTEL)		
1.	https://onlinecourses.nptel.ac.in/noc24_cs23/preview	
2.	https://onlinecourses.nptel.ac.in/noc24_cs28/preview	
3.	https://onlinecourses.nptel.ac.in/noc24_cs45/preview	

Course Code	Course Name	Category	Hours / Week	Credits
24MCS12C	Python Programming	Core - II	4	4

Course Objectives

The course intends to cover

- Elementary data structures of Python programming.
- Modules to perform specific task.
- Python libraries and frameworks for rapid application development.

Course Learning Outcomes

On the successful completion of the course, students will be able to

CLO	CLO Statements	Knowledge Level
CLO1	Recite the basic concepts of Python.	K1
CLO2	Understand the Object-Oriented concepts and modules in Python.	K2
CLO3	Analyze the data storage, databases, web and network applications.	K4
CLO4	Build real time applications using Python libraries.	K3
CLO5	Create an application through Python frameworks Django and Flask.	K6
K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** – Analyze; **K6** - Create		

CLO – PLO Mapping

CLOs/PLOs	PLO1	PLO2	PLO3	PLO4	PLO5
CLO1	2	2	3	-	3
CLO2	2	3	3	-	3
CLO3	2	3	3	-	3
CLO4	3	3	3	1	3
CLO5	3	3	3	1	3
3 - Substantial (high)		**2** - Moderate (medium)		**1** - Slight (low)	

Core – II : Python Programming

Unit	Content	No. of Hours
I	**Introduction**: Numbers – Strings – Variables – Lists – Tuples – Dictionaries – Sets– Comparison. **Code Structures:** if, elseif, and else – Repeat with while – Iterate with for – Comprehensions – Functions – Generators – Decorators – Namespaces and Scope – Handle Errors with try and except – User Exceptions.	12
II	**Modules and Programs:** Standalone Programs – Command-Line Arguments – Modules and the import Statement – The Python Standard Library. Objects and Classes: Define a Class – Inheritance – Override a Method – Add a Method – Get and Set Attribute Values with Properties –- Method Types– Special Methods.	10
III	**Storing and Retrieving Data**: File Input/Output – Structured Text Files – Structured Binary Files. Database Programming using Python: Connecting to a database (sqlite, mysql) using Python, Sending DML and DDL queries and processing the result from the Python Program. Web: Web Clients – Web Servers – Web Services and Automation. Networks: Patterns – The Publish-Subscribe Model – TCP/IP – Sockets – Internet Services.	12
IV	**NumPy**: Operations using NumPy - NumPy for Arrays - Data Type Objects (dtype) – NumPy Mathematical Operations. Pandas: Key Features of Pandas – Pandas data structures – series and DataFrame – Loading a dataset into a dataframe – Selecting columns and rows from dataframe – Adding new data and deleting data from a dataframe. Matplotlib: Use of Matplotlib – Types of Plots –Working with multiple Plots.	13
V	**Python Frameworks:** Frameworks - Types of Python Frameworks - Django: Install Django – Web frameworks – The development server – Model-view-controller vs Model view template - Initial Setup - First Django project – Create an app – URL confs – Pages app. Flask: Introduction to Flask - Installation - Basic Application Structure - Initialization - Routes and views function - Server startup - A Complete application - The Request-Response cycle.	13
	Total Hours	**60**

Text Books	
1	Jameer Basha A, Lokesh S and Kiruba B (2024), Python Programming, 3rd Impression, Pearson Publications.
2	Yashvant Kanetkar, Aditya Kanetkar (2023), Let us Python, 6th Edition, BPB Publications.
3	Bill Lubanovic (2014), Introducing Python, 1st Edition-Second Release, O'Reilly Media Publisher.
4	William S Vincent (2020), Django for beginners Build websites with python & Django, 2020 Edition, WelcomeToCode publisher.
5	Malhar Lathkar (2021), Building Web Apps with Python and Flask, 2021 Edition, BPB Publications.
Reference Books	
1	Alex Martelli, Anna Ravenscroft, Steve Holden (2017), Python in Nutshell, 3rd Edition, O'Reilly Media Publisher.
2	Sheetal Taneja, Naveen Kumar (2017), Python Programming – A Modular Approach, Pearson Publications.
3	Antonio Mele (2020), Django by Example Build Powerful and reliable python web applications from scratch, 3rd Edition, Packt Publications.
4	Shalabh Aggarwal (2019), Flask Framework cookbook, 2nd Edition, Packt Publications.
Web Resources (Swayam / NPTEL)	
1	https://onlinecourses.nptel.ac.in/noc24_cs54/preview
2	https://onlinecourses.swayam2.ac.in/aic20_sp33/preview
3	https://onlinecourses.swayam2.ac.in/cec22_cs20/preview
4	https://onlinecourses.swayam2.ac.in/cec24_cs03/preview

Course Code	Course Name	Category	Hours / Week	Credit
24MCS13P	Lab: Python Programming	Core Lab – I	4	3

S. No.	List of Programs
1	Basic programs using Lists, Dictionaries, Tuples and Sets.
2	Implement conditional structures and loops.
3	Demonstrate Python programs using modules.
4	Programs to implement file operations.
5	Implement database connectivity, execute DDL and DML queries.
6	Programs using NumPy library.
7	Programs using Pandas library.
8	Develop a various charts using Matplotlib library.
9	Design a simple form using Django.
10	Design a multipage website using flask.
	Total Hours **60**
Text Books	
1.	Yashvant Kanetkar, Aditya Kanetkar (2023), Let us Python, 6th Edition, BPB Publications.
2.	Bill Lubanovic (2014), Introducing Python, 1st Edition-Second Release, O'Reilly Media Publisher.
Reference Books	
1.	Alex Martelli, Anna Ravenscroft, Steve Holden (2017), Python in Nutshell, 3rd Edition, O'Reilly Media Publisher.
2.	Sheetal Taneja, Naveen Kumar (2017), Python Programming – A Modular Approach, Pearson Publications.
3.	Antonio Mele (2020), Django by Example Build Powerful and reliable python web applications from scratch, 3rd Edition, Packt Publications.
4.	Shalabh Aggarwal (2019), Flask Framework cookbook, 2nd Edition, Packt Publications.
Web Resources (Swayam / NPTEL)	
1	https://onlinecourses.nptel.ac.in/noc24_cs54/preview
2	https://onlinecourses.swayam2.ac.in/aic20_sp33/preview
3	https://onlinecourses.swayam2.ac.in/cec22_cs20/preview
4	https://onlinecourses.swayam2.ac.in/cec24_cs03/preview

Course Code	Course Name	Category	Hours / Week	Credits
24MCS14C	MongoDB	Core - III	4	4

Course Objectives

The course intends to cover

- MongoDB fundamentals such as databases, collections and CRUD operations.
- Indexing strategies to improve query performance.

Course Learning Outcomes

On the successful completion of the course, students will be able to

CLO	CLO Statements	Knowledge Level
CLO1	Understand NoSQL Database and differences with RDBMS and CAP Theorem.	K1, K2
CLO2	Apply data modelling and schema validation.	K3
CLO3	Analyze the requirement and design the MongoDB documents and collections.	K4
CLO4	Understand the aggregation operators in MongoDB.	K2
CLO5	Create Shards in MongoDB.	K6
K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** – Analyze; **K6** - Create		

CLO-PLO Mapping

CLOs/PLOs	PLO1	PLO2	PLO3	PLO4	PLO5
CLO1	2	3	3	2	2
CLO2	3	3	3	2	3
CLO3	3	3	3	3	3
CLO4	2	3	3	2	2
CLO5	3	3	3	3	2
3 - Substantial (high)		2 - Moderate (medium)		1 - Slight (low)	

Core - III : MongoDB

Unit	Content	No. of Hours
I	**Introduction to NoSQL:** Types of NoSQL Databases – MongoDB – Differences between MongoDB and RDBMS – CAP theorem – JSON – BSON – MongoDB document.	10
II	**MongoDB Installation and Data Modeling:** Databases and collections-Introduction to MongoDB shell-Configuring MongoDB shell-Accessing the MongoDB shell-Understanding data types - MongoDB data modeling-Embedded data model-References data model-Perform schema validations.	12
III	**CRUD Operations:** Introduction to CRUD operations - creating databases and collections-Insert operation-Ready operation-Update operation- Delete operation. Additional CRUD Related Methods: Overview of CRUD methods - insert() method-update()method-find()method-findOneandDelete()method-findOneAndReplace() method-findOneAndUpdate() method - findAndModify() method.	12
IV	**Aggregation:** Aggregation operators-Aggregation stage operators-Expression operators: Expression arithmetic operators- Set expression and array operators-Expression boolean operators - Expression comparison operators- Expression date operators- Expression string operators.	12
V	**Indexes and Performance Tuning:** Different types of Indexes-Index Creation listing the indexes-Default_Id index-Drop an Index-Single Field Index Compound Index. Introduction to Storage and Storage Engine: WiredTiger/In Memory Storage Engine. Introduction to MongoDB Sharding: Advantages o sharding- Architecture overview- development, continuous deployment and staging environments-Planning ahead on sharding – Shard key – Choosing a Shard key.	14
	Total Hours	**60**

Text Books

1.	Kristina Chodorow (2013), MongoDB: The Definitive Guide.

Reference Books	
1.	Alex Giamas (2017), Mastering MongoDB 3.x, Packt Publishing Ltd.
2.	Manu Sharma (2021), MongoDB Complete Guide, BPB Publication.
Web Resources (Swayam / NPTEL)	
1.	https://nptel.ac.in/courses/106104135
2.	Amit Phaltankar, Juned Ahsan,Michael Harrison,Liviu Nedov (2020),MongoDB Fundamentals: A hands-on guide to using MongoDB and Atlas in the real world, Packt Publishing.

Course Code	Course Name	Category	Hours / Week	Credits
24MCS15P	Lab: MongoDB	Core Lab - II	4	3

S. No.	List of Programs
1.	Build a database in MongoDB.
2.	Create MongoDB Database with Employee Collection, having Employee ID, Employee Name, Department, Salary, Deductions, Gross and NetSalary.
3.	Model collections in different perspective of Employee collection/ Department collection.
4.	Perform Schema Validations -Validate Schema of inserted documents, whether minimum expected schema is matched.
5.	Perform Read operations based on specific conditions.
6.	Perform insertion, deletion, updating documents based on conditions to the collection.
7.	Perform aggregations using various operators.
8.	Add appropriate single field and multiple field index.
9.	Perform aggregations on documents based on criteria.
10.	Update Document using: a) update() method b) save() method.
11.	MongoDB Projection.
12.	Perform limit(), skip() and sort() methods in MongoDB.
13.	MongoDB string expression and array update operators.
Total Hours	**60**
Text Books	
1.	Amit Phaltankar, Juned Ahsan, Michael Harrison, Liviu Nedov (2020), MongoDB Fundamentals: A hands-on guide to using MongoDB and Atlas in the real world, Packt Publishing.
2.	Kristina Chodoro (2013), MongoDB: The Definitive Guide.
Reference Books	
1.	Manu Sharma (2021), MongoDB Complete Guide, BPB Publication.
2.	Alex Giama (2017), Mastering MongoDB 3.x, Packt Publishing Ltd.
Web Resources (Swayam / NPTEL)	
1.	https://nptel.ac.in/courses/106104135

Course Code	Course Name	Category	Hours / Week	Credits
24MCS16C	Advanced Operating Systems	Core - IV	4	4

Course Objectives

The course intends to cover

- Different types of operating systems and their functions.
- Components and management aspects of real time and mobile OS.

Course Learning Outcomes

On the successful completion of the course, students will be able to

CLO	CLO Statements	Knowledge Level
CLO1	Recite the different kinds of operating systems and process scheduling.	K1
CLO2	Understand the design issues associated with distributed operating system.	K2
CLO3	Interpret the concepts of real time operating system and task scheduling.	K2
CLO4	Explore the operating systems for handheld systems.	K4
CLO5	Analyze operating systems like LINUX and iOS.	K4
K1 – Remember; **K2** – Understand; **K4** – Analyze		

CLO-PLO Mapping

CLOs/PLOs	PLO1	PLO2	PLO3	PLO4	PLO5
CLO1	2	3	3	1	2
CLO2	3	3	3	2	2
CLO3	3	3	3	3	3
CLO4	3	3	3	3	3
CLO5	2	3	2	2	2
3 - Substantial (high)		2 - Moderate (medium)		1 - Slight (low)	

Core - IV : Advanced Operating Systems

Unit	Content	No. of Hours
I	**Basics of Operating Systems:** Operating System Overview – Main frame Systems – Desktop Systems – Multiprocessor Systems – Distributed Systems – Clustered Systems –Real-Time Systems – Handheld Systems – Feature Migration – Computing Environments -Process Scheduling – Cooperating Processes – Inter Process Communication- Deadlocks –Prevention – Avoidance – Detection – Recovery.	14
II	**Distributed Operating Systems:** Issues – Communication Primitives – Lamport's Logical Clocks – Deadlock handling strategies – Issues in deadlock detection and resolution-distributed file systems –design issues – Case studies – The Sun Network File System-Coda.	12
III	**Real Time Operating System :** Introduction – Applications of Real Time Systems – Basic Model of Real Time System – Characteristics – Safety and Reliability - Real Time Task Scheduling	10
IV	**Operating Systems for Handheld Systems:** Requirements –Technology – Overview– Handheld Operating Systems –Palm OS-Symbian Operating System Android – Architecture of android – Securing Handheld systems.	12
V	**Case Studies:** Linux System: Introduction – Memory Management – Process Scheduling – Scheduling Policy - Managing I/O devices – Accessing Files- iOS: Architecture and SDK Framework - Media Layer - Services Layer - Core OS Layer - File System.	12
	Total Hours	**60**
Text Books		
1.	Abraham Silberschatz, Peter Baer Galvin, Greg Gagne (2012), Operating System Concepts, 9th Edition, John Wiley & Sons.	
2.	Mukesh Singhal and Niranjan G. Shivaratri (2001), Advanced Concepts in Operating Systems –Distributed, Database, and Multiprocessor Operating Systems, 2nd Edition Tata McGraw-Hill.	
Reference Books		
1.	Rajib Mall (2006), Real-Time Systems: Theory and Practice, Pearson Education India.	
2.	Pramod Chandra P. Bhatt (2010), An introduction to operating systems, concept and practice, 3rd Edition, PHI.	
3.	Daniel.P Bovet and Marco Cesati (2005), Understanding the Linux Kernel,3rd Edition.	
4.	Neil Smyth (2011), iPhone iOS 4 Development Essentials–Xcode, 4th Edition, Payload media.	
Web Resources (Swayam / NPTEL)		
1.	https://onlinecourses.nptel.ac.in/noc20_cs04/preview	
2.	https://archive.nptel.ac.in/courses/106/105/106105172/	

Course Code	Course Name	Category	Hours / Week	Credits
24MCS1AE	Exploratory Data Analysis	Elective - I	4	4

Course Objectives

The course intends to cover

- Methods for data preparation and data understanding.
- Techniques such as correlation analysis, time series and dimensionality reductions.

Course Learning Outcomes

On the successful completion of the course, students will be able to

CLO	CLO Statements	Knowledge Level
CLO1	Understand missing data in the real-world data sets by choosing appropriate methods.	K1, K2
CLO2	Apply the data transformation techniques.	K3
CLO3	Analyze the correlation and time series.	K4
CLO4	Explain the importance of clustering algorithms and outlier detection.	K5
CLO5	Evaluate dimensionality reduction and model development.	K5
K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate		

CLO-PLO Mapping

CLOs/PLOs	PLO1	PLO2	PLO3	PLO4	PLO5
CLO1	3	2	3	3	3
CLO2	3	3	2	-	3
CLO3	3	3	3	-	2
CLO4	2	2	3	2	3
CLO5	3	3	3	3	3
3 - Substantial (high)		2 - Moderate (medium)		1 - Slight (low)	

Elective - I : Exploratory Data Analysis

Unit	Content	No. of Hours
I	**Introduction to Exploratory Data Analysis:** Steps in EDA, Data Types, Numerical Data – Discrete data, continuous data – Categorical data – Measurement Scales: Nominal, Ordinal, Interval, Ratio – Comparing EDA with classical and Bayesian Analysis – Software tools for EDA.	10
II	**Data Transformation:** Transformation Techniques: Performing data deduplication - replacing values – Discretization and binning. Introduction to Missing data, handling missing data: Traditional methods - Maximum Likelihood Estimation	10
III	**Correlation Analysis and Time Series Analysis:** Types of analysis: Univariate analysis - bivariate analysis - multivariate analysis. Time Series Analysis (TSA): Fundamentals of TSA - characteristics of TSA – Time based indexing - visualizing time series – grouping time series data - resampling time series data.	12
IV	**Clustering Algorithms:** Introduction to Spectral clustering – Document clustering – Minimum Spanning Tree clustering. Overview of Model-based clustering – Expectation-Maximization algorithm – Hierarchical Agglomerative model-based clustering. Outlier detection using Clustering.	12
V	**Dimensionality Reduction:** Linear Methods: Principal Component Analysis (PCA) – Singular Value Decomposition – Factor Analysis -Intrinsic Dimensionality. Non Linear methods: Multidimensional Scaling – Manifold Learning – Self-Organizing Maps. Model Development and Evaluation: Constructing linear regression model – evaluation – computing accuracy – understanding accuracy. Understanding reinforcement learning: Difference between supervised and reinforcement learning – Applications of reinforcement learning.	16
	Total Hours	**60**

Text Books

1.	Suresh Kumar Mukhiya, Usman Ahmed, (2020), Hands-On Exploratory Data Analysis with Python, 1st Edition, Packt Publishing.
2.	Martinez, W, Martinez A & J.L. Solka (2017), Exploratory Data Analysis with MATLAB,3rd Edition, CRC Press, A Chapman & Hall Book.

Reference Books	
1.	Charu C. Aggarwal (2015), Data Mining the Textbook, Springer.
2.	Craig K. Enders (2010), Applied Missing Data Analysis, 1st Edition, The Guilford Press.
3.	Michael Jambu (1991), Exploratory and multivariate data analysis, 1st Edition, Academic Press Inc.
Web Resources (Swayam / NPTEL)	
1.	https://drmcet.digimat.in/nptel/courses/video/103106112/L07.html
2.	https://nptel.ac.in/courses/109107190

Course Code	Course Name	Category	Hours / Week	Credits
24MCS1BE	Blockchain Technology and Applications	Elective - I	4	4

Course objectives

The course intends to cover

- Fundamentals of blockchain and crypto currency.
- Blockchain security features and its significance.
- Problems and challenges in blockchain

Course Learning Outcomes

On the successful completion of the course, students will be able to

CLO	CLO Statements	Knowledge Level
CLO1	Reminisce blockchain technology and understand crypto currency.	K1, K2
CLO2	Understand the mining mechanism in blockchain.	K2
CLO3	Apply the Cryptocurrency and trust model.	K3
CLO4	Interpret the Crypto economics and Cryptocurrency regulations.	K2
CLO5	Analyze the challenges and opportunities in blockchain.	K4
K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze		

CLO – PLO Mapping

CLOs/PLOs	PLO1	PLO2	PLO3	PLO4	PLO5
CLO1	3	2	3	-	-
CLO2	3	3	3	2	2
CLO3	3	2	3	3	3
CLO4	2	3	3	3	2
CLO5	3	3	3	3	3
3 - Substantial (high)		**2** - Moderate (medium)		**1** - Slight (low)	

Elective- I: Blockchain Technology and Applications

Unit	Content	No. of Hours
I	**Introduction to Blockchain:** The big picture of the industry – size, growth, structure, players. Bit coin versus Crypto currencies versus Blockchain - Distributed Ledger Technology (DLT). Strategic analysis of the space – Blockchain platforms, regulators, application providers. The major application: currency, identity, chain of custody	12
II	**Features of Blockchain**: Advantage over conventional distributed database – Blockchain Network, Mining Mechanism, Distributed Consensus, Blockchain 1.0, 2.0 and 3.0 – transition, advancements and features. Privacy, Security issues in Blockchain.	12
III	**Cryptocurrency** - History, Distributed Ledger, Bitcoin protocols - Symmetric-key cryptography - Public-key cryptography - Digital Signatures -High and Low trust societies - Types of Trust model: Peer-to-Peer, Leviathan, and Intermediary. Application of Cryptography to Blockchain	12
IV	**Cryptocurrency Regulation** - Stakeholders, Roots bit coin, Legal views - exchange of cryptocurrency – Black Market – Global Economy. **Cyrpto Economics**: assets, supply and demand, inflation & deflation – Regulation	12
V	**Opportunities and challenges in Blockchain:** Application of Blockchain - Industry 4.0 – machine to machine communication –Data Management Industry 4.0 – future chain in Health 4.0 – Blockchain properties - Healthcare Costs - Healthcare Quality - Healthcare Value - Challenges for using Blockchain for healthcare data	12
	Total Hours	**60**
Text Books		
1.	Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder (2016), Bitcoin and Crypto Currency Technologies: A Comprehensive Introduction, Princeton University Press.	
2.	Antonopoulos (2014), Mastering Bitcoin: Unlocking Digital Crypto Currencies, O'Reilly Media.	
Reference Books		
1.	Satoshi Nakamoto, Bitcoin: A Peer-to-Peer Electronic Cash System.	
2.	Rodrigoda Rosa Righi, Antonio Marcos Alberti, Madhusudan Singh (2020), Blockchain Technology for Industry 4.0, Springer.	
Web Resources (Swayam / NPTEL)		
1.	https://onlinecourses.swayam2.ac.in/aic21_ge01/preview	
2.	https://onlinecourses.nptel.ac.in/noc24_cs15/announcements?force=true	
3.	https://nptel.ac.in/courses/106105184	

Course Code	Course Name	Category	Hours / Week	Credits
24MCS1CE	Data Preprocessing and Visualization	Elective - I	4	4

Course Objectives

The course intends to cover

- Different types of databases.
- Data cleaning levels for data preprocessing.
- Data visualization using Python with 2D and 3D plotting.

Course Learning Outcomes

On the successful completion of the course, students will be able to

CLO	CLO Statements	Knowledge Level
CLO1	Understand the basic concepts of data and types of databases.	K1, K2
CLO2	Apply various levels of data cleaning in data preprocessing.	K3
CLO3	Interpolate data integration and data reduction.	K3
CLO4	Explore the data transformation and visualization skills using Python.	K4
CLO5	Infer advanced plotting techniques using matplotlib library in Python.	K3
K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** – Analyze		

CLO – PLO Mapping

CLOs/PLOs	PLO1	PLO2	PLO3	PLO4	PLO5
CLO1	2	2	2	1	1
CLO2	2	2	2	-	2
CLO3	3	3	2	1	2
CLO4	3	3	1	-	3
CLO5	3	3	1	-	3
3 - Substantial (high)		**2** - Moderate (medium)		**1** - Slight (low)	

Elective – I: Data Preprocessing and Visualization

Unit	Content	No. of Hours
I	**Introduction**: Data, Information, Knowledge and Wisdom (DIKW) pyramid – DIKW for data analytics – Data Preprocessing for data analytics versus machine learning – Data Objects – Data Attributes – types of data values – Information versus Pattern - Databases – Types of Databases – Connecting to, and pulling data from databases.	11
II	**The Preprocessing**: Purpose of data analytics – Tools for data analytics - Levels of data cleaning –Mapping the purposes and tools of analytics to the levels of data cleaning – Cleaning up the table –Unpacking columns and reformulating the table – restructuring the table – Missing values – Outliers – Errors.	11
III	**Data Fusion and Data Integration**: Data fusion versus Data integration – Directions of data integration – Entity identification – Unwise data collection – Index mismatched formatting – Aggregation mismatch – Duplicate data objects – data redundancy. Data Reduction: Objectives of data reduction – distinction between data reduction and data redundancy – Random sampling – Stratified sampling – Random over/under sampling – Performing dimensionality data reduction.	14
IV	**Data Transformation and Massaging**: Normalization and standardization – Binary coding, ranking transformation and discretization – Attribute construction – Feature extraction – Log transformation – Smoothing, aggregation and binning. Data Visualization: Data visualization in Python – Matplotlib for data visualization –Matplotlib figure with two subplots – Saving plots to file – Customize plot – Changing line and marker styles – Adding annotations and text – Creating subplots – Adjusting axis limits and tick marks – Using color maps.	12
V	**Advanced Plotting Techniques 2D:** Bar plot – Histogram – Box plot – Violin plot – Area plot – Stacked area plot –Polar plot – Pie chart – Heatmap – Contour plot – Hexbin plot – Stream plot. Advanced Plotting Techniques 3D: Surface terrain plot – Quiver plot – Tri-surface plot – Wireframe plot – Ribbon plot – Delaunay Triangulation plot – 3D polar plot – 3D Scatter plot – 3D Vector plot – Animated plot.	12
	Total Hours	**60**

Text Books

1.	Roy Jafari (2022), Hands-on Data Preprocessing in Python, Packt Publishing Ltd.
2.	Dr. Abhinav (2023), Data Visualization using Python Programming, Shashwat Publication.

Reference Books	
1.	Reis, Joe, Housley, Matt (2022), Fundamentals of Data Engineering, O'Reilly Media.
2.	Ihab F. Ilyas, Xu Chu (2019), Data Cleaning, Association for Computing Machinery.
Web Resources (Swayam / NPTEL)	
1.	https://onlinecourses.nptel.ac.in/noc22_cs32/preview
2.	https://onlinecourses.nptel.ac.in/noc21_cs45/preview

Components for Internal Assessment and

Distribution of Marks for CIA and ESE (Theory)

Max Marks	Marks for		Components for CIA									
	CIA	ESE	CIA – I		CIA – II		Best of CIA-I & CIA-II	Model		Attendance	Active Engagement	Total
100	25	75	Actual	Weightage	Actual	Weightage	Weightage	Actual	Weightage	5	5	25
			50	**5**	50	**5**	**5**	75	**10**			

Question Paper Pattern

Component	Duration in Hrs.	Section A			Section B			Section C			Total
		Type of question	No. of questions	Marks	Type of question	No. of questions	Marks	Type of question	No. of questions	Marks	
CIA – I &II	2	MCQ	8	8x1=8	Either or	3	3x6=18	Either or	3	3x8=24	50
Model Exam /ESE	3	MCQ	10	10x1=10	Either or	5	5x5=25	Either or	5	5x8=40	75

Components for Internal Assessment and Distribution of Marks for CIA (Lab)

Max Marks	Marks for		Components for CIA							
	CIA	ESE	Test – I		Test - II		Model		Observation	Total
100	40	60	Actual	Weightage	Actual	Weightage	Actual	Weightage	5	40
			50	**10**	50	**10**	60	**15**		

Examination Pattern

Component	Duration in Hrs.	Marks			Weightage
		Practical	Record	Total Marks	
Test – I	2	50	-	50	10
Test – II	2	50	-	50	10
Model	3	60	-	60	15
ESE	3	50	10	60	-

Part – IV : Ability Enhancement Compulsory Courses

(All the Undergraduate Programmes)

Course Code	Course Name	Category	Hours	Credits
24QUA1AE	Quantitative Aptitude	AECC - I	2	2

Course Objectives

The course intends to cover

- Basic concepts of numbers, time and work, interests, data representation and graphs
- Concepts of permutation, probability, discounts, percentage & profit loss.

Course Learning Outcomes

On the successful completion of the course, students will be able to

CLO	CLO Statements	Knowledge Level
CLO1	Remember and Understand the concepts of numbers and average	K1, K2
CLO2	Understand about percentage and apply profit & loss related processing.	K2, K3
CLO3	To understand the concepts of time and work and interest calculations.	K2
CLO4	To understand about the concepts of permutation, combination and probability.	K2
CLO5	Understand , Apply and analyze the concept of problem solving involved in graphs and age.	K2,,K3,K4
K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** -Analyze		

Ability Enhancement Compulsory Course(AECC) - I: Quantitative Aptitude

Unit	Content	No. of Hours
I	Numbers - Simplification - BODMAS rule - Algebraic formulas - Decimal fractions - Square root and cube roots - Surds and indices - Divisibility rules - HCF and LCM - same remainder - different remainder - application problems – average – equation - mistaken value – replacement - including/excluding.	6
II	Percentage - increase/decrease – netchange – salary – election – marks – consumption - population / machine - profit and loss - profit and loss % - finding cp and sp - profit=loss - same product cp and sp with percentage – discount - ratio and proportion - divided into parts - based on numbers - increase/decrease/ income / expenditure – coins – partnership.	6
III	Time-and-work - individual/combined - alternative days - remaining work - efficiency based - amount split - chain rule - group of male and female or boys - pipes and cistern - finding time - efficiency based – alternative - remaining part - capacity of the tank - simple interest - finding principal - rate of interest – amount - time period - doubles or triples - compound interest - finding rate - finding time, principal - doubles or triples - difference between SI and CI.	6
IV	Permutation - finding value - vowels come together - vowel never comes together -some letters come together - no two vowels come together - vowels in odd/even places - based on repetition - circular permutation – application – combination - finding value and application – probability – coins - dice-cards - balls and miscellaneous problems - odd man out and number series.	6
V	Clock - finding angle - reflex angle - gain or loss – calendars - finding particular day - data interpretation - bar chart - line chart - pie chart – table – combined –ages ratio-twice or thrice - addition /subtraction - family based - problems on numbers - equations.	6
	Total Hours	**30**
Text Book		
1.	R.S. Aggarwal , Quantitative Aptitude, S.Chand & Company Ltd.,	
Reference Book		
1.	Ashish Arora, Quantitative Aptitude.	
Web Resources		
1.	https://www.javatpoint.com/aptitude/quantitative	
2.	https://www.indiabix.com/aptitude/questions-and-answers/	

Components for and Distribution of Marks for ESE (Theory)

Ability Enhancement Compulsory Course(AECC)

Duration in Hrs.	Mode of exam	Type of questions	No. of questions	Marks
2	Online	MCQ	50	50x1=50

Semester 2

Course Code	Course Name	Category	Hours / Week	Credits
24MCS21C	Advanced Java Programming	Core - V	5	4

Course Objectives

The course intends to cover

- Advanced concepts of Java programming.
- JDBC, Servlet packages, Java Server Pages and JAR file formats.
- GUI based program using swing concepts.

Course Learning Outcomes

On the successful completion of the course, students will be able to

CLO	CLO Statements	Knowledge Level
CLO1	Recite the basic and networking concepts of Java Programming.	K1
CLO2	Understand the remote method invocation.	K2
CLO3	Infer Java with databases and Hibernate.	K3
CLO4	Analyze Servlet and evaluate JSP for client and server web application.	K4, K5
CLO5	Create interactive applications using advanced techniques.	K6
K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** – Analyze; **K5** – Evaluate; **K6** - Create		

CLO – PLO Mapping

CLOs/PLOs	PLO1	PLO2	PLO3	PLO4	PLO5
CLO1	2	1	3	2	2
CLO2	3	2	1	3	3
CLO3	1	3	2	2	3
CLO4	2	3	3	1	2
CLO5	3	2	3	3	3
3 - Substantial (high)		**2** - Moderate (medium)		**1** - Slight (low)	

Core V - Advanced Java Programming

Unit	Content	No. of Hours
I	**Introduction:** Java Basics Review: Components and event handling – Threading concepts. Java Networking: Network Basics and Socket overview - TCP/IP client sockets - TCP/IP server sockets – Datagrams - java.net package Socket- Server Socket- Inet Address- URL- URL Connection	12
II	**Remote Method Invocation**: Distributed Application Architecture- Creating stubs and skeletons - Defining Remote objects- Remote Object Activation- Object Serialization-Java Spaces	15
III	**Database**: Java in Databases- JDBC principles - database access- Interacting-database search - Creating multimedia databases - Database support in web applications. Hibernate 4.0:Overview of Hibernate, Hibernate Architecture, Hibernate Mapping Types, Hibernate O/R Mapping, Hibernate Annotation, Hibernate Query Language	16
IV	**Java Servlets**: Java Servlet and CGI programming- A simple java Servlet-Anatomy of a java Servlet-Reading data from a client-Reading http request header-sending data to a client and writing the http response header-working with cookies Java Server Pages: JSP Overview-Installation-JSP tags-Components of JSP page-Expressions – Scriptlets - Directives-Declarations-A complete example.	16
V	**Advanced Techniques**: JAR file format creation - Internationalization - Swing Programming - Advanced Java techniques. Java Server Faces2.0-Introduction to JSF, JSF request processing Life cycle, JSF Components.	16
	Total Hours	**75**

Text Books	
1.	Jamie Jaworski (1999), Java Unleashed, SAMST Tech Media Publications.
2.	Campione, Walrath and Huml (1999), The Java Tutorial, Addison Wesley.
Reference Books	
1.	Cay S.Horstmann (2024), Core Java Advanced Features, Pearson education.
2.	JimKeogh (2010), The Complete Reference J2EE, Tata McGraw Hill Publishing Company Ltd.
3.	David Swayer McFarland (2011), Java Script and JQuery – The Missing Manual, 3rd Edition, Oreilly Publication.
Web Resources (Swayam / NPTEL)	
1.	https://onlinecourses.nptel.ac.in/noc22_cs47/preview
2.	https://onlinecourses.swayam2.ac.in/nou24_cs09/preview

Course Code	Course Name	Category	Hours / Week	Credits
24MCS22P	Lab: Advanced Java Programming	Core Lab - III	4	3

S. No.	List of Programs
1.	Basic Java program using OOPs concept.
2.	Display a welcome message using Servlet.
3.	Write a program to build a simple Client Server application using RMI.
4.	Write a program using JDBC for creating a table, Inserting, deleting records and list out the records.
5.	Prepare an Employee pay slip using JSP.
6.	Creating a Database Application using Hibernate.
7.	Program using Java Servlet to handle form data.
8.	Develop a simple Servlet program to create a table of all the headers it receives along with their associated values.
9.	Program in JSP by using session object.
10.	Design a Purchase Order form using Html form and JSP.
11.	Create a web application that utilizes UI components using Java Server Faces.
12.	Create UI widgets and other components including windows, menus and buttons using AWT and Swing.
13.	Program to send a text message to another system and receive the text message from the system (use socket programming).
	Total Hours **60**

Text Books	
1.	Jamie Jaworski (1999), Java Unleashed, SAMST Tech Media Publications.
2.	Campione, Walrath and Huml (1999), The Java Tutorial, Addison Wesley.
Reference Books	
1.	Cay S.Horstmann (2024), Core Java Advanced Features, Pearson education.
2.	JimKeogh (2010), The Complete Reference J2EE, Tata McGraw Hill Publishing Company Ltd.
3.	David Swayer McFarland (2011), Java Script and JQuery – The Missing Manual, 3rd Edition, Oreilly Publication.
Web Resources (Swayam / NPTEL)	
1.	https://onlinecourses.nptel.ac.in/noc22_cs47/preview
2.	https://onlinecourses.swayam2.ac.in/nou24_cs09/preview
3.	https://onlinecourses.nptel.ac.in/noc19_cs84/preview
4.	https://onlinecourses.nptel.ac.in/noc21_cs03/preview

Course Code	Course Name	Category	Hours / Week	Credits
24MCS23C	Artificial Intelligence and Machine Learning	Core - VI	5	4

Course Objectives

The course intends to cover

- Functions of AI, General Search Techniques.
- Concepts of representations, mappings and predicate logic.
- Machine Learning with Data Mining, Big Data and Cloud.
- Applications and impact of Machine Learning.

Course Learning Outcomes

On the successful completion of the course, students will be able to

CLO	CLO Statements	Knowledge Level
CLO1	Demonstrate AI problems and design the techniques.	K1, K2
CLO2	Understand knowledge designing techniques and use algorithms for ML training.	K2, K3
CLO3	Apply basic principles of AI in solutions that require problem solving, inference, perception, knowledge representation, and learning.	K3, K4
CLO4	Explore the impact of machine learning on applications for real time implementation.	K4
CLO5	Analyze real-world problems for implementation and understand the dynamic behaviour of a system.	K4
K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze		

CLO – PLO Mapping

CLOs/PLOs	PLO1	PLO2	PLO3	PLO4	PLO5
CLO1	1	2	3	3	3
CLO2	1	2	3	3	3
CLO3	3	2	3	3	3
CLO4	3	2	3	3	3
CLO5	3	2	3	3	3
3 - Substantial (high)		**2** - Moderate (medium)		**1** - Slight (low)	

Core – VI: Artificial Intelligence and Machine Learning

Unit	Content	No. of Hours
I	**Introduction:** AI Problems - Al techniques - Criteria for success. Problems, Problem Spaces, Search: State space search - Production Systems - Problem Characteristics - Issues in design of Search.	14
II	**Heuristic Search techniques:** Generate and Test - Hill Climbing- Best-First, Problem Reduction, Constraint Satisfaction, Means-end analysis. Knowledge representation issues: Representations and mappings -Approaches to Knowledge representations -Issues in Knowledge representations - Frame Problem.	15
III	**Using Predicate logic**: Representing simple facts in logic - Representing Instance and Isa relationships - Computable functions and predicates - Resolution - Natural deduction. Representing knowledge using rules: Procedural Vs Declarative knowledge- Logic programming –Forward Vs Backward reasoning -Matching-Control knowledge.	16
IV	**Understanding Machine Learning:** Introduction to Machine Learning-defining Big Data –Big Data in Context with Machine Learning-The Importance of the Hybrid Cloud-Leveraging the Power of Machine Learning - The Roles of Statistics and Data Mining with Machine Learning-Putting Machine Learning in Context-Approaches to Machine Learning.	16
V	**Looking Inside Machine Learning:** The Impact of Machine Learning on Applications – Data Preparation-The Machine Learning Cycle.	14
	Total Hours	**75**
Text Books		
1.	Elaine Rich and Kevin Knight (2017), Artificial Intelligence, Tata McGraw Hill Publishers company Pvt Ltd, 2nd Edition.	
2.	Stuart J. Russell and Peter Norvig (2010), Artificial Intelligence A Modern Approach, 3rd Edition, Pearson Education.	
3.	Denis Rothmanl (2022), Artificial Intelligence, By Example 2nd Edition, Packt.	
4.	Vinod Chandra, (2022) Artificial Intelligence and Machine Learning, 1st Edition, kindle.	
Reference Books		
1.	George F Luger (2002), Artificial Intelligence, 4th Edition Pearson Education Publication.	
2.	Judith Hurwitz, Daniel Kirsch (2010), Machine Learning For Dummies IBM Limited Edition.	
Web Resources (Swayam / NPTEL)		
1.	https://nptel.ac.in/courses/106106226	
2.	https://nptel.ac.in/courses/106106140	
3.	https://nptel.ac.in/domains/discipline/106?course=106_0	
4.	https://nptel.ac.in/courses/106106158	
5.	https://nptel.ac.in/courses/106101360	

Course Code	Course Name	Category	Hours / Week	Credits
24MCS24P	Lab: Artificial Intelligence and Machine Learning	Core Lab - IV	4	3

S. No.	List of Programs
1.	Basics of PROLOG Programming language and its Functions.
2.	Write simple facts for the statements using PROLOG.
3.	Implementation of Depth First Search for Water Jug problem.
4.	Implementation of Breadth First Search for Tic-Tac-Toe problem.
5.	Solve an 8-puzzle problem using Best First Search.
6.	Write a PROLOG program to solve the N-Queens problem.
7.	Implementation of Traveling Salesman Problem
8.	Implementation of Python Basic Libraries such as Math, NumPy and SciPy
9.	Implementation of Python Libraries for ML applications such as Pandas and Matplotlib.
	Total Hours **60**

Text Books

1.	George F Luger (2022), Artificial Intelligence, 4th Edition Pearson Education Publication.
2.	Vinod Chandra (2022), Artificial Intelligence and Machine Learning, 1st Edition, kindle.

Reference Books

1.	Denis Rothmanl (2022), Artificial Intelligence by Example 2nd Edition, Packt.
2.	Judith Hurwitz, Daniel Kirsch (2010), Machine Learning for Dummies, IBM Limited Edition.

Web Resources (Swayam / NPTEL)

1.	https://nptel.ac.in/courses/106106226
2.	https://nptel.ac.in/courses/106106140

Course Code	Course Name	Category	Hours / Week	Credits
24MCS25C	Data Mining	Core - VII	4	4

Course Objectives

The course intends to cover

- Various data mining algorithms to solve real-world problems.
- Classification, prediction, clustering and association rule mining of Data mining process.

Course Learning Outcomes

On the successful completion of the course, students will be able to

CLO	CLO Statements	Knowledge Level
CLO1	Understand the basic data mining techniques and algorithms	K1, K2
CLO2	Interpret the Association rules, Clustering techniques.	K2, K3
CLO3	Analyze and evaluate different data mining techniques like classification, prediction, Clustering and association rule mining.	K4, K5
CLO4	Explore statistical methods and visualization techniques.	K4
CLO5	Apply appropriate data mining algorithms to solve real world problems.	K3
K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze ; **K5**-Evaluate		

CLO – PLO Mapping

CLOs/PLOs	PLO1	PLO2	PLO3	PLO4	PLO5
CLO1	3	2	2	-	2
CLO2	3	2	2	-	2
CLO3	3	3	3	2	2
CLO4	3	3	3	3	3
CLO5	3	3	3	3	3
3 - Substantial (high)		**2** - Moderate (medium)		**1** - Slight (low)	

Core – VII : Data Mining

Unit	Content	No. of Hours
I	**Basic data mining tasks** – data mining versus knowledge discovery in databases – data mining issues – data mining metrics – social implications of data mining – data mining from a database perspective. Data mining techniques: Introduction – a statistical perspective on data mining – similarity measures – decision trees – neural networks – genetic algorithms.	12
II	**Classification:** Introduction –Statistical –based algorithms -distance–based algorithms-decision tree-based algorithms-neural network–based algorithms – rule – based algorithms – combining techniques.	12
III	**Clustering:** Introduction–Similarity and Distance Measures – Outliers – Hierarchical Algorithms – Partitional Algorithms. Association rules: Introduction - large item sets - basic algorithms – parallel & distributed algorithms – comparing approaches- incremental rules – advanced association rules techniques – measuring the quality of rules.	12
IV	**Statistical Descriptions and Data Visualization:** Basic Statistical Descriptions of Data - Measuring the Central Tendency: Mean, Median, and Mode - Measuring the Dispersion of Data: Range, Quartiles, Variance, Standard Deviation, and Interquartile Range - Graphic Displays of Basic Statistical Descriptions of Data. Data visualization: Pixel-Oriented Visualization Techniques- Geometric Projection Visualization Techniques - Icon-Based Visualization Techniques - Hierarchical Visualization Techniques - Visualizing Complex Data and Relations.	14
V	**Data Mining Trends And Research Frontiers:** Mining Complex Data Types, Other Methodologies of Data Mining, Data Mining Applications, Data Mining and Society, Data Mining trends.	10
	Total Hours	**60**

Text Books	
1.	Margaret H Dunham (2003), Data Mining Introductory and Advanced topics, Pearson Education/Prentice Hall.
2.	Jiawei Han & Micheline Kamber (2012), Data Mining Concepts & Techniques, 3rd Edition, Academic press.
Reference Books	
1.	Arun K Pujari (2003), Data Mining Techniques, 3rd Edition, Universities Press.
2.	Alex Berson, Stephen J. Smith (2001), Data Warehousing, Data Mining and OLAP, TMCH.

Web Resources (Swayam / NPTEL)	
1.	https://onlinecourses.nptel.ac.in/noc24_cs22/preview
2.	https://onlinecourses.swayam2.ac.in/cec19_cs01/preview

Course Code	Course Name	Category	Hours / Week	Credits
24MCS2AE	Big Data Analytics	Elective - II	4	4

Course Objectives

The course intends to cover

1. R Programming, Mapreduce and Hadoop based analytics and HDFS architecture.
2. Big data collection and analysis.
3. Project development under big data.

Course Learning Outcomes

On the successful completion of the course, students will be able to

CLO	CLO Statements	Knowledge Level
CLO1	Interpret the basic and importance of big data.	K1, K2
CLO2	Understand the R language and its application with big data.	K2
CLO3	Apply the Hadoop features and HDFS.	K3
CLO4	Infer the security controls in big data.	K3
CLO5	Analyze HDFS, MapReduce architecture and Machine learning concepts.	K4
K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze		

CLO – PLO Mapping

CLOs/PLOs	PLO1	PLO2	PLO3	PLO4	PLO5
CLO1	3	2	-	3	3
CLO2	3	2	3	3	2
CLO3	2	3	2	-	3
CLO4	2	2	-	3	2
CLO5	3	-	-	2	3
3 - Substantial (high)		**2** - Moderate (medium)		**1** - Slight (low)	

Elective - II : Big Data Analytics

Unit	Content	No. of Hours
I	**Importance of Big Data:** Introduction to big data analytics - what is big data? - Challenges in big data - Big data in business perspectives - Big data from technology perspectives - 5 V's of big data - Importance of Big Data: A Flood of Mythic. Industry Examples of Data: Digital Marketing and the Non - line World – Database Marketers, Pioneers of Big Data – Big Data and the New School of Marketing.	12
II	**Data analytics tools for Big Data:** An overview of analytics tools : R & Hadoop - Installing R - Installing RStudio - Understanding the features of R language - Using R - packages - Performing data operations - Increasing community support - Performing data modeling in R.- Hadoop environment - Core component of hadoop - Mapreduce working methodology - Case study: Walmart data processing.	10
III	**HDFS and Storage of data**: Understanding Hadoop features - Understanding HDFS - Understanding the characteristics of HDFS - Understanding MapReduce - Learning the HDFS and MapReduce architecture. Big Data Storage - Big Data Storage Challenges - Key Insights for Big Data Storage - Data storage methods: Warehouse Storage - Cloud Storage. Data Storage Technologies: Hadoop - HBase. Case Study: Health care data storage and challenges.	14
IV	**Security Planning in Big data:** Big data security - Important to secure big data - The architecture of big data security - Big data security works - Types of data security controls - The major big data security challenges - The big data security best practices. The best security tools for big data storage.	12
V	**MapReduce Architecture & ML:** Understanding the HDFS architecture - Understanding HDFS components - Understanding the MapReduce architecture - Understanding MapReduce components. Machine Learning: Introduction, Supervised Learning, Unsupervised Learning, Big Data Analytics with R.	12
	Total Hours	**60**

Text Books	
1.	Michael Minelli , Michele Chambers , Ambiga Dhiraj (2014), Big Data Big Analytics, Wiley Publications, Indian Reprint.
2.	Wiley, John Wiley and Sons (2015), Data Science in Big Data Analytics.
Reference Books	
1.	Vignesh Prajapati (2013), Big Data Analytics with R and Hadoop, PACKT Publishing.
3.	Chris Eaton, Dirk Deroos,Tom Deutsch, George Lapis, Paul Zikopoulos (2012), Understanding Big Data, Analytics for Enterprise Class Hadoop and Streaming Data, Tata Mc Graw Hill.
Web Resources (Swayam / NPTEL)	
1.	https://onlinecourses.nptel.ac.in/noc20_cs92/preview

Course Code	Course Name	Category	Hours / Week	Credits
24MCS2BE	Ethical Hacking	Elective - II	4	4

Course Objectives

The course intends to cover

- Fundamentals of hacking, foot printing and scanning.
- Threats caused by malware, denial of service, sniffers and session hijacking.
- Problems and solutions for web server and database server hacking.
- Attacks of mobile security, wireless technologies, IDS and firewalls.

Course Learning Outcomes

On the successful completion of the course, students will be able to

CLO	CLO Statements	Knowledge Level
CLO1	Understand the foundations of Ethical hacking.	K1, K2
CLO2	Defend the concepts of foot printing, windows enumeration and system hacking.	K2
CLO3	Explore the various forms of malware threats.	K4
CLO4	Analyze on the web server and web application hacking.	K4
CLO5	Apply the concept of firewalls, honeypots and physical security.	K3
K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze		

CLO – PLO Mapping

CLOs/PLOs	PLO1	PLO2	PLO3	PLO4	PLO5
CLO1	2	1	3	2	2
CLO2	3	2	1	3	3
CLO3	1	3	2	2	3
CLO4	2	3	3	1	2
CLO5	3	2	3	3	3
3 - Substantial (high)		**2** - Moderate (medium)		**1** - Slight (low)	

Elective- II: Ethical Hacking

Unit	Content	No. of Hours
I	**An Introduction to ethical Hacking:** Security Fundamental - Security testing - Hacker and Cracker – Descriptions - Test Plans - keeping It legal - Ethical and Legality. The Technical Foundations of Hacking: The Attacker's Process -The Ethical Hacker's Process - Security and the Stack.	10
II	**Foot printing and scanning:** Information Gathering, Determining the Network Range, Identifying Active Machines, Finding Open Ports and Access Points, OS Fingerprinting Services, Mapping the Network Attack Surface. Enumeration and System Hacking : Windows Enumeration - NetBIOS and LDAP Enumeration - SNMP Enumeration - Nontechnical Password Attacks - Technical Password Attacks - Privilege Escalation and Exploiting Vulnerabilities	14
III	**Malware Threats**: Viruses and Worms - Trojans - Covert Communication - Keystroke Logging and Spyware - Malware Counter measures – Sniffers. Session Hijacking and Denial of Service : Sniffers - Session Hijacking - Denial of Service and Distributed Denial of Service	11
IV	**Web Server - Applications and Database Attacks**: Web Server Hacking - Web Application Hacking - Database Hacking - Wireless Technologies - Mobile Security and Attacks : Wireless Technologies - Mobile Device Operation and Security - Wireless LANs - Wireless Hacking Tools - Securing Wireless Networks	13
V	**IDS - Firewalls and Honeypots** : Intrusion Detection Systems - Firewalls - Honeypots - Physical Security and Social Engineering: Physical Security - Social Engineering	12
	Total Hours	**60**
Text Books		
1.	Michael Gregg (2017), Certified Ethical Hacker, Version 9, 2nd Edition, Pearson IT Certification.	
2.	Ankit Fadia, The Unofficial Guide to Ethical Hacking, Premier Press.	
Reference Books		
1.	Gray hat hacking (2011), The Ethical hackers handbook – Allen Harper,Shon Harris, Jonathan Ness, 3rd Edition, Mc GrawHill.	
2.	Alana Maurushat (2019), Ethical Hacking University of Ottawa Press.	
Web Resources (Swayam / NPTEL)		
1.	https://onlinecourses.nptel.ac.in/noc23_cs44/preview	
2.	https://onlinecourses.nptel.ac.in/noc22_cs13/preview	

Course Code	Course Name	Category	Hours / Week	Credits
24MCS2CE	Neural Networks and Deep Learning	Elective - II	4	4

Course Objectives

The course intends to cover

- Neural networks in engineering, artificial intelligence and cognitive modelling.
- Supervised learning in neural networks.
- Role of machine learning and deep neural networks.

Course Learning Outcomes

On the successful completion of the course, students will be able to

CLO	CLO Statements	Knowledge Level
CLO1	Recite the basics of neural networks.	K1
CLO2	Understand the various techniques of single layer perceptron.	K2
CLO3	Apply the back propagation techniques.	K3
CLO4	Interpolate the basics of machine learning.	K2
CLO5	Infer the newer optimization methods for deep neural networks.	K3
K1 - Remember; **K2** - Understand; K**3** - Apply		

CLO – PLO Mapping

CLOs/PLOs	PLO1	PLO2	PLO3	PLO4	PLO5
CLO1	1	1	1	2	2
CLO2	2	2	2	2	2
CLO3	2	3	2	2	2
CLO4	1	2	2	2	2
CLO5	2	3	2	2	2
3 - Substantial (high)		**2** - Moderate (medium)		**1** - Slight (low)	

Elective II : Neural Networks and Deep Learning

Unit	Content	No. of Hours
I	**Introduction**: Overview of neural network - Human Brain - Models of a Neuron - Neural networks viewed as Directed Graphs-Network Architectures - Knowledge Representation, Artificial Intelligence and Neural Networks	11
II	**Single Layer Perceptron**: Adaptive filtering problem - Unconstrained Organization Techniques - Linear least square filters - least mean square algorithm - learning curves- Learning rate annealing techniques- perception –convergence theorem - Relation between perception and Bayes classifier for a Gaussian Environment	13
III	**Back Propagation**: Back propagation and differentiation - Hessian matrix - Generalization - Cross validation - Network pruning Techniques - Virtues and limitations of back propagation learning - Accelerated convergence - supervised learning.	12
IV	**Introduction to Machine Learning:** Scalars – Vectors – Matrices – Tensors – Identity and Inverse Matrices – Linear Dependence and Span– Eigen Decomposition – Probability – Random Variables – Conditional Probability – Expectation –Variance – Covariance –Bayes' Rule – Supervised Learning Algorithm – Unsupervised Learning Algorithm.	13
V	**Deep Neural Networks**: Difficulty of training deep neural networks- Greedy layer wise training. **Better Training of Neural Networks**: Newer optimization methods for neural networks - second order methods for training - Saddle point problem in neural networks.	11
	Total Hours	**60**
Text Books		
1.	Ian Goodfellow, Yoshua Bengio and Aaron Courville (2017), Deep Learning, MIT Press.	
2.	Charu C. Aggarwal (2018), Neural Networks and Deep Learning.	
Reference Books		
1.	Umberto Michelucci (2018), Applied Deep Learning. A Case-based Approach to Understanding Deep Neural Networks.	
2.	Kevin P. Murphy (2012), Machine Learning: A Probabilistic Perspective, The MIT Press.	
3.	Aaron Courville, Ian Goodfellow, Yoshua Bengio (2016), Deep Learning (Adaptive Computation and Machine Learning series).	
4	Haykin (2016), Neural Networks and Learning Machines.	

Web Resources (Swayam / NPTEL)	
1.	https://onlinecourses.nptel.ac.in/noc20_cs88/preview
2.	https://onlinecourses.nptel.ac.in/noc24_ge17/preview
3.	https://onlinecourses.nptel.ac.in/noc24_ee01/preview

Course Code	Course Name	Category	Hours / Week	Credits
24MCS26P	Lab: Data Mining	SEC Lab - I	2	3

S. No.	List of Programs
1.	Perform data cleaning techniques for a data set.
2.	Perform Data Normalization using min-max, z-score and normalization by decimal scaling methods.
3.	Find the outliers using various Outlier detection methods.
4.	Implement k-means clustering technique.
5.	Implement any one Hierarchical Clustering.
6.	Implement Classification algorithm.
7.	Implement Decision Tree.
8.	Linear Regression.
9.	Implement Apriori algorithm to extract association rule of data mining.
10.	Data Visualization.
	Total Hours **30**
Text Books	
1.	Margaret H Dunham (2003), Data Mining Introductory and Advanced topics, Pearson Education/Prentice Hall.
2.	Jiawei Han & Micheline Kamber, (2012), Data Mining Concepts & Techniques, 3rd Edition, Academic press.
Reference Books	
1.	Arun K Pujari (2003) Data Mining Techniques, 3rd Edition, Universities Press.
2.	Alex Berson, Stephen J. Smith (2001), Data Warehousing, Data Mining and OLAP, MCH.
Web Resources (Swayam / NPTEL)	
1.	https://onlinecourses.nptel.ac.in/noc24_cs22/preview
2.	https://onlinecourses.swayam2.ac.in/cec19_cs01/preview

Components for Internal Assessment and Distribution of Marks for CIA and ESE (Theory)

Max Marks	Marks for		Components for CIA									
	CIA	ESE	CIA – I		CIA – II		Best of CIA-I & CIA-II	Model		Attendance	Active Engagement	Total
100	25	75	Actual	Weightage	Actual	Weightage	Weightage	Actual	Weightage	5	5	25
			50	5	50	5	5	75	10			

Question Paper Pattern

Component	Duration in Hrs.	Section A			Section B			Section C			Total
		Type of question	No. of questions	Marks	Type of question	No. of questions	Marks	Type of question	No. of questions	Marks	
CIA – I &II	2	MCQ	8	8x1=8	Either or	3	3x6=18	Either or	3	3x8=24	50
Model Exam /ESE	3	MCQ	10	10x1=10	Either or	5	5x5=25	Either or	5	5x8=40	75

Components for Internal Assessment and Distribution of Marks for CIA (Lab)

Max Marks	Marks for		Components for CIA							
	CIA	ESE	Test – I		Test - II		Model		Observation	Total
100	40	60	Actual	Weightage	Actual	Weightage	Actual	Weightage	5	40
			50	10	50	10	60	15		

Examination Pattern

Component	Duration in Hrs.	Marks			Weightage
		Practical	Record	Total Marks	
Test – I	2	50	-	50	10
Test – II	2	50	-	50	10
Model	3	60	-	60	15
ESE	3	50	10	60	-

Part – IV : Ability Enhancement Compulsory Courses

(All the Undergraduate Programmes)

Course Code	Course Name	Category	Hours / week	Credits
24SOF2AE	Soft Skills	AECC - II	2	2

Course Objectives

The course intends to cover

- The essential soft skills that is crucial for success in today's dynamic and interconnected workplace.

Course Learning Outcomes

On the successful completion of the course, students will be able to

CLO	CLO Statements	Knowledge Level
CLO1	Understand the comprehensive skills to participate actively in conversation, writing short texts with expression	K1, K2, K3
CLO2	Infer the cohesive devices to describe and discuss any objects, pictures using compound, complex sentence forms.	K2, K3
CLO3	Comprehend the logic in the given situation to organize the ideas to write formal and informal letters.	K2, K3
CLO4	Understand the given material to organize it in a logical sequence to present a paragraph with main and supporting ideas with concluding sentences.	K3
CLO5	Present valuable ideas in conversation to emulate the main ideas and key points in short essays.	K3
K1 - Remember; **K2** - Understand; **K3** - Apply;		

Ability Enhancement Compulsory Course - II : Soft Skills

Unit	Details	No. of Hours
I	**Presentation Skills : Getting to Know You:** Grammar: Introduction to Tenses; Listening: Fill in the blanks; Speaking: Self Introduction, Everyday English, Role-Play; Reading: Different ways of communication. **My Day:** Grammar: Present simple positive & negative / Adverbs of Frequency; Vocabulary & Speaking: Daily Activities; Listening: Observe and Answer / Telling the time; Reading & Writing: Describe where you live. **Your World:** Grammar: Possessive determiners; Vocabulary & Speaking: Talk about countries, nationalities; Listening: Positive & negative contractions; Reading & Writing: Personal profile. **The World Of Work:** Grammar: Yes/No & Wh Questions; Vocabulary & Speaking: Jobs; Listening: Recognize the schwa sound; Reading & Writing: Opening and closing an email. .**Places And Things:** Grammar: There is / there are, articles; Vocabulary & Speaking: Talk about rooms & furniture; Listening: Directions; Reading & Writing: Imperatives.**24 Hours:** Grammar: Likes & Dislikes; Vocabulary & Speaking: Speak about hobbies and interests; Listening: Observe & answer; Reading: Match the photos with descriptions; Writing: Write complete sentence using prompts;	6
II	**Confidence : Clothes and Shopping:** Grammar: Modal verbs / Adverbs of Frequency / Adjectives and Adverbs; Vocabulary & Speaking: Shopping; Listening: Observe and Answer; Reading & Writing: Product Review. **Travel & Transport:** Grammar: Past simple questions; Vocabulary & Speaking: Talk about holidays; Listening: At the train station; Reading & Writing: Email - A perfect holiday. **Health & Fitness:** Grammar: Past simple irregular verbs; Vocabulary & Speaking: Talk about a healthy lifestyle; Listening: Listen & Answer; Reading & Writing: Time sequencers. **Music:** Grammar: Present perfect simple; Vocabulary & Speaking: Survey about music; Listening: Listen two people talk about music; Reading: Use adjectives and create sentences. **Let's go shopping:** Grammar: Countable & Uncountable; Vocabulary & Speaking: Town Survey; Listening: Listen and answer; Reading & Writing: Read and match	6
III	**Creativity :Cooking & Eating:** Grammar: Some & Any, Quantifiers; Vocabulary & Speaking: Food & Drink; Listening: Kitchen conversation; Reading & Writing: Article reading & answering. **Survival:** Grammar: Comparison of adjectives; Vocabulary & Speaking: Describing people; Listening: Listen & Answer; Reading & Writing: Read and Answer. **Working Together:** Grammar: Verb + Noun phrases; Vocabulary & Speaking: Talk about technology; Listening: Listen & Answer; Reading & Writing: Notice. **Music:** Grammar: Present perfect simple; Vocabulary & Speaking: Survey about music; Listening: Listen two people talk about music; Reading: Use adjectives and create sentences. **Culture and Arts:** Grammar: Present perfect; Vocabulary & Speaking: Speak on the phone; Listening: Listen and answer; Reading & Writing: Review	6

Unit	Content	
IV	**Problem-Solving :Do's and Don'ts:** Grammar: Modal verbs; Vocabulary & Speaking: Role play; Listening: Holidays in January; Reading & Writing: Article reading & answering. **Body:** Grammar: First conditional; Vocabulary & Speaking: Personality & Appearance; Listening: Listen to conversations about personality; Reading & Writing: Read and Answer about your skills. **Speed:** Grammar: Present simple passive; Vocabulary & Speaking: Talk about relationships; Listening: Listen & Answer; Reading & Writing: Error spotting. **Work:** Grammar: Adverbs of manner; Vocabulary & Speaking: Talk about work advice; Listening: Observe & Answer; Reading: Read & check your ideas	6
V	**Critical Thinking : Influence:** Grammar: would / past habits; Listening: Sentence Correction; Speaking & Vocabulary: Your inspiration; Reading: Picture description; Writing: Rewrite the sentences. **Money:** Grammar: Second conditional; Listening: radio programme; Speaking & Vocabulary: Talk about games; Reading & Writing: Fill in the blanks. **Things that changed the world:** Grammar: articles; Speaking & Listening: Talk about chewing gum; Reading & Writing: Read and write a book review	6
	Total Hours	**30**

Components for and Distribution of Marks for ESE (Theory)

Ability Enhancement Compulsory Course(AECC)

Duration in Hrs.	Mode of Exam	Type of Questions	No. of Questions	Marks
2	Online	MCQ	50	50x1=50

Semester 3

Semester – 3									
Course Code	**Part**	**Course Category**	**Course Name**	**Hours / Week**	**Examination**				**Credits**
					Duration in hrs.	**Max Marks**			
						CIA	**ESE**	**Total**	
24MCS31C	III	Core – VIII	Digital Image Processing	6	3	25	75	100	4
24MCS32C	III	Core – IX	Network Security and Cryptography	6	3	25	75	100	4
24MCS33P	III	Core Lab - V	**(Embedded) Lab:** Cloud Computing	7	3	40	60	100	5
24MCS34P	III	Core Lab- VI	**Lab:** Web Application Development and Hosting	4	3	40	60	100	3
24MCS3AE	III	Elective - III	Social Network Analytics	5	3	25	75	100	4
24MCS3BE	III		Digital and Mobile Forensics						
24MCS3CE	III		Generative AI and Prompt Engineering						
24MCS35P	III	SEC Lab - II	**Lab:** Digital Image Processing	2	3	40	60	100	3
24MCS37I	III	SEC	**SEC:**Internship	-	-	50	-	50	2
24MOO3AE	IV	AECC – III	Online Course MOOC	-	-	50	-	50	2
Total				**30**				**700**	**27**

Course Code	Course Name	Category	Hours / Week	Credits
24MCS31C	Digital Image Processing	Core - VIII	6	4

Course Objectives

This course intends to cover

- Basics of Image Processing.
- Image Transformation and Enhancement.
- Image Compression and Segmentation.

Course Learning Outcomes

On the successful completion of the course, students will be able to

CLO	CLO Statements	Knowledge Level
CLO1	Identify the core concepts of Digital Image Processing.	K1
CLO2	Understand the image enhancement techniques.	K2
CLO3	Apply image filtering, segmentation, and compression methods.	K3
CLO4	Analyze appropriate methods for real-time applications.	K4
CLO5	Evaluate applications using image filtering, segmentation, and recognition.	K5
K1 – Remember; **K2** - Understand; **K3** - Apply; **K4** – Analyze; **K5** – Evaluate		

CLO – PLO Mapping

CLOs/PLOs	PLO1	PLO2	PLO3	PLO4	PLO5
CLO1	3	3	1	3	2
CLO2	3	3	3	3	2
CLO3	3	3	3	3	3
CLO4	3	3	3	3	3
CLO5	2	3	3	3	3
3 - Substantial (high)		2 - Moderate (medium)		1 - Slight (low)	

Core VIII : Digital Image Processing

Unit	Content	No. of Hours
I	**Introduction:** What is Digital Image Processing – the origin of DIP – Fundamentals steps in DIP – Components of an image processing system. Digital Image Fundamentals: Elements of Visual perception – Light and the electromagnetic spectrum – Image sensing and acquisition – Image sampling and Quantization – Some Basic relationship between Pixels – Linear & Nonlinear operations.	18
II	**Image Enhancement in the spatial domain:** Background – some basic gray level transformations – Histogram Processing – Enhancement using Arithmetic / Logic operations – Basics of spatial filtering – Smoothing spatial filters – Sharpening spatial filters – Combining spatial enhancement methods.	18
III	**Image Restoration:** A model of the Image Degradation / Restoration Process – Noise models – Restoration is the process of noise only – Spatial Filtering – Periodic Noise reduction by frequency domain filtering – Linear, Portion – Invariant Degradations – Estimating the degradation function – Inverse filtering – Minimum mean square Error Filtering – Constrained least squares filtering – Geometric mean filter – Geometric Transformations.	19
IV	**Image Segmentation:** Detection and Discontinuities – Edge Linking and Boundary deduction – Thresholding – Region-Based segmentation – Segmentation by Morphological watersheds – The use of motion in segmentation. Color Image Processing: Color Fundamentals, Color Models, Color Segmentation.	17
V	**Image Compression:** Fundamentals – Image compression models – Elements of Information Theory – Error Free compression – Lossy compression – Image compression standards. Digital Image Processing Applications: Medical Imaging, Industrial Automation, Scientific Research, Remote sensing. Imaging, Industrial Automation, Scientific Research, Remote sensing.	18
	Total Hours	**90**
Text Books		
1.	Rafael C. Gonzalez, Richard E. Woods, (2018), Digital Image Processing, 4th Edition, Pearson Education.	
2.	Chanda B, Dutta Majumder D, (2009), Digital Image Processing and Analysis, PHI.	
Reference Book		
1.	Sandipan Dey, (2018), Hands-On Image Processing with Python, O'Reilly.	
Web Resources (Swayam / NPTEL)		
1.	https://onlinecourses.nptel.ac.in/noc22_ee116/preview	

Course Code	Course Name	Category	Hours / Week	Credits
24MCS32C	Network Security and Cryptography	Core - IX	6	4

Course Objectives

The course intends to cover

- Basics of Network Security and Cryptography.
- Crypto system and various domains of network security.
- Web security protocols and challenges.
- Various cryptographic algorithms.

Course Learning Outcomes

On the successful completion of the course, students will be able to

CLO	CLO Statements	Knowledge Level
CLO1	Remember and understand the process of Cryptography and its algorithms.	K1, K2
CLO2	Understand the concepts of cryptosystem and key management techniques.	K2
CLO3	Apply the network security concepts in various domains.	K3
CLO4	Analyze the web security protocols and challenges.	K4
CLO5	Evaluate cryptographic algorithm using programs.	K5
K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** – Analyze; **K5** - Evaluate		

CLO-PLO Mapping

CLOs/PLOs	PLO1	PLO2	PLO3	PLO4	PLO5
CLO1	2	2	2	2	2
CLO2	2	2	2	2	2
CLO3	2	2	2	2	2
CLO4	3	3	3	3	3
CLO5	2	2	2	2	2
3 - Substantial (high)		2 - Moderate (medium)		1 - Slight (low)	

Core - IX : Network Security and Cryptography

Unit	Content	No. of Hours
I	**Introduction to Cryptography:** The OSI Security Architecture - Security Attacks – Security Services –Security mechanism - A model of Network Security - Symmetric cipher and Block cipher - Steganography - The Euclidean Algorithm – DES – Triple DES – AES cipher – Blowfish.	18
II	**Public Key Encryption and Hash Functions:** Introduction to Number Theory - RSA Algorithm – Key Management - Diffie-Hellman Key exchange – ElGamal Cryptosystem - Elliptic Curve Cryptography - Message Authentication and Hash functions – Hash and Mac Algorithm – Secure Hash Algorithm - HMAC - CMAC.	18
III	**Digital Signature and Authentication Protocols:** Digital signature standard - Network Security Applications - Authentication Applications – Kerberos – X.509 Authentication - Public key infrastructure - Electronic mail Security – PGP – S / MIME – IP Security - Architecture.	18
IV	**Web Security:** IP Security - Secure Socket Layer – Transport Layer Security (TLS) - Secure Electronic Transaction. System Security - Intruders and Viruses – Firewalls– Password Security.	17
V	**Implementation of Cryptographic Algorithms:** RSA – DSA – ECC - Network Forensic – Security Audit - Other Security Mechanism: Introduction to Stenography – Quantum Cryptography – Water Marking - DNA Cryptography. Case Study: IBM Secret Key Management Protocol – MITRENET – KryptoKnight – SESAME – PEM – MSP.	19
	Total Hours	**90**

Text Books	
1.	William Stallings, (2023), Cryptography and Network Security, Principles and Practice, 8th Edition, Global Edition, Pearson Education Limited.
2.	Wenbo Mao, (2003), Modern Cryptography: Theory and Practice, Hewlett-Packard Company.
3.	Bruce Schneir, (1996), Applied Cryptography, 2nd Edition, CRC Press.
Reference Books	
1.	Jonathan Katz, Yehuda Lindell, (2024), Introduction to Modern Cryptography, 4th Edition, CRC Press.
2.	William Stallings, (2022), Network Security Essentials: Applications and Standards, 7th Edition, Pearson.
Web Resources (Swayam / NPTEL)	
1.	https://onlinecourses.nptel.ac.in/noc23_cs127/preview
2.	https://onlinecourses.nptel.ac.in/noc22_cs90/preview

Course Code	Course Name	Category	Hours/Week	Credits
24MCS33P	Cloud Computing	Core Lab-V (Embedded)	Theory - 3 Lab - 4	5

Course Objectives

This course intends to cover

- Basics of cloud computing concepts and architecture.
- Cloud models, services, techniques, and applications.
- Real time implementations by using various cloud service providers.
- Cloud storage and sharing.

Course Learning Outcomes

On the successful completion of the course, students will be able to

CLO	CLO Statements	Knowledge Level
CLO1	Recite the concepts of cloud computing and its architecture.	K1
CLO2	Understand the basics of cloud models, services and types.	K2
CLO3	Understand the appropriate tools in the cloud for Schedules, Word Processing, Mail, Calendar, and Database.	K2
CLO4	Apply ideas on cloud computing in terms of cloud providers, types, and social platforms.	K3
CLO5	Apply cloud computing techniques for various cloud applications, storage, and its services.	K3
K1 - Remember; **K2** - Understand; **K3** - Apply		

CLO-PLO Mapping

CLOs/PLOs	PLO1	PLO2	PLO3	PLO4	PLO5
CLO1	1	3	3	3	-
CLO2	1	3	3	3	-
CLO3	1	3	3	3	-
CLO4	1	3	3	3	2
CLO5	1	3	3	3	3
3 - Substantial (high)		2 - Moderate (medium)		1 - Slight (low)	

Core Lab V (Embedded): Cloud Computing

Unit	Details	No. of Hours
I	**Introduction**: Cloud Computing Fundamentals-Motivation for Cloud Computing-Defining Cloud Computing-Cloud Architecture-Working of cloud computing-Requirements for Cloud Services-Benefits and Drawbacks-cloud computing characteristics-Applications on the Cloud - Managing the Cloud - Migrating Application to Cloud. 1. Working of Goggle Drive to make spread sheet and notes. 2. Launch a Linux Virtual Machine. 3. Use Git applications in managing cloud.	T-7 L-10
II	**Cloud Deployment Models:** Private Cloud-Public Cloud - Community Cloud-Hybrid Cloud - Cloud Service Models: Introduction - Infrastructure as a Service-Platform as a Service - Software as a Service -Web Services-On-Demanding Computing- Other Cloud Service Models. 1. To host a static website. 2. Working on cloud for creating an Appointment Quest. 3. Explore cloud for Event management and Schedules.	T-7 L-10
III	**Cloud Services**: Exploring Online Calendar Applications-Exploring Online scheduling Applications-Schedules and task management in cloud-collaborating on event management - Understanding Contact Management - CRM - Applications - Exploring Project Management - collaborating on word processing - Zoho Creator - Online Databases and Reports. 1. Exploring Google cloud for the following a) Storage of data b) Sharing of data. 2. Exploring cloud for a) Managing your calendar b) To-do lists. 3. Installation and Configuration of Justcloud.	T-11 L-10
IV	**Outside the Cloud**: Discovering cloud services-Amazon Cloud Types-Amazon Simple Storage Service-Google App Engine-Google cloud content-IBM Smart Cloud-Evaluating webmail services-Evaluating instant messaging-Evaluating web conference tools-creating groups on social networks-Evaluating online groupware - Airset-OpenTeams-Other Applications. 1. Explore cloud services and editing tools using Zoho applications. 2. Create a live website with different layouts and publish in the cloud. 3. To create and manage online file storage in cloud.	T-11 L-15
V	**Storing and Sharing**: Understanding cloud storage-Risk of storing data in clouds-Evaluating online file storage-ElephantDrive-Microsoft Office Live Workspace-exploring online bookmarking services-exploring online photo editing applications-exploring photo sharing communities-Cloud based desktops and applications. 1. To create and query a NoSQL Table. 2. Working and installation of Microsoft Azure. 3. Explore photo editing applications in cloud infrastructure.	T-9 L-15
	Total Hours	**T - 45** **L - 60**

Text Books	
1	Michael Miller (2020), Cloud Computing, 2nd Edition, Pearson Education, New Delhi. (Unit - I, II, III)
2	Rohit Agarwal and Dilip K Prasad (2024), Cloud computing for Everyone, 2nd Edition, BPB Publication, India. (Unit-III, IV)
3	Thomas Eric (2023), Cloud Computing Concepts, Technology, Security and Architecture, 2nd Edition, Pearson Education, New Delhi. (Unit-IV, V)
Reference Books	
1	Rajkumar Buvya, Christian Vecchiola, Thamarai Selvi, Shivananda Poojara, Satish N Srirama (2024), Mastering Cloud Computing, 2nd Edition, Tata McGraw Hill Education Private Limited.
2	Stephen Baron, (2020), The Complete Beginner's Guide, 1st Edition, AWS.
3	Daniel Kirsch, Judith Hurwitz, (2021), Cloud Computing for Dummies, 2nd Edition, Paperback Publication.
Web Resources (Swayam / NPTEL)	
1.	https://nptel.ac.in/courses/106105167/
2.	https://onlinecourses.swayam2.ac.in/aic20_sp10

Course Code	Course Name	Category	Hours / Week	Credits
24MCS34P	Lab: Web Application Development and Hosting	Core Lab - VI	4	3

S. No.	List of Programs
1	Sample programs using basic HTML tags.
2	Design a static web site with home page, login page, catalogue page and registration page for an online book store web site.
3	Demonstrate the applications of Lists, Tables, Images, Section, article and aside elements.
4	Investigate the various components of CSS.
5	Develop web pages using HTML and various elements of CSS.
6	Design simple dynamic webpages using Java script.
7	Write a PHP program to display current date, time and day using PHP script.
8	Write an XML file to display the book information which includes the following: Title of the book, Author name, ISBN number, Publisher name, Edition and Price.
9	Write a program to update customer information using JDBC.
10	Write a servlet program to generate a plain text.
11	Design a servlet program to display cookie id.
12	Write a JSP program to represent basic arithmetic functions.
13	Write a JSP program to create check boxes.
Total Hours	**60**
Text Books	
1	Ivan Bayross, (2025), Web Enabled Commercial Application Development Using HTML, JavaScript, DHTML and PHP, 4th Revised Edition, BPB Publications.
2	Yang hu, (2019), Easy Learning JDBC + MySQL, JDBC for Beginner's Guide, Amazon Digital Services LLC.
Reference Books	
1	A.K.Saini and SumintTuli, (2002), Mastering XML, First Edition, New Delhi.
2	Jayson Falkner, Kevin Jones, (2003), Servlets and Java Server Pages, The J2EE Technology Web Tier, Pearson Education, Inc.
Web Resources (Swayam / NPTEL)	
1.	https://onlinecourses.swayam2.ac.in/nou24_cs09/preview
2.	https://onlinecourses.nptel.ac.in/noc20_cs52/preview

Course Code	Course Name	Category	Hours / Week	Credits
24MCS3AE	Social Network Analytics	Elective - III	5	4

Course Objectives

The course intends to cover

- Components and entities of social network.
- Centrality, social subgroups and structural equivalence.
- Models in social network.

Course Learning Outcomes

On the successful completion of the course, students will be able to

CLO	CLO Statements	Knowledge Level
CLO1	Recite the basic concepts of social network.	K1
CLO2	Understand the prominent actors and relate social network models.	K2
CLO3	Understand the subgroups and nodal degree.	K2
CLO4	Apply the structural equivalence and block model.	K3
CLO5	Apply the various types of social network model.	K3
K1 – Remember; **K2** – Understand; **K3** – Apply		

CLO-PLO Mapping

CLOs/PLOs	PLO1	PLO2	PLO3	PLO4	PLO5
CLO1	3	3	-	2	2
CLO2	3	3	-	1	1
CLO3	3	3	-	-	2
CLO4	2	2	-	-	-
CLO5	2	2	-	-	-
3 - Substantial (high)		2 - Moderate (medium)		1 - Slight (low)	

Elective - III : Social Network Analytics

Unit	Content	No. of Hours
I	**Fundamentals of Social Network Analysis:** Social Network Perspective. Fundamentals concepts in Network Analysis: Sociogram, Sociometry Social Network Data: Types of Networks - One-Mode – TwoMode – Affiliation - Ego-centered and Special Dyadic Networks - Network Data - Measurement and Collection - Notations for Social Network Data: Graphs - Directed - Singed Valued graphs - Multigraph - Relations and Matrices.	15
II	**Centrality and Prestige:** Prominence - Actor-Centrality, Prestige, Group-Centrality, Prestige, Non directional Relations - Degree, Closeness, Betweenness, Directional Relations - Centrality, Prestige. Structural Balance and Transitivity: Signed Non directional, Signed Directional Relations, Checking for Balance, Index for Balance, Clusterability - Clustering Coefficient and Transitivity.	17
III	**Cohesive Subgroups:** Social Group and Subgroup-Notation, Subgroups Based on Complete Mutuality: Clique, Reachability and Diameter: n-cliques, n-clans and n-clubs, Subgroups Based on Nodal Degree: k-plexes, k-cores, Measures of Subgroup Cohesion, Community detection using Subgroups and Betweenness.	15
IV	**Structural Equivalence:** Definition - Social Roles and Positional Analysis - Measuring Structural Equivalence - Representation of Network Positions - Block Models: Introduction, Network Positions and roles.	13
V	**Models in Social Network:** Small world network- Watt Strogatz networks - statistical models for social networks - network evaluation model - Preferential attachment - power law - Random Model: Erdos -Renyi model - Barabasi Albert model - Epidemic model.	15
	Total Hours	**75**
Text Books		
1.	Wasserman Stanley, and Katherine Faust, (2012), Social Network Analysis: Methods and Applications, Structural Analysis in the Social Sciences, Online Edition, Cambridge University Press.	
2.	Albert-László Barabási, (2016), Network Science, 1st Edition, Cambridge University Press.	
Reference Books		
1.	John Scott, (2017), Social Network Analysis, 4th Edition, Sage Publications Limited.	
2.	David Knoke & Song Yang, (2020), Social Network Analysis, 3rd Edition, Sage Publishing.	
Web Resources (Swayam / NPTEL)		
1.	https://onlinecourses.nptel.ac.in/noc20_cs78/preview	
2.	https://onlinecourses.nptel.ac.in/noc22_cs117/preview	

Course Code	Course Name	Category	Hours / Week	Credits
24MCS3BE	Digital and Mobile Forensics	Elective - III	5	4

Course Objectives

The course intends to cover

- Digital forensics methods, Systems, Services and Cybercrime Detection Techniques.
- Network forensics and OS artifacts.
- Data preservation for evidence reconstruction.

Course Learning Outcomes

On the successful completion of the course, students will be able to

CLO	CLO Statements	Knowledge Level
CLO1	Remember the core concepts of digital forensics technology and services.	K1
CLO2	Understand legal procedures and standards in recovering and seizing data from a crime scene without damage	K2
CLO3	Apply the forensic data acquisition and artifacts across various operating systems.	K3
CLO4	Apply forensic tools and concepts to modern frameworks.	K3
CLO5	Analyze network forensics from virtual networks, emails, and operating systems.	K4
K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** – Analyze		

CLO – PLO Mapping

CLOs/PLOs	PLO1	PLO2	PLO3	PLO4	PLO5
CLO1	1	1	2	1	1
CLO2	2	1	3	2	2
CLO3	2	2	2	2	1
CLO4	1	1	2	1	3
CLO5	3	2	1	2	3
3 - Substantial (high)		**2** - Moderate (medium)		**1** - Slight (low)	

Elective- III: Digital and Mobile Forensics

Unit	Content	No. of Hours
I	**Digital forensics fundamentals:** Use of Computer Forensics - Benefits of Professional Forensics Methodology - Steps Taken by Computer Forensics Specialists - Case Studies - Types of Computer Forensics Technology: Military, Law Enforcement, Business - Specialized Forensics Techniques - Hidden Data and How to Find It - Protecting Data from Being Compromised - Internet Tracing Methods. Types of Computer Forensics Systems: Firewall and IDS Security Systems - Storage Area Network Security Systems - Instant Messaging (IM) Security Systems - Biometric Security Systems.	16
II	**Computer Forensics Services:** Occurrence of Cyber Crime - Cyber Detectives - Fighting Cyber Crime with Risk Management Techniques - Computer Forensics Investigative Services - Forensic Process Improvement. Data Recovery: Data Backup and Recovery, Data-Recovery Solution, Hiding and Recovering Hidden Data. Evidence Collection and Data Seizure: Collection of Evidence and Options, Obstacles - Types of Evidence - The Rules of Evidence - Volatile Evidence - Volatile Memory Forensics.	15
III	**Duplication and Preservation of Digital Evidence:** Preserving the Digital Crime Scene - Computer Evidence Processing Steps - Legal Aspects of Collecting and Preserving Evidence -Computer Image Verification and Authentication - Computer Forensics Analysis: Discovery of Electronic Evidence - Identification of Data - Reconstructing Past Events - disk and file system analysis.	14
IV	**Network forensics:** Investigation on virtual network and Email, Internet Artifacts - Damaging Computer Evidence - System Testing - Operating System Artifacts: Windows System Artifacts, Linux System Artifacts- Mobile Forensics: Acquisition Procedures for Mobile, Equipment, Tools, Internet of Anything.	15
V	**Cloud Forensics:** Service Levels, cloud vendors, Legal Challenges and Technical Challenges, Acquisition, Investigation, Tools: Open-Stack, F-Response, AXIOM.- Open source tools: The Sleuth Kit (TSK) and Autopsy - SANS SIFT Investigative tool - Volatility - CAINE investigative environment - windows System internals-Commercial tools: Encase, FTK, PRO Discover Basic, Nirsoft.	15
	Total Hours	**75**

Text Books

1. John R. Vacca, Computer Forensics: Computer Crime Scene Investigation, (2015), 2nd Edition, Charles River Media, Inc.
2. Cory Altheide, Harlan Carvey, (2011), Digital Forensics with Open Source Tools: Using Open Source Platform Tools, 1st Edition, British Library Cataloguing-in-Publication Data.

Reference Book	
1.	B. Nelson, A. Phillips, F. Enfinger, and C. Steuart, (2019), Guide to Computer Forensics and Investigations, 6th Edition, CENGAGE, INDIA.
Web Resources (Swayam / NPTEL)	
1.	https://onlinecourses.swayam2.ac.in/cec20_lb06/preview
2.	https://onlinecourses.swayam2.ac.in/nou22_cs05/preview

Course Code	Course Name	Category	Hours / Week	Credits
24MCS3CE	Generative AI and Prompt Engineering	Elective - III	5	4

Course Objectives

The course intends to cover

- Fundamentals of Generative AI, models and challenges.
- Advanced generative AI models, GAN training and evaluation techniques.
- Generative AI tools and applications.

Course Learning Outcomes

On the successful completion of the course, students will be able to

CLO	CLO Statements	Knowledge Level
CLO1	Remember the fundamental concepts of Generative AI.	K1
CLO2	Understand the importance of Generative AI models	K2
CLO3	Apply the GANs for image and text generation.	K3
CLO4	Analyze the concept of prompt engineering and fine tuning.	K4
CLO5	Analyze the importance of Generative AI techniques in various domains.	K4
K1 – Remember; **K2** - Understand; **K3** - Apply; **K4** – Analyze		

CLO – PLO Mapping

CLOs/PLOs	PLO1	PLO2	PLO3	PLO4	PLO5
CLO1	3	3	3	3	3
CLO2	2	2	2	2	2
CLO3	1	1	1	1	1
CLO4	3	3	3	3	3
CLO5	3	3	3	3	3
3 - Substantial (high)		**2** - Moderate (medium)		**1** - Slight (low)	

Elective – III: Generative AI and Prompt Engineering

Unit	Content	No. of Hours
I	**Introduction to Generative AI:** Understanding AI, Machine Learning and Deep Learning - Generative AI - Discriminative and Generative models – Why use Generative models – Challenges of Generative models.	15
II	**Generative AI Model:** ML Model Building Process-Data Collection and Pre-processing-Training and Evaluation Overview-Transfer Learning and Pre-trained Models-Advanced Generative AI Models-GAN Training Techniques-GAN Evaluation Techniques - Additional Considerations.	15
III	**Generative Adversarial Networks (GANs):** Image generation with GANs-Style transfer with GANs - StyleGAN - Cycle GAN - Disco GAN - Recent Advancements in GANs and Style Transfer -Deepfakes with GAN-The rise of methods for text generation.	15
IV	**Prompting and Creativity through Gen AI:** Prompt Engineering-Prompt Engineering Examples- Prompt Engineering Techniques - Mistakes to Avoid when Crafting Prompts - Fine Tuning-Fine Tuning Using Additional Data. Introduction to Generative AI Creativity Tools-Visual, Audio, Test Generators & Code Generators -Ethical Considerations.	15
V	**Emerging Applications of Generative AI:** Generative AI for Healthcare – Clinical Administration Support – Clinical Decision Support –Generative AI for Media – Storytelling – Generative AI for Mobile Networks - Building Design and Economic Research.	15
	Total Hours	**75**
Text Books		
1	Babcock, Joseph, and Bali, Raghav, (2021), Generative AI with Python and TensorFlow 2: Create Images, Text, and Music with VAEs, GANs, LSTMs, Transformer Models. United Kingdom, Packt Publishing.	
2	Alto, Valentina, (2023), Modern Generative AI with ChatGPT and OpenAI Models: Leverage the Capabilities of OpenAI's LLM for Productivity and Innovation with GPT3 and GPT4. United Kingdom, Packt Publishing.	
3	L. Reynolds and K. McDonell, (2021), Prompt Programming for Large Language Models: Beyond the Few-Shot Paradigm in Extended Abstracts of the 2021 CHI Conference on Human Factors in Computing Systems.	
4	Ian Khan, (2024), The Quick Guide to Prompt Engineering, John Wiley & Sons. Inc.	
Reference Book		
1	James Phoenix, and Mike Taylor. (2024), Prompt Engineering for Generative AI Future Proof Inputs for Reliable AI Outputs, O'Reilly.	
Web Resources (Swayam / NPTEL)		
1	https://onlinecourses.swayam2.ac.in/imb25_mg46/preview	

Course Code	Course Name	Category	Hours / Week	Credits
24MCS35P	Lab: Digital Image Processing	SEC Lab - II	2	3

S. No.	List of Programs	
1.	Basic techniques in MATLAB.	
2.	Implement Image enhancement Technique.	
3.	Implementation of Relationship between pixels.	
4.	Contrast stretching of a low-contrast image, Histogram, and Histogram Equalization.	
5.	Implement Image Filtering.	
6.	Implementation of Image Smoothening Filters (Mean and Median filtering of an Image).	
7.	Implement Image Restoration.	
8.	Implementation of Transformation of an image.	
9.	Perform Boundary Extraction using morphology.	
10.	Implement Image Segmentation algorithm.	
11.	Implement image compression.	
	Total Hours	**30**
Text Books		
1.	Rafael C. Gonzalez, Richard E. Woods, (2018), Digital Image Processing, 4th Edition, Pearson Education.	
2.	Chanda B, Dutta Majumder D, (2009), Digital Image Processing and Analysis. PHI.	
Reference Books		
1.	Sandipan Dey, (2018), Hands-On Image Processing with Python, O'Reilly.	
2.	Image Processing Toolbox-For use with MATLAB, (2003), User's Guide, Version 3.	
Web Resources (Swayam / NPTEL)		
1.	https://onlinecourses.nptel.ac.in/noc22_ee116/preview	

Components for Internal Assessment and Distribution of Marks for CIA and ESE (Theory)

Max Marks	Marks for		Components for CIA						
100	CIA	ESE	CIA		Model		Attendance	Active Engagement	Total
	25	75	Actual	Weightage	Actual	Weightage	5	5	25
			50	**5**	75	**10**			

Question Paper Pattern

Component	Duration in Hours	Section A			Section B			Section C			Total
		Type of Question	No. of Questions	Marks	Type of Question	No. of Questions	Marks	Type of Question	No. of Questions	Marks	
CIA	2	MCQ	8	8x1=8	Either or	3	3x6=18	Either or	3	3x8=24	50
Model Exam / **ESE**	3	MCQ	10	10x1=10	Either or	5	5x5=25	Either or	5	5x8=40	75

Components for Internal Assessment and Distribution of Marks for CIA (Core & Embedded Lab)

Max Marks	Marks for		Components for CIA						
	CIA	ESE	Test		Model		Experiments / Programs	Observation	Total
100	40	60	Actual	Weightage	Actual	Weightage	Marks	5	40
			50	**10**	60	**15**	**10**		

Examination Pattern

Component	Duration in Hours	Marks			Total Marks
		Practical Exam	Record	Weightage	
Test	2	50	-	**10**	50
Model	3	60	-	**15**	60
Experiments	-	-	-	**10**	10
Observation	-	-	-	**05**	05
			Total Marks - CIA	**40**	**40**
ESE	3	50	10	-	**60**

Components for and Distribution of Marks for ESE (Theory) Ability Enhancement Compulsory Courses (AECC) & Question Paper Pattern

Duration in Hours	Mode of Exam	Type of Questions	No. of Questions	Marks
2	Online	MCQ	50	50x1=50