KSR College of Engineering

NAAC ACCREDITED A++ | NBA ACCREDITED PROGRAMMES

AN AUTONOMOUS INSTITUTION

MCA – MASTER OF COMPUTER APPLICATIONS

Curriculum & Syllabus

REGULATIONS 2024

(Academic Year2024 - 2025 onwards)

K.S.R. COLLEGE OF ENGINEERING: TIRUCHENGODE – 637215
(Autonomous)
DEPARTMENT OF COMPUTER APPLICATIONS
M.C.A. – Master of Computer Applications
(Regulations – 2024)

Vision of the institution

IV	To become a globally renowned institution in Engineering and Management, committed to providing holistic education that fosters research, innovation and sustainable development.

Mission of the institution

IM 1	Deliver value-based quality education through modern pedagogy and experiential learning.
IM 2	Enrich Engineering and Managerial Skills through cutting-edge laboratories to meet evolving global demands.
IM 3	Empower research and innovation by integrating collaboration, social responsibility, and commitment to sustainable development.

Vision of the Department/Programme: (Master of Computer Applications)

DV	To empower future IT professionals through cutting-edge education and research in computer applications, enabling them to innovate for a sustainable digital world.

Mission of the Department/Programme: (Master of Computer Applications)

DM 1	To deliver a rigorous and industry-relevant curriculum that equips students with cutting-edge knowledge and practical skills in computer applications.
DM 2	To create a dynamic academic ecosystem through state of art infrastructure to explore, experiment, and excel in the field of computer applications
DM 3	To foster innovation and research through creative problem-solving, collaboration, and emerging technologies for sustainable solutions

Program Educational Objectives (PEOs) : (Master of Computer Applications)

PEO 1	**Core Competency:** Design, develop, and maintain software applications using modern tools and technologies.
PEO 1	**Professionalism:** Exhibit leadership and entrepreneurial initiatives by leveraging their skills in computing, management, and decision-making.
PEO 1	**Career Development:** Engage in lifelong learning upholding ethical values to create inclusive, socially responsible, and environmentally conscious solutions.

Program Outcomes (POs) : (Master of Computer Applications)

PO 1	**(Foundation Knowledge):** Apply knowledge of mathematics, programming logic and coding fundamentals for solution architecture and problem solving.
PO 2	**(Problem Analysis):** Identify, review, formulate and analyze problems for primarily focusing on customer requirements using critical thinking frameworks.
PO 3	**(Development of Solutions):** Design, develop and investigate problems with as an innovative approach for solutions incorporating ESG/SDG goals.
PO 4	**(Modern Tool Usage):** Select, adapt and apply modern computational tools such as development of algorithms with an understanding of the limitations including human biases.
PO 5	**(Individual and Teamwork):** Function and communicate effectively as an individual or a team leader in diverse and multidisciplinary groups. Use methodologies such as agile.
PO 6	**(Project Management and Finance):** Use the principles of project management such as scheduling, work breakdown structure and be conversant with the principles of Finance for profitable project management.
PO 7	**(Ethics):** Commit to professional ethics in managing software projects with financial aspects. Learn to use new technologies for cyber security and insulate customers from malware
PO 8	**(Life-long learning):** Change management skills and the ability to learn, keep up with contemporary technologies and ways of working.

	K.S.R. COLLEGE OF ENGINEERING (Autonomous) (Approved by AICTE & Affiliated to Anna University) K.S.R. Kalvi Nagar, Tiruchengode - 637 215	Curriculum PG R - 2024
Department	Computer Applications	
Programme	Master of Computer Applications	

SEMESTER - I

Sl. No.	Course Code	Course Name	Category	Periods / Semester					Credit	Maximum Marks		
				L	T	P	SL	Tot		CA	ES	Total
THEORY COURSES												
1.	MA24T14	Mathematical Foundation for Computer Applications	FC	45	0	0	45	90	3	40	60	100
2.	CA24T11	Advanced Data Structures and Algorithms	PCC	45	0	0	45	90	3	40	60	100
3.	CA24T13	Advanced Database Management Systems	PCC	45	0	0	45	90	3	40	60	100
4.	CA24T14	Python Programming	PCC	45	0	0	45	90	3	40	60	100
5.	CA24T15	Research Methodology and IPR	RMC	45	0	0	45	90	3	40	60	100
THEORY COURSES WITH LABORATORY COMPONENT												
6.	CA24T12	Computer Networks and Management	PCC	45	0	30	45	120	4	50	50	100
LABORATORY COURSES												
7.	CA24P11	Advanced Data Structures and Algorithms Laboratory	PCC	0	0	60	0	60	2	60	40	100
8.	CA24P12	Advanced Database Management Systems Laboratory	PCC	0	0	60	0	60	2	60	40	100
9.	CA24P13	Python Programming Laboratory	PCC	0	0	60	0	60	2	60	40	100
Total				**270**	**0**	**210**	**270**	**750**	**25**	**900**		

SEMESTER - II

Sl. No.	Course Code	Course Name	Category	Periods / Semester					Credit	Maximum Marks		
				L	T	P	SL	Tot	C	CA	ES	Total
THEORY COURSES												
1.	CA24T21	Advanced Java Programming	PCC	45	0	0	45	90	3	4	6	100
2.	CA24T22	Internet of Things	PCC	45	0	0	45	90	3	4	6	100
3.	CA24T23	Artificial Intelligence and Machine Larning	PCC	45	15	0	60	120	4	4	6	100
4.	CA24T24	Full Stack Development	PCC	45	0	0	45	90	3	4	6	100
5.		Professional Elective I	PEC	45	0	0	45	90	3	4	6	100
6.		Professional Elective II	PEC	45	0	0	45	90	3	4	6	100
LABORATORY COURSES												
7.	CA24P21	Internet of Things Laboratory	PCC	0	0	60	0	60	2	6	4	100
8.	CA24P22	Advanced Java Programming Laboratory	PCC	0	0	60	0	60	2	6	4	100
9.	CA24P23	Full Stack Development Laboratory	PCC	0	0	60	0	60	2	6	4	100
				270	**15**	**180**	**285**	**750**	**25**	**900**		

SEMESTER - III												
Sl. No.	Course Code	Course Name	Category	Periods / Semester					Credit	Maximum Marks		
				L	T	P	SL	Tot	C	CA	ES	Total
THEORY COURSES												
1.	CA24T31	Cloud Computing	PCC	45	0	0	45	90	3	40	60	100
2.	CA24T32	Big Data Analytics	PCC	45	0	0	45	90	3	40	60	100
3.	CA24T33	Software Testing & Quality Assurance	PCC	45	0	0	45	90	3	40	60	100
4.	CA24T34	Cryptography and Network Security	PCC	45	0	0	45	90	3	40	60	100
5.		Professional Elective III	PEC	45	0	0	45	90	3	40	60	100
LABORATORY COURSES												
7.	CA24P31	Cloud Computing Laboratory	PC	0	0	60	0	60	2	60	40	100
8.	CA24P32	Big Data Analytics Laboratory	PC	0	0	60	0	60	2	60	40	100
9.	CA24P33	Mobile Application Development Laboratory	PC	0	0	60	0	60	2	60	40	100
Total				**225**	**0**	**180**	**225**	**630**	**21**	**800**		

SEMESTER - IV												
Sl. No.	Course Code	Course Name	Category	Periods / Semester					Credit	Maximum Marks		
				L	T	P	SL	Tot	C	CA	ES	Total
THEORY COURSES												
1	CA24P41	Project work	EEC	0	0	360	0	360	**12**	60	40	100
Total				**0**	**0**	**360**	**0**	**360**	**12**	**100**		

Total Credits: 83

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Programme	Master of Computer Applications	

List of Electives

PROFESSIONAL ELECTIVE - I

Sl. No.	Course Code	Course Name	Category	Periods / Semester					Credit	Maximum Marks		
				L	T	P	SL	Tot		CA	ES	Total
1.	MA24E01	Probability and Statistics	PEC	45	0	0	45	90	3	40	60	100
2.	CA24E01	TCP/IP	PEC	45	0	0	45	90	3	40	60	100
3.	CA24E02	Unix and Network Programming	PEC	45	0	0	45	90	3	40	60	100
4.	CA24E03	Web Programming Essential	PEC	45	0	0	45	90	3	40	60	100
5.	CA24E04	Middleware Technology	PEC	45	0	0	45	90	3	40	60	100
6.	CA24E05	Devops	PEC	45	0	0	45	90	3	40	60	100
7.	BA24E51	Health Care Information Systems	PEC	45	0	0	45	90	3	40	60	100

PROFESSIONAL ELECTIVE - II

Sl. No.	Course Code	Course Name	Category	Periods / Semester					Credit	Maximum Marks		
				L	T	P	SL	Tot		CA	ES	Total
1.	MA24E02	Resource Management	PEC	45	0	0	45	90	3	40	60	100
2.	CA24E06	Software Project Management	PEC	45	0	0	45	90	3	40	60	100
3.	CA24E07	Advanced Operating Systems	PEC	45	0	0	45	90	3	40	60	100
4.	CA24E08	E-Learning Techniques	PEC	45	0	0	45	90	3	40	60	100
5.	CA24E09	Soft Computing	PEC	45	0	0	45	90	3	40	60	100
6.	CA24E10	Object Oriented Analysis and	PEC	45	0	0	45	90	3	40	60	100
7.	BA24E52	Organizational Behavior	PEC	45	0	0	45	90	3	40	60	100

PROFESSIONAL ELECTIVE - III

Sl. No.	Course Code	Course Name	Category	Periods / Semester					Credit	Maximum Marks		
				L	T	P	SL	Tot		CA	ES	Total
1.	CA24E11	M-Commerce	PEC	45	0	0	45	90	3	40	60	100
2.	CA24E12	Block Chain Technology	PEC	45	0	0	45	90	3	40	60	100
3.	CA24E13	Robotic Process Automation	PEC	45	0	0	45	90	3	40	60	100
4.	CA24E14	Data Visualization Techniques	PEC	45	0	0	45	90	3	40	60	100
5.	CA24E15	Data Science	PEC	45	0	0	45	90	3	40	60	100
6.	CA24E16	Deep Learning	PEC	45	0	0	45	90	3	40	60	100
7.	CA24E17	Mobile Computing	PEC	45	0	0	45	90	3	40	60	100

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BRIDGE COURSES

Sl.No.	Course Code	Course Name	Category	Periods / Semester					Credit	Maximum Marks		
				L	T	P	SL	Tot		CA	ES	Total
BRIDGE COURSE – I Classes are to be conducted and completed before the start of the class of **first semester**.												
01.	BC5001	Computer Fundamentals										
02.	BC5002	Problem Solving and Programming in C										
BRIDGE COURSE – II Classes are to be conducted and completed before the start of the class of **second semester**.												
01.	BC5003	Core Java Programming										
02.	BC5004	Software Engineering										

Master of Computer Applications						
S. No.	Subject Area	Credit Per Semester				Credits Total
		Semester 1	Semester II	Semester III	Semester 4	
1	FC	3				3
2	PCC	19	19	18		56
3	PEC		6	3		9
4	EEC				12	12
5	RMC	3				3
Total		25	25	21	12	83
FC – Foundation Course, PC – Professional Core Courses, PE – Professional Elective Courses, EEC – Employability Enhancement Courses, RMC -Methodology and IPR Courses						

MA24T14	MATHEMATICAL FOUNDATION FOR COMPUTER APPLICATIONS	Category	L	T	P	SL	C
		FC	45	0	0	45	3

PREREQUISITE: The students should have basic knowledge in logical operations, set theory concepts, optimization problems, algebraic equations and manipulating expressions.

OBJECTIVES:

To equip students with essential mathematical concepts and techniques foundational to understanding and solving problems in computer applications.

UNIT - I	PROPOSITIONAL CALCULUS	(9)

Propositions – Logical connectives – Compound propositions - Conditional and biconditional propositions - Truth tables- Tautologies and contradictions - Logical equivalences and implications - Normal forms - Principal conjunctive and disjunctive normal forms - Rules of inference Theory.

UNIT - II	PREDICATE CALCULUS	(9)

Predicates - Statement functions – Variables - Free and bound variables – Quantifiers - Universe of discourse - Logical equivalences and implications for quantified statements - Theory of inference - The rules of universal specification and generalization.

UNIT - III	LINEAR PROGRAMMING	(9)

Formation of Linear Programming Problems - Graphical method - Simplex method – Big M Method - Dual simplex method.

UNIT - IV	NETWORK ANALYSIS	(9)

Network Construction - Critical Path Method - Computation of earliest start time, latest start time, Total, free and independent float time -PERT - Computation of optimistic, most likely Pessimistic and expected time – Probabilistic estimation for completion of project.

UNIT - V	NUMERICAL TECHNIQUES	(9)

Solution of algebraic and transcendental equation – Newton Rap son's method – Interpolation – Newton's forward and backward interpolation method- Lagrange's interpolation formula.

L:45, SL: 45, TOTAL: 90 PERIODS

COURSE OUTCOMES:

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

COs	*Course Outcomes*	Cognitive Level
CO1	Apply the propositional concepts to determine tautologies, normal forms and validate arguments using rules of inference.	Apply
CO2	Apply the concepts of predicates, quantifiers and rules of inference to validate arguments involving quantified statements.	Apply
CO3	Apply linear programming techniques for effective decision-making in uncertain situation.	Apply
CO4	Apply Fulkerson's rule to design project networks and solve them using Critical Path Method CPM and PERT.	Apply
CO5	Apply the Newton- Raphson method and interpolation techniques to solve algebraic and transcendental equations.	Apply

REFERENCES:

1. Tremblay J P, Manoharan R, "Discrete Mathematical Structures with Applications to Computer Science", McGraw-Hill, International Edition, 5th Edition, 2016.

2. Gupta P K, Man Mohan, "Operations Research", Sultan Chand & Sons Publications, New Delhi, 12th Edition, 2013

3. Bernard Kolman, Robert Busby, Sharon Cutler Ross, "Discrete Mathematical Structures for Computer Science", PHI Learning, 6th Edition, 2013.

4. Taha H A, "Operations Research", Pearson Education, New Delhi, 9th Edition, 2012.

5. Grimaldi R P, Ramana BV, "Discrete and Combinatorial Mathematics", Pearson Education, 5th Edition, 2006.

6. Kandasamy P, Thilagavathy K, Gunavathy K, "Numerical Methods", S. Chand & Company Ltd, New Delhi,5th Edition, 2016.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	3	-	1	-	-	1
CO2	3	3	3	-	1	-	-	1
CO3	3	3	3	-	1	-	-	1
CO4	3	3	3	-	1	-	-	1
CO5	3	3	3	-	1	-	-	1

CA24T11	ADVANCED DATA STRUCTURES AND ALGORITHMS	Category	L	T	P	SL	C
		PCC	45	0	0	45	3

PREREQUISITE:

Programming fundamentals: Understand the basics of programming, including variables, data types, loops, conditional statements, functions and arrays.

COURSE OBJECTIVES:

Understand and implement essential abstract data types like arrays, lists, stacks, queues, trees, graphs, hash tables and sorting techniques.

UNIT - I	INTRODUCTION	(9)

Introduction: Basic Terminology, Data type, Data object, Need of Data Structure, Types of Data Structure, Elementary Data Organization, Data Structure operations, Algorithm Complexity and Time-Space trade-off.

UNIT - II	ARRAYS	(9)

Arrays - Single and Multidimensional Arrays - address calculation - application of arrays - Character String in C - Sparse Matrices - Vectors - Searching: Sequential search - binary search - Sorting algorithms with efficiency - Bubble sort - Insertion sort - Merge sort - Quick Sort.

UNIT - III	STACKS	(9)

Stacks: Representation and Implementation of stack - Operations on Stacks: Push & Pop - Linked Representation of Stack - Operations Associated with Stacks. Applications of stack: Conversion of Infix to Prefix and Postfix Expressions - Evaluation of the postfix expression using stack. Recursion: Recursive definition and processes

UNIT - IV	QUEUES and TREES	(9)

Queues: Array and linked representation and implementation of queues - Operations on Queue: Create - Add - Delete - Full and Empty. Circular queue - Deque, and Priority Queue. Linked list: Representation and Implementation of Singly Linked Lists. Trees: Basic terminology - Binary Trees - Binary tree representation - algebraic Expressions - Complete Binary Tree - Extended Binary Trees - BST - Traversing Binary trees

UNIT - V	GRAPH	(9)

Graph algorithms: Representations of graphs – Graph traversal: DFS – BFS – applications Connectivity, strong connectivity, bi-connectivity Minimum spanning tree: Kruskal's and Prim's algorithm- shortest path: Bellman-Ford algorithm – Dijkstra's algorithm – Floyd- War shall algorithm

L:45, SL: 45, TOTAL: 90 PERIODS

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

COs	Course Outcomes	Cognitive Level
CO1	Summarize the concept of fundamental data structures to solve problems efficiently, analyze algorithm complexity.	Understand
CO2	Describe the concept of arrays, perform basic operations like insertion, deletion, traversal.	Understand
CO3	Demonstrate the concept operations and apply them to solve problems like expression evaluation and backtracking.	Apply
CO4	Implement and apply queues and trees for efficient data handling, traversal, and hierarchical problem solving.	Apply
CO5	Demonstrate the concept of graph representations and apply traversal algorithms to solve network and connectivity problems.	Apply

Reference Books:	
1	A. M. Tanenbaum, Y. Langsam, M. J. Augustein, Data Structures using C, Prentice Hall of India, Delhi. Revised Edition 2023.
2	Yedidyah Langsam Moshe J. Augenstein, Aaron M. Tenenbaum, Data Structures using C & C++, PHI Publications, New Delhi, Second Edition 2017.
3	Mark Allen Weiss, Data structures and Algorithm Analysis in C++, Pearson Education. Ltd., Third Edition, 2016.
4	Michael Goodrich, R. Tamassia and D. Mount, Wiley, Data structures and Algorithms in C++, John Wiley and Son, Seventh Edition, 2018.
5	S.Sahan, Data structures Algorithms and Applications in C, Universities Press India Private Limited., Second Edition, 2019.
6	A. M. Tanenbaum, Data Structures using C, Prentice Hall of India, New Delhi., Revised Edition 2023.

Mapping of COs with POs and PSOs

COs/ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
CO1	3	2	-	-	1	-	-	2
CO2	3	2	-	-	1	-	-	3
CO3	3	3	2	-	1	-	-	2
CO4	3	3	2	-	1	-	-	3
CO5	3	3	2	-	1	-	-	2

K.S.R. COLLEGE OF ENGINEERING (Autonomous)							R 2024
SEMESTER -I							
CA24T12	**COMPUTER NETWORKS AND MANAGEMENT**	**Category**	**L**	**T**	**P**	**SL**	**C**
		PCC	**45**	**0**	**30**	**45**	**4**

PREREQUISITE:

Foundational Knowledge, Basic Computer Literacy, Understanding of Networking Fundamentals, Basic Knowledge of Computer Architecture.

COURSE OBJECTIVES:

Learn how to design, operate, monitor, and secure modern network infrastructures—covering layered protocols, network management frameworks and performance/security best practices.

UNIT - I	**DATA COMMUNICATION AND NETWORKING**	**(9)**

Data communication systems – Components and their functions - Building networks – Hosts and Networking devices – Switched Networks and Broadcast Networks – Transmission medium -Networking Devices: Hubs, Bridges, Switches, Routers, and Gateways -Role of software and hardware in networking – Layered Architecture – OSI and TCP/IP Reference Models.

UNIT - II	**PHYSICAL AND DATA LINK LAYERS**	**(9)**

Wired and wireless media – Functions of physical layer – Transmission errors – Error detection and correction – Framing - Flow control – Sub layers of DLL – Collision Domain - Ethernet – CSMA/CD – Token Ring – VLAN– IEEE 802.11 - WLAN – CSMA/CA – Bluetooth – Ad hoc networks.

UNIT - III	**NETWORK LAYER**	**(9)**

Routing – Distance Vector and Link State Algorithms – RIP, OSPF and BGP -IPV4 Packet Format and Addressing – Effective IP address management techniques – CIDR – DHCP – ICMP – Need for IPv6 – Addressing methods and types in IPv6 – IPv6 header – Advantages of IPv6 – Transition from IPv4 to IPv6.

UNIT - IV	**TRANSPORT AND APPLICATION LAYERS**	**(9)**

Functions of transport layer - User Datagram Protocol – UDP Applications – Transmission Control Protocol – Connection establishment and release – Retransmission Strategies – Congestion Control – Application layer – Sockets – Protocols – HTTP – FTP- Email Protocols – DNS.

UNIT - V	**NETWORK MONITORING AND MANAGEMENT**	**(9)**

Network centric operations - Network monitoring – Open-source network monitoring tools – Network management model – Abstract Syntax Notation – Overview of MIB and SNMP – Wire shark tool – 16 Network provisioning – Fault detection, location and isolation.

LIST OF EXPERIMENTS

1. Practice different network commands available in Windows and Linux Operating Systems and troubleshoot the network.
2. Configure the network devices such as Router, Switch, Hub, Bridge and Repeater.
3. Analyzing the Network traffic using Packet Analyzer (Wireshark) and understanding the various protocol headers.
4. Configure IPv4 and IPv6 addressing for a network using static and dynamic approaches (SLAAC and DHCP).
5. Configure firewalls and honey pots
6. Performance analysis of Network using NS2/NS3/OPNET (Delay, Bandwidth etc.)
7. Develop client/server-based applications using TCP and UDP sockets.

L:45, SL: 45, TOTAL: 90 PERIODS

COURSE OUTCOMES: At the end of the course, the student will be able to:		
COs	**Course Outcomes**	**Cognitive Level**
CO1	Describe the principles of data communication and networking, including protocols, transmission methods.	Understand
CO2	Explain the functions and protocols of the Physical and Data Link Layers for reliable data transmission across networks.	Understand
CO3	Demonstrate the principles, protocols, and addressing methods of the Network Layer for efficient data routing and delivery.	Apply
CO4	Apply the concept of functions and protocols of the Application Layer to enable user-level network services and communication.	Apply
CO5	Investigate the network management concepts, tools, and protocols for monitoring, controlling.	Analyze

Reference Books:

1	Mani Subramanian, “Network Management: Principles and Practices”, Second Edition, Pearson Education, 2015.
2	William Stallings, “Data and Computer Communications”, Tenth Edition, Pearson Education, 2017.
3	Larry L. Peterson, Bruce S. Davie, “Computer Networks: A Systems Approach”, Sixth Edition, Morgan Kaufmann Publishers Inc., 2022.
4	Andrew S Tanenbaum, Nick Feamster and David J Wetherall, “Computer Networks”, Sixth Edition, Pearson Education, 2022.
5	James F. Kurose, Keith W. Ross, “Computer Networking: A Top-Down Approach”, Eighth Edition, Pearson Education, 2022.
6	Stephen Morris, "Network Management, MIBs and MPLS - Principles, Design and Implementation", Pearson Education, 2013.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	2	-	-	1	-	-	3
CO2	3	2	-	-	1	-	-	2
CO3	3	3	2	-	1	-	-	3
CO4	3	3	2	-	1	-	-	2
CO5	3	3	3	-	1	-	-	3

CA24T13	ADVANCED DATABASE MANAGEMENT SYSTEMS	Category	L	T	P	SL	C
		PCC	45	0	0	45	3

PREREQUISITE:

Programming Fundamentals: Knowledge of at least one programming language (like Python, Java, or C++).

COURSE OBJECTIVES:

Advanced DBMS design and operation—including query optimization, transaction processing, distributed/NoSQL architectures, and database tuning for high-performance and scalable applications

UNIT - I	INTRODUCTION	(9)

Database System Applications – Purpose of Database System. View of Data: Data Abstraction – Instances and Schemas – Data Models – Relational Database – Database Design –The Entity Relationship model.

UNIT - II	STORAGE AND FILE STRUCTURE	(9)

Overview of physical storage media – Magnetic Disks – Tertiary Storage – Storage Access. File Organization: Fixed Length Records – Variable Length Records. Organization of Records in Files: Sequential File Organization – Multi table Clustering File Organization – Data Dictionary Storage.

UNIT - III	RELATIONAL MODEL	(9)

Structure of Relational Databases –Fundamental Relational Algebra Operation. Transactions: Transaction Concept – Transaction State – Implementation of Atomicity and Durability – Concurrent Execution-Serializability.

UNIT - IV	SQL	(9)

Background – Data Definition- Basic Structure of SQL Queries – Set Operations – Aggregate Functions – Nested sub queries – Views – Joined Relations. Relational Database Design: Atomic Domain and First Normal Forms. Decom Position using Functional Dependencies: Keys and Functional Dependencies – Third Normal Form Boyce Codd Normal Form.

UNIT - V	INTRODUCTION OF PL/SQL	(9)

Advantages of PL/SQL –The Generic PL/ SQL Block. PL/SQL: Data types –Variables – Constants – Control Structures Cursors – Exception Handling –Procedures and Functions –Packages – Triggers.

L:45, SL: 45, TOTAL: 90 PERIODS

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

COs	Course Outcomes	Cognitive Level
CO1	Describe the fundamental concepts of DBMS, including database models, architecture, and basic operations.	Understand
CO2	Explain about storage mechanisms and file organization techniques for efficient data retrieval and management in DBMS.	Understand
CO3	Develop the relational data model, including tables, keys, and integrity constraints for effective database design.	Apply
CO4	Describe about write and execute SQL queries for data definition, manipulation, and retrieval in relational databases.	Understand
CO5	Apply the basics of PL/SQL and develop programs using procedures and functions.	Apply

Reference Books:

1	Abraham Silberschatz ,Henry F.Korth ,S.Sudarshan ,Database System Concepts, Tata McGraw Hill, Singapore, New Delhi, Fifth Edition, 2023.

2	Ivan Bayross, The Programming Languages of Oracle, BPB Publications, New Delhi, Third Edition, 2012.
3	C.J Date, An Introduction to Database System, Pearson Education, New Delhi, First Edition, 2015.
4	P.S.Deshpande, SQL & PL/SQL for Oracle 10g, Dream Tech Press, New Delhi, Third Edition, 2007.
5	Abraham Silberschatz, Hentry F.Korth and S.Sudharssan, Database System Concepts, Tata McGraw Hill, New Delhi , Fourth Edition, 2008.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	2	-	-	1	-	-	3
CO2	3	2	-	-	1	-	-	2
CO3	3	3	2	-	1	-	-	3
CO4	3	2	-	-	1	-	-	2
CO5	3	3	2	-	1	-	-	3

CA24T14	PYTHON PROGRAMMING	Category	L	T	P	SL	C
		PCC	45	0	0	45	3

PREREQUISITE:

Basic computer skills should be comfortable using a computer, typing and navigating through files and folders, Understanding of basic programming concepts.

COURSE OBJECTIVES:

To equip students with foundational knowledge and practical skills in Python programming for problem-solving and application development.

UNIT - I	INTRODUCTION TO PYTHON	(9)

Introduction – Features – Downloading and Installing python - Executing a Python program – Flavors of Python – Memory Management in python – Garbage Collection – Comparisons between C and Python – Comparisons between Java and Python – Data types in Python: Comments –Built-in Data type – bool Data type – Sequences – Sets – literals – Identifiers and Reserved words – Naming Conventions.

UNIT - II	LANGUAGE COMPONENTS	(9)

Condition Statements: if, if-else statement. Looping Statement: While – for-Infinite loop – Nested loop - Break – Continue-Pass- Assert – Return. Operators – Input and Output Statements – Array: Creating – Importing the Array Module – Processing the Array – Types of Array – Operations on Arrays – Attributes of an Array- Case studies.

UNIT - III	STRINGS, LISTS AND TUPLES	(9)

Strings: Creating – Functions – Indexing - Slicing – Concatenation- Repetition – Membership – Comparing string – Testing Strings – Searching for sub strings – Converting Strings – Stripping White space Characters from a string – Formatting strings. Lists: Creating Lists – Updating -Concatenation - Repetition - Methods – Sorting- Nested Lists. Tuples: Creating - Accessing – Operations – Functions - Nested Tuples - Inserting Elements, Modifying Elements, Deleting Elements from a Tuple – Case studies.

UNIT - IV	DICTIONARIES AND FUNCTIONS	(9)

Dictionaries: Operations – Methods - Using for Loop with Dictionaries – Sorting the Elements of a Dictionary using Lambdas - Converting Lists and Strings into Dictionary - Passing Dictionaries to Functions - Ordered Dictionaries. Functions: Function Vs. Method - Defining – Calling – Returning - Pass by Object Reference –Arguments: Formal, Actual, Positional, Keyword, Default & Variable Length Arguments. Local and Global Variables - Recursive Functions - Lambdas - Function Decorators – Case studies.

UNIT - V	FILES AND MODULES	(9)

Files - Types of Files - Opening & Closing a File - Working with Text Files Containing Strings - Working with Binary Files - with Statement - seek () and tell () Methods - Random Accessing of Binary Files - Random Accessing of Binary Files using mmap - Zipping and Unzipping Files - Working with Directories. - Modules: Name spaces - Importing Modules – Module Built- in-functions- Standard Modules: math and dir function – Case studies.

L:45, SL: 45, TOTAL: 90 PERIODS

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

COs	Course Outcomes	Cognitive Level
CO1	Describe the concept of Python fundamentals and write basic programs using variables, control structures.	Understand
CO2	Interpret the core Python language components such as data types, operators, control flow, functions.	Understand

CO3	Demonstrate the able to manipulate and perform operations on strings, lists, and tuples to solve programming problems in Python.	Apply
CO4	Develop and apply dictionaries and functions in Python to create efficient and modular programs.	Apply
CO5	Implement to handle file operations and use modules in Python for structured and reusable code development.	Apply

Reference Books:

1	Nageswara Rao, R., Core Python Programming, Dream tech Press, New Delhi, Second Edition, January 2018.
2	Robert Sedgewick, Kevin Wayne, Robert Dondero, Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., New Delhi, First Edition, 2016.
3	Daniel Liang Y., Introduction to Programming using Python, Pearson Education, New Delhi, Second
4	Wesley J. Chun, Core Python Programming, Pearson Education, New Delhi, Second Edition, 2010.
5	Kenneth A. Lambert, Fundamentals of Python: First Programs, Cengage Learning, New Delhi, 2016.
6	Guido van Rossum and Fred L. Drake Jr, An Introduction to Python Revised and updated for Python 3.2, Network Theory Ltd., New Delhi, 2011.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	2	-	-	1	-	-	3
CO2	3	2	-	-	1	-	-	2
CO3	3	3	2	-	1	-	-	3
CO4	3	3	2	-	1	-	-	2
CO5	3	3	2	-	1	-	-	3

CA24T15	Research Methodology and IPR	Category	L	T	P	SL	C
		RMC	45	0	30	45	3

PREREQUISITE:

Research Methodology is a fundamental subject that equips students with the necessary skills to design, conduct, and evaluate research studies. IPR prerequisite may cover Copyright laws, Patent laws, Trademark laws, Trade secrets, Industrial design rights.

COURSE OBJECTIVES:

To provide students with a comprehensive understanding of research processes and methodologies, along with insights into intellectual property rights (IPR) for protecting innovations.

UNIT - I	BASCIS OF RESEARCH PROBLEM	(9)

Meaning of research problem – Sources of research problem – Criteria Characteristics of a good research problem – Errors in selecting a research problem – Scope and objectives of research problem. Approaches of investigation of solutions for research problem – Data collection – Analysis – Interpretation – Necessary instrumentations.

UNIT - II	TECHNICAL WRITING AND PROPOSAL	(9)

Effective literature studies approach – Analysis Plagiarism – Research ethics – Effective technical writing – How to write Report – Paper – Developing Research Proposal – Format of research proposal – Presentation and Assessment by a review committee.

UNIT - III	INTELLECTUAL PROPERTY	(9)

Nature of Intellectual Property: Patents – Designs –Trade and Copyright. Process of Patenting and Development: Technological research – Innovation – Patenting – Development. International Scenario: International cooperation on Intellectual Property – Procedure for grants of patents – Patenting under PCT.

UNIT - IV	PATENT RIGHTS	(9)

Patent Rights: Scope of Patent Rights – Licensing and transfer of technology – Patent information and databases – Geographical Indications.

UNIT - V	DEVELOPMENTS IN IPR	(9)

New Developments in IPR: Administration of Patent System – New developments in IPR – IPR of Biological Systems – Computer Software – Traditional knowledge Case Studies – IPR and IITs.

L:45, SL: 45, TOTAL: 90 PERIODS

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

COs	Course Outcome	Cognitive Level
CO1	Classify the fundamentals of identifying and formulating research problems with a focus on systematic inquiry and investigation.	Understand
CO2	Summarize skills in technical writing and preparing research proposals with clarity, structure, and academic rigor.	Understand
CO3	Describe the concept of Intellectual Property and its importance in protecting creative and research outcomes.	Understand
CO4	Calculate the process, types, and significance of patent rights in safeguarding innovative research and inventions.	Apply
CO5	Demonstrate the recent developments and emerging trends in Intellectual Property Rights (IPR) globally.	Apply

Reference Books:	
1	Ranjit Kumar, Research Methodology, A Step by Step Guide for beginners, SAGE Publications Asia Pacific Pvt Ltd, Singapore, Fourth Edition, 2023.
2	Robert P. Merges, Peter S. Menell, Mark A. Lemley, Intellectual Property in New Technological Age, Aspen Publishers, New York, And Sixth Edition 2016.
3	Stuart Melville and Wayne Goddard, Research methodology: an introduction for science & engineering students, Juta & Co , Kenwyn, South Africa, Second Edition,2014.
4	Wayne Goddard and Stuart Melville, Research Methodology, An Introduction, Juta and Company Ltd, Lansdowne, Second Edition, 2014.
5	Stuart Melville and Wayne Goddard, Research methodology: an introduction for science & engineering students, Lansdowne, Juta and Company Ltd, Second Edition, 2014.
6	T. Ramappa, Intellectual Property Rights Under WTO, S. Chand, Wheeler Publishing, Hyderabad, Second Revised Edition, 2016
7	Halbert, Resisting Intellectual Property, Taylor & Francis Ltd, London, second Edition, 2012.

Mapping of COs with POs and PSOs

COs/ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
CO1	3	2	-	-	1	-	-	3
CO2	3	2	-	-	1	-	-	2
CO3	3	3	2	-	1	-	-	3
CO4	3	3	2	-	1	-	-	2
CO5	3	3	2	-	1	-	-	3

CA24P11	ADVANCED DATA STRUCTURES AND ALGORITHMS LABORATORY	Category	L	T	P	SL	C
		PCC	0	0	60	0	2

PREREQUISITE:

Programming fundamentals: Students should have a solid grasp of programming concepts, including data types, variables, control structures, functions and arrays.

COURSE OBJECTIVES:

To develop students' practical skills in implementing advanced data structures and algorithms for efficient problem-solving and software development.

LIST OF EXPERIMENTS

1. Write a C program for implementation of stack using array
2. Write a C program for implementation of queue using array
3. Write a C program for implementation of circular queue using array
4. Write a C program evaluate postfix expression using stack.
5. Design, develop and execute a program in C to read a sparse matrix of integer values and make a transpose of it. Use the triple to represent an element in sparse matrix.
6. Design, develop and execute a program in C to implement singly linked list where each node consist of integers.
7. Write a C program evaluate sort a given set of elements using Quick sort.
8. Write a C program evaluate sort a given set of elements using Merge sort.
9. Compute the transitive closure of a given directed graph using Warshall's algorithm.
10. Find minimum cost spanning tree for a given undirected graphs using Kruskls algorithms

P:60, TOTAL: 60 PERIODS

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

COs	Course Outcome	Cognitive Level
CO1	Develop the programming skills in design and implementation of data structures and their applications.	Apply
CO2	Solve and execute programs in C to implement circular queue and evaluation of postfix expression.	Apply
CO3	Solve and execute programs in C to implement of sparse matrix and singly linked list.	Apply
CO4	Develop and execute various sorting techniques to organize data efficiently based on different algorithmic approaches.	Apply
CO5	Demonstrate the C Program to find transitive closure and minimum spanning tree of a given graph.	Apply

REFERENCES :

1. Reema Thareja, Data Structures using C, Oxford University Press, Third Edition, 2023.
2. Hemant Jain, Problem Solving in Data Structures & Algorithms Using C, Third Edition, 2022.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	2	3	1	-	-	3
CO2	3	3	2	3	1	-	-	2
CO3	3	3	2	3	1	-	-	3
CO4	3	3	2	3	1	-	-	2
CO5	3	3	2	3	1	-	-	3

CA24P12	ADVANCED DATABASE MANAGEMENT SYSTEMS LABORATORY	Category	L	T	P	SL	C
		PCC	0	0	60	0	2

PREREQUISITE:

Programming fundamentals: Familiarity with fundamental database design and SQL skills. Intermediate SQL: Proficiency in writing and optimizing more complex SQL queries and scripts.

COURSE OBJECTIVES:

To provide hands-on experience in implementing advanced database concepts and techniques for efficient data management and application development.

LIST OF EXPERIMENTS

1. Design a Table and Execute DDL, DML and DCL Queries.
2. Design a Table and Execute Aggregate Functions and Set Operations.
3. Write a Program on Normalization.
4. Execute a SQL Command to Perform Sub Queries and Joins.
5. Implement a Nested Sub Queries and Correlated Sub Queries.
6. Create Views for a Particular Database.
7. Implement a PL/SQL Procedure for an Application Using Procedure.
8. Implement a PL/SQL Procedure for an Application Using Function.
9. Implement a SQL Comments Triggers.
10. Implement a PL/SQL Procedure for an Application Using Exception Handling.

P:60, TOTAL: 60 PERIODS

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

COs	Course Outcome	Cognitive Level
CO1	Explain basic database concepts, applications, data models, schemas and instances.	Understand
CO2	Demonstrate the use of database constraints and perform relational algebra operations for effective query processing and data integrity.	Apply
CO3	Develop the concept of normalization techniques to design efficient, redundant-free database schemas.	Apply
CO4	Describe the basics of SQL and construct and execute SQL queries to retrieve and manipulate data from relational databases.	Apply
CO5	Apply the concept of familiarize concurrency control and transaction management techniques to ensure data consistency.	Apply

REFERENCES:

1. Abraham Silberschatz, Henry F. Korth, S. Sudharshan, “Database System Concepts”, 6th edition, Tata McGraw Hill, 2021
2. Ramez Elmasri, Shamkant B. Navathe, “Fundamentals of Database Systems”, 4th Edition, Pearson/Addision wesley, 2017.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	2	-	3	1	-	-	3
CO2	3	3	2	3	1	-	-	2
CO3	3	3	2	3	1	-	-	3
CO4	3	3	2	3	1	-	-	2
CO5	3	3	2	3	1	-	-	3

CA24P13	PYTHON PROGRAMMING LABORATORY	Category	L	T	P	SL	C
		PCC	0	0	60	0	2

PREREQUISITE: Foundational Knowledge, Basic Computer Literacy, Mathematical Skills, Introduction to Programming Concepts and Basic Programming Knowledge

COURSE OBJECTIVES:

To equip students with practical skills in Python programming for solving problems and developing efficient software applications. 5.Develop and Debug Python Code

LIST OF EXPERIMENTS

1. Program using Operators
2. Program using Conditional Statements
3. Program using Looping
4. Program using Strings
5. Program using Lists
6. Program using Dictionaries
7. Program using Tuples
8. Program using Functions
9. Program using File handling
10. Program using Modules
11. Develop the simple project

P:60, TOTAL: 60 PERIODS

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

COs	Course Outcome	Cognitive Level
CO1	Demonstrate the Python language syntax including control statements, loops and functions.	Apply
CO2	Solve the programs for a wide variety problem in mathematics, science, and games.	Apply
CO3	Apply the Test and develop skills to identify, analyze, and fix errors in Python programs for effective debugging.	Apply
CO4	Implement Conditionals and use loops to implement repetitive tasks efficiently in Python programs.	Apply
CO5	Demonstrate the Use functions and represent Compound data using Lists, Tuples and Dictionaries.	Apply

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	2	3	1	-	-	3
CO2	3	3	2	3	1	-	-	2
CO3	3	3	2	3	1	-	-	3
CO4	3	3	3	3	1	-	-	2
CO5	3	3	2	3	1	-	-	3

CA24T21	ADVANCED JAVA PROGRAMMING	Category	L	T	P	SL	C
		PCC	45	0	0	45	2

PREREQUISITE:

Introduction to programming: Students should have a basic understanding of programming concepts, including data types, variables, control structures, functions and arrays.

OBJECTIVES:

To equip students with foundational and advanced knowledge of Java programming for developing robust, object-oriented applications.

UNIT - I	OVERVIEW OFJAVA	(9)

Introduction-Java-Object Oriented Programming Concepts- Data Types- Variables and Arrays – Control Statements–Method Overriding.

UNIT - II	PACKAGES	(9)

Packages – Importing Packages- I/O Package – Interfaces – Exception Handling – Multithreaded Programming- String Operations. The Java I/O Classes– File – Byte Streams – The Character Streams – Serialization. AWT Package: AWT Classes – Window Fundamentals – Working with Graphics– Working with Color – Working with Fonts – Applet Package: Applet Basics – Applet Architecture – Reading and Writing in Console – Print Writer class.

UNIT - III	NETWORK PROGRAMMING IN JAVA	(9)

Sockets – secure sockets – custom sockets – UDP data grams – multicast sockets –URL classes – Reading Data from the server – writing data – configuring the connection – Reading the header – telnet application – Java Messaging services.

UNIT - IV	APPLICATIONS IN DISTRIBUTED ENVIRONMENT	(9)

Remote method Invocation – activation models – RMI custom sockets – Object Serialization – RMI – IIOP implementation – CORBA – IDL technology – Naming Services – CORBA programming Models - JAR file creation

UNIT - V	EVENT-DRIVEN PROGRAMMING	(9)

Graphics programming – Frame – Components – working with 2D shapes – Using color, fonts, and images - Basics of event handling – event handlers – adapter classes – actions – mouse events – AWT event hierarchy – introduction to Swing – Model-View- Controller design pattern – buttons – layout management – Swing Components.

L:45, SL: 45, TOTAL: 90 PERIODS

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

COs	Course Outcome	Cognitive Level
CO1	Classify the basic Java programming concepts including variables, data types, control structures, and object-oriented principles.	Understand
CO2	Summarize the use Java packages, create multithreaded programs, and apply string methods for efficient application development.	Understand
CO3	Develop and utilize Java I/O and networking package classes and methods to handle data streams and network communication.	Apply
CO4	Solve the applications designed for distributed computing environments, ensuring scalability and reliability.	Apply
CO5	Compute and implement event-driven programming concepts to create interactive and responsive applications.	Apply

Reference Books :	
1	Herbert Schildt, The Complete Reference JAVA, Tata McGraw Hill, Noida, Thirteenth Edition, 2017.
2	Gavin King, Java Persistence with Hibernate, Manning Publications, United States, Second Edition, 2016.
3	Anuradha A. Puntambekar, Advance Java, Technical Publications, First Edition, New Delhi, 2021., India
4	Kogent, Java 6 Programming Black Book, Kogent Learning Solutions, New Delhi, 2017.
5	Steven Holzner, Java2 (JDK 5 Edition) Programming, Dream tech Press India Pvt. Ltd, New Delhi, 2016.
6	Prem Kumar, Getting Inside Java - Beginners Guide, Pencil, First Edition, 2021.

Mapping of COs with POs and PSOs

COs/ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
CO1	3	2	-	-	1	-	-	3
CO2	3	2	-	-	1	-	-	2
CO3	3	3	2	-	1	-	-	3
CO4	3	3	2	-	1	-	-	2
CO5	3	3	2	-	1	-	-	3

CA24T22	INTERNET OF THINGS	Category	L	T	P	SL	C
		PCC	45	0	0	45	3

PREREQUISITE:

Connectivity, Sensors and Actuators, Microcontrollers or Processors, Power Supply, Communication Protocols, Data Storage and Analytics, Security and Interoperability.

COURSE OBJECTIVES:

To provide students with a comprehensive understanding of the Internet of Things (IoT) concepts, technologies, and applications for developing smart, connected systems.

UNIT - I	TECHNOLOGIES IN INTERNET OF THINGS	(9)

Various Technologies Used in IoT - IoT Revolution - Benefits of IoT - IoT Frameworks: Value Chain - Frameworks and Platforms -AWS IoT– Waston IoT Platform-IoT Ecosystem - Elements for IoT Implementation - Case Studies: E-Health System – Environmental Monitoring.

UNIT - II	COMPONENTS IN INTERNET OF THINGS: DESIGN PATTERN, IOT ARCHITECTURE AND CORE MODULES	(9)

Various Design Patterns - Challenges and Solutions for Designing Architecture for IoT - Four Layer Architecture - Seven Layer Architecture - Core Modules: Protocols – Sensors – Endpoints - Data Communication - IoT Data Managements - Analytics.

UNIT - III	IOT IMPLEMENTATION	(9)

IoT Implementation Strategies: Challenges and Solutions - Things to Know Before an IoT Implementation - Types of Testing in IoT- Testing Challenges and Tools - Testing Smart Wearables. Case Studies: Monitoring Traffic Volume in Petrol Stations to Improve Sales Strategies, Smartphone Detection System in the Crowd.

UNIT - IV	TECHNOLOGIES BEHIND IOT	(9)

Artificial Intelligence for IoT: Exploring the world of AI, IoT and AI in the context of Industry 4.0 – Data Analytics and Machine Learning for IoT – Security Challenges for IoT.

UNIT - V	INTERNET OF THINGS IN INDUSTRY	(9)

Industries: Manufacturing – Oil and Gas – Transportation – Public Safet.

L:45, SL: 45, TOTAL: 90 PERIODS

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

COs	Course Outcomes	Cognitive Level
CO1	Construct the Working Principles of various technologies and IoT platforms to design and develop connected smart applications.	Understand
CO2	Describe About the Components of IoT architecture and core modules to design and manage effective IoT systems.	Understand
CO3	Demonstrate the Process of IoT technologies to implement solutions across diverse real-world applications and industries.	Apply
CO4	Apply the Various Technologies of IoT and Industrial IoT, including their architecture, protocols, and applications in smart industries.	Apply
CO5	Implement IoT solutions using various sensors to address and solve real-world problems effectively.	Apply

Reference Books:

1	David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry “IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things”, 9th Impression, Pearson Publication, 2022. (UnitV)
2	MayurRamgir, “Internet of Things- Architecture, Implementation, and Security”, 1st Edition, Pearson Publication, 2020. (Unit I - IV)

3	Dr. OvidiuVermesan and Dr. Peter Friess, "Internet of Things: From research and innovation to market deployment", River Publishers, 2014.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	2	-	-	1	-	-	3
CO2	3	2	-	-	1	-	-	2
CO3	3	3	2	-	1	-	-	3
CO4	3	3	2	-	1	-	-	2
CO5	3	3	2	-	1	-	-	3

CA24T23	ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING	Category	L	T	P	SL	C
		PCC	45	15	0	60	4

PREREQUISITE:

Understanding vectors, matrices, and operations on these is key, as many ML algorithms rely on linear algebra concepts.

COURSE OBJECTIVES:

To equip students with the fundamentals and practical skills of Artificial Intelligence and Machine Learning for building intelligent systems and data-driven applications.

UNIT - I	INTRODUCTION TO AI SEARCH AND OPTIMIZATION ALGORITHM	(9)

The Foundations of Artificial Intelligence - History of AI - State of the Art -how do AI algorithm work-Types of AI: Supervised Learning-Unsupervised Learning - Reforcement Learning- Creating your own Chatbot using Dialog Flow Introduction to search algorithm-Greedy search algorithm-Hill Climbing Algorithm- A* Search algorithm

UNIT - II	FUZZY LOGIC	(9)

Introduction to Fuzzy Logic-Crisp sets-Fuzzy Sets-Architecture of Fuzzy Logic-Membership Function-Fuzzy Logic Algorithm-Fuzzy control-Sugeno style of Fuzzy Inference Processing-Fuzzy Hedges-alpha cut Treshold-Neuro Fuzzy systems.

UNIT - III	MACHINE LEARNING	(9)

Classification - Navie Bayes-Decision Tree-Rule based learning-k nearest neighbor -Support vector machine-Regression-Linear Regression-Logistic Regression-Multivariate Regression-Multiple Regression-Clustering-K-means Clustering-Fuzzy C-means-EM algorithm-Hierarchical clustering algorithms. Machine learning Application: Heart Disease Prediction- Titanic Survival using NAÏVE BAYES.

UNIT - IV	NEURAL NETWORKS AND DEEP LEARNING	(9)

Neural Networks

Introduction to Artificial Neural Networks-Artificial neuron Model and Linear Regression-Gradient Descent Algorithm-Learning Mechanism-Hebbian, Competitive, Boltzmann-Associative memory.

Deep Learning

Introduction – Neurons and Activation Functions-Deep learning libraries- Image Classification using Convolutional Neural Networks (CNN) -Hand Gesture Recognition with Deep Learning-Detecting Plant Leaf Diseases using Deep Learning- Drowsiness Detection for Driver Safety

UNIT - V	NLP AND COMPUTER VISION	(9)

Introduction to NLP-Types of NLP algorithm: Sentiment analysis, Keyword extraction, Knowledge graphs, Word clouds, Text summarization - Applications: Generating Titles from Text using NLP- Analyzing Speech and Emotions using CNN and NLP Introduction to computer vision-history of Computer Vision-Task associated with computer vision - applications: Moving Object Detection using Open CV Advanced Face Detection and Tracking.

L:45, T:15, SL: 60 TOTAL: 120 PERIODS

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

COs	Course Outcomes	Cognitive Level
CO1	Illustrate the basics of AI, focusing on search strategies and optimization algorithms to solve complex problems.	Understand
CO2	Classify various techniques of fuzzy logic principles and apply them to handle uncertainty and reasoning in intelligent systems.	Understand
CO3	Summarize knowledge of machine learning concepts and apply algorithms to build predictive models from data.	Understand

CO4	Apply the architecture and functioning of neural networks and apply deep learning techniques for complex data-driven tasks.	Apply
CO5	Solve the fundamentals of Natural Language Processing and Computer Vision to develop intelligent systems that interpret text and visual data.	Apply

Reference Books:

1	Nigel Toon, How AI Thinks: How we built it, how it can help us, and how we can control it Paperback, 8 February 2024
2	VaibhavVerdhan ,Computer Vision Using Deep Learning Neural Network Architectures with Python and Keras Paperback Import, 15 February 2021
3	Laurence Moroney , AI and Machine Learning for Coders A Programmer's Guide to Artificial Intelligence, Grayscale Indian Edition Paperback – 25 October 2020
4	Eduonix Learning Solutions, Machine Learning for Healthcare Analytics Projects Paperback – Large Print, 29 October 2018
5	Ajit K Jha , A Strategic Approach to Artificial Intelligence Projects: Learn AI & Ml Without Coding, AI Project Lifecycle, AI Leadership Approach, Ai In Cyber security, Intelligence for managers and leaders, Kindle Edition.
6	Kevin Knight, Elaine Rich, B. Nair, Artificial Intelligence, Paperback, Third Edition, July 2017.
7	Rajendra Akerkar, Introduction to Artificial Intelligence, PHI Learning,2nd Edition, July 2014.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	2	-	-	2	-	-	3
CO2	3	2	-	-	2	-	-	2
CO3	3	2	-	-	2	-	-	3
CO4	3	3	2	-	2	-	-	2
CO5	3	3	2	-	2	-	-	3

CA24T24	FULL STACK DEVELOPMENT	Category	L	T	P	SL	C
		PCC	45	0	0	45	3

PREREQUISITE:
Full stack development involves working on both the front-end and back-end aspects of web applications.

COURSE OBJECTIVES:
To train students in Full Stack Development by covering both front-end and back-end technologies for building dynamic, end-to-end web applications.

UNIT - I	SERVER-SIDE ACTION	(9)

Node and NPM - Installation - Commands - Packaging – file system - http/ https - OS - Path - Process - collaborative version control system git – Introduction to MERN stack.

UNIT - II	CLIENT-SIDE ACTIONS	(9)

React - Writing different components - Introduction to Typescript - Programming structures - Boolean - Arrays - Tuples - function.

UNIT - III	ADVANCED TYPESCRIPT	(9)

Classes - Inheritance - Interfaces - Namespaces - Modules - Decorators - Debugging Typescript apps - development of a simple web application with typescript.

UNIT - IV	WEBPACK	(9)

Introduction to web pack - dependency graph - Plugins - Modules - Adding node modules - REST Endpoint - mailer - other examples

UNIT - V	DEPLOYMENT THROUGH CONTAINERS	(9)

Containerization - Installation of Docker - Pulling Images - Creating Images - Deploying to Docker hub - Development and deployment of is applications in docker.

L:45, SL: 45, TOTAL: 90 PERIODS

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

COs	Course Outcomes	Cognitive Level
CO1	Describe and implement server-side programming to manage backend logic, database interactions, and API integrations in full stack development.	Understand
CO2	Construct the interactive client-side applications using HTML, CSS, and JavaScript for responsive user interfaces in full stack development.	Understand
CO3	Apply advanced TypeScript features to build robust, scalable, and type-safe front-end and back-end applications.	Apply
CO4	Demonstrate the use Webpack for module bundling and optimizing front-end assets in full stack web applications.	Apply
CO5	Develop full stack applications using containerization technologies to ensure scalable and portable software environments.	Apply

Reference Books:

1	Vasan Subramanian, Pro MERN Stack, Full Stack Web App Development with Mongo, Express, React, and Node, A Press Publisher, Second Edition 2019.
2	Karl Seguin, The Little Mongo DB Book, O Reilly, First Edition, 2018.
3	Gareth Dwyer, Flask by Example, Packt Publishers, Second Edition, 2016.
4	Gene Kim, Kevin Behr, George Spafford, The Phoenix Project, A Novel about IT, DevOps, IT Revolution Press, Fifth Edition, 2018.

Mapping of COs with POs and PSOs								
COs/ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
CO1	3	2	-	-	2	-	-	3
CO2	3	2	-	-	2	-	-	2
CO3	3	3	2	-	2	-	-	3
CO4	3	3	2	-	2	-	-	2
CO5	3	3	2	-	2	-	-	3

CA24P21	INTERNET OF THINGS LABORATORY	Category	L	T	P	SL	C
		PCC	0	0	60	0	2

PREREQUISITE:

Microcontrollers, Sensors, Actuators, Development boards, Power supplies and Communication modules.

COURSE OBJECTIVES:

To provide hands-on experience in designing, developing, and testing IoT applications using sensors, microcontrollers, and communication protocols.

LIST OF EXPERIMENTS

1. Familiarization with concept of IoT, Arduino / Raspberry-Pi and perform necessary software installation.
2. Study of different operating systems for Raspberry-Pi. Understanding the process of OS installation on Raspberry-Pi.
3. Study of connectivity and configuration of Raspberry-Pi with basic peripherals, LED ON / OFF using Push Button, understanding GPIO and its use in program.
4. Understanding and connectivity of Raspberry-Pi with Distance measuring using Ultrasonic Sensor. Write an application to measure the distance of the obstacle using Ultrasonic Sensor.
5. Understanding and connectivity of Raspberry-Pi with Temperature and Humidity Sensor. Write an application to read an environment temperature and Humidity value. If a temperature crosses a threshold value, the application indicated user using LEDs.
6. Understanding and connectivity of Raspberry-Pi with IR Sensor. Write an application to detect obstacle and notify user using LEDs.
7. Understanding and connectivity of Raspberry-Pi with camera. Write an application to detect the color of the object or obstruction detection.
8. Write an application using Raspberry-Pi based health monitoring using heartbeat and Pulse Sensor
9. Write an application using Raspberry-Pi based Eye blinking/closeness detection sensor.
10. Write an application using Raspberry-Pi based Rain fall detection using Rain Sensor.

P:60, TOTAL: 60 PERIODS

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

COs	Course Outcome	Cognitive Level
CO1	Describe the basic concepts, architecture, and applications of the Internet of Things in real-world scenarios.	Understand
CO2	Develop the design, interface, and integrate various sensors and devices with microcontrollers for real-time data acquisition and control.	Apply
CO3	Determine systematically collect, process, and analyze data to derive meaningful insights and support decision-making.	Apply
CO4	Implement the various IoT protocols and communication technologies for efficient and secure data exchange in IoT systems.	Apply
CO5	Develop and demonstrate programming and development skills for building and deploying IoT applications using sensors, microcontrollers.	Apply

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	2	-	2	1	-	-	3
CO2	3	3	2	2	1	-	-	2
CO3	3	3	2	2	1	-	-	3
CO4	3	3	2	2	1	-	-	2
CO5	3	3	2	2	1	-	-	3

CA24P22	ADVANCED JAVA PROGRAMMING LABORATORY	Category	L	T	P	SL	C
		PCC	0	0	60	0	2

PREREQUISITE:

Introduction to Programming: Students should have a basic understanding of programming concepts, including data types, variables, control structures, functions and arrays.

OBJECTIVES:

To provide practical experience in building advanced Java applications using features like JDBC, Servlets, JSP, and networking concepts.

LIST OF EXPERIMENTS

1. Write a Java Program to Illustrate the use of Object-Oriented Programming Concepts
2. Write a java Program to represent Array List class.
3. Write a Java Program to Illustrate the use of Overriding.
4. Write a Java Program to Implement String Handling Functions.
5. Write a Java Program to Implement any 4 File Operations.
6. Create a Calculator Using AWT Controls and use Event Handling for Calculations.
7. Write a java program to Implement Action Listener.
8. Create a Java Application using Packages.
9. Create a Java Application using RMI
10. Develop a Graphics Program using Swing Concept.

P:60, TOTAL: 60 PERIODS

COURSE OUTCOMES: At the end of the course, the students will be able to:

COs	Course Outcome	Cognitive Level
CO1	Demonstrate the fundamental concepts of Object-Oriented Programming to design and develop modular, reusable, and maintainable software.	Apply
CO2	Implement the concept of method overriding in Java to achieve runtime polymorphism and enhance code flexibility.	Apply
CO3	Determine the concept of exception handling in Java to write robust and error-resilient programs.	Apply
CO4	Develop and organize Java programs using packages to promote modularity, reusability, and better code management.	Apply
CO5	Implement Java Swing concepts to create graphical user interfaces (GUIs) for interactive desktop applications.	Apply

REFERENCES:

1. Herbert Schildt, The Complete Reference JAVA, Tata McGraw Hill, Noida, Thirteenth Edition, 2017.
2. Gavin King, Java Persistence with Hibernate, Manning Publications, United States, Second Edition, 2016.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	2	2	1	-	-	3
CO2	3	3	2	2	1	-	-	2
CO3	3	3	2	2	1	-	-	3
CO4	3	3	2	2	1	-	-	2
CO5	3	3	2	2	1	-	-	3

CA24P23	FULL STACK DEVELOPMENT LABORATORY	Category	L	T	P	SL	C
		PCC	0	0	60	0	2

PREREQUISITE

To get started with full-stack development, it's important to have a foundational understanding of both front-end and back-end development, along with some key tools and concepts.

COURSE OBJECTIVES:

To offer hands-on experience in developing complete web applications using front-end and back-end technologies, frameworks, and databases.

LIST OF EXPERIMENTS

1.Working with git commands
2. Installation of Typescript
3. Programming with different data structures and functions using Typescript
4. Programming with classes and inheritance
5. Organization of the code with namespace
6. Packaging the code with added modules
7. Development of a web application using React.js
8. Development of a web application using Node.js
9. Development of a full stack web application
10. Deployment of web application using Docker

P:60, TOTAL: 60 PERIODS

COURSE OUTCOMES: At the end of the course, the students will be able to:

COs	Course Outcome	Cognitive Level
CO1	Summarize the programming skills in different parts of the application, including APIs, databases and user interfaces.	Understand
CO2	Describe clean, maintainable and modular code that can be easily updated or scaled as the application grows.	Understand
CO3	Demonstrate robust server-side logic to handle client requests, process data, and manage application state.	Apply
CO4	Develop and execute programs latest industry trends, tools, and best practices to improve the development process.	Apply
CO5	Design, develop, and deploy applications using Docker for efficient containerization and environment consistency.	Apply

REFERENCES :

1. Mina Andrawos, Hands-On Full Stack Development with Go: Build full stack web applications with Go, React, Gin, and Gopher JS, Packt Publishing, First Edition, 2022.

2. Chris Northwood, The Full Stack Developer: Your Essential Guide to the Everyday Skills Expected of a Modern Full Stack Web Developer, Apress, Second Edition,2018.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	2	-	1	2			2
CO2	3	2	-	1	2			3
CO3	3	3	2	1	2			2
CO4	3	3	2	1	2			3
CO5	3	3	2	1	2			2

CA24T31	CLOUD COMPUTING	Category	L	T	P	SL	C
		PCC	45	0	0	45	3

PREREQUISITE:
Learning cloud computing include virtualization, programming, networking, databases maintenance, information security and operating systems.

COURSE OBJECTIVES:
To understand the fundamental concepts, models, and technologies of cloud computing and develop skills to design and manage cloud-based solutions.

UNIT-I	INTRODUCTION	(9)

Introduction to Cloud Computing – Definition of Cloud – Evolution of Cloud Computing – Underlying Principles of Parallel and Distributed Computing – Cloud Characteristics – Elasticity in Cloud – On-demand Provisioning.

UNIT- II	CLOUD ENABLING TECHNOLOGIES	(9)

Service Oriented Architecture – REST and Systems of Systems – Web Services – Publish – Subscribe Model – Basics of Virtualization – Types of Virtualization – Implementation Levels of Virtualization – Virtualization Structures – Tools and Mechanisms – Virtualization of CPU – Memory – I/O Devices – Virtualization Support and Disaster Recovery.

UNIT- III	CLOUD ARCHITECTURE, SERVICES AND STORAGE	(9)

Layered Cloud Architecture Design – NIST Cloud Computing Reference Architecture – Public, Private and Hybrid Clouds – Laas – PaaS – SaaS – Architectural Design Challenges – Cloud Storage –Storage-as-a-Service – Advantages of Cloud Storage – Cloud Storage Providers – S3.

UNIT- IV	RESOURCE MANAGEMENT AND SECURITY IN CLOUD	(9)

Inter Cloud Resource Management – Resource Provisioning and Resource Provisioning Methods –Global Exchange of Cloud Resources – Security Overview – Cloud Security Challenges – Software-as-a-Service Security – Security Governance – Virtual Machine Security – IAM – Security Standards.

UNIT-V	CLOUD TECHNOLOGIES AND ADVANCEMENTS	(9)

Hadoop – Map Reduce – Virtual Box – Google App Engine – Programming Environment for Google App Engine – Open Stack – Federation in the Cloud – Four Levels of Federation – Federated Services and Applications – Future of Federation.

L:45, SL: 45 TOTAL: 90 PERIODS

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

Cos	*Course Outcomes*	Cognitive Level
CO1	Classify the fundamental concepts, architecture, and service models of cloud computing for scalable and on-demand computing solutions.	Understanding
CO2	Compare the cloud enabling technologies such as virtualization, service-oriented architecture, and web services to support scalable.	Understanding
CO3	Demonstrate the cloud architecture, service models, and storage solutions to design efficient and scalable cloud-based systems.	Apply
CO4	Apply resource management techniques and implement security measures to ensure efficient and secure cloud computing environments.	Apply
CO5	Determine the proper cloud computing solutions and advice in accordance with the apps being employed.	Apply

Reference Books:

1	Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2022.
2	Ritting house, JohnW., and James F. Ransome, “Cloud Computing: Implementation, Management and Security”, CRC Press, 2019.

3	Rajkumar Buyya, Christian Vecchiola, S. ThamaraiSelvi, “Mastering Cloud Computing”, Tata Mcgraw Hill, 2017.
4	Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing -A Practical Approach”, Tata Mcgraw Hill, 2017.
5	Barrie Sosinsky, “Cloud Computing”, 1stEdition, Wiley Publishing inc, Canada, 2018.
6	Anthony T. Velte, Toby.J.Velte, Robert Elsenpeter, ”Cloud Computing A practical Approach”, MCGraw Hill,2012.

Mapping of Cos with Pos and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	2	-	-	2	-	-	2
CO2	3	2	-	-	2	-	-	3
CO3	3	3	2	-	2	-	-	3
CO4	3	3	2	-	2	-	-	2
CO5	3	3	2	-	2	-	-	3

CA24T32	BIG DATA ANALYTICS	Category	L	T	P	SL	C
		PCC	45	0	0	45	3

PREREQUISITE:
To excel in Big Data Analytics, one should possess a combination of technical, business, and soft skills. From a technical standpoint.

COURSE OBJECTIVES:
To equip learners with the skills to analyze, process, and extract insights from large and complex data sets using big data technologies

UNIT-I	INTRODUCTION TO BIG DATA	(9)

Introduction to Big Data Platform–Challenges of Conventional Systems - Intelligent data analysis– Nature of Data - Analytic Processes and Tools - Analysis vs. Reporting - Modern Data Analytic Tools-Statistic Concepts: Sampling Distributions - Re-Sampling - Statistical Inference - Prediction Error.

UNIT- II	MINING DATA STREAMS	(9)

Introduction To Streams Concepts – Stream Data Model and Architecture - Stream Computing -Sampling Data in a Stream – Filtering Streams – Counting Distinct Elements in a Stream – Estimating Moments – Counting Oneness in a Window – Decaying Window - Real time Analytics Platform(RTAP)Applications –- Case Studies - Real Time Sentiment Analysis, Stock Market Predictions.

UNIT- III	HADOOP ENVIRONMENT	(9)

History of Hadoop-The Hadoop Distributed File System – Components of Hadoop -Analyzing the Data with Hadoop- Scaling Out- Hadoop Streaming- Design of HDFS-Hadoop file systems-Java interfaces to HDFS- Basics-Developing a Map Reduce Application-How Map Reduce Works-Anatomy of a Map Reduce Job run-Failures-Job Scheduling.

UNIT- IV	DATA ANALYSIS SYTEMS AND VISUALIZATION	(9)

Link Analysis – Page Rank - Efficient Computation of Page Rank- Topic-Sensitive Page Rank – Link Spam- Recommendation Systems- A Model for Recommendation Systems- Content Based Recommendations - Collaborative Filtering- Dimensionality Reduction- Visualizations - Visual data analysis techniques- interaction techniques- Systems and applications.

UNIT-V	FRAMEWORKS AND APPLICATIONS	(9)

IBM for Big Data –Framework - Hive – Shading – NoSQL Databases –Mango DB-Cassandra H Base – Impala – Analyzing big data with twitter – Big data for Ecommerce – Big data for blogs.

L:45, SL: 45 TOTAL: 90 PERIODS

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

Cos	*Course Outcomes*	Cognitive Level
CO1	Describe the fundamentals of Big Data, its characteristics, tools, and applications in real-world data processing.	Understand
CO2	Summarize the ability to analyze and extract insights from real-time data streams using scalable algorithms and techniques.	Understand
CO3	Implement the proficiency in using the Hadoop ecosystem for distributed storage, processing, and management of large-scale data.	Apply
CO4	Compare the skills to analyze complex data and create effective visualizations for informed decision-making.	Apply
CO5	Demonstrate the various big data frameworks and their applications in solving real-world data-driven problems.	Apply

Reference Books:

1	AnandRajaraman and Jeffrey David Ullman, Mining of Massive Datasets, Cambridge University
2	Chris Eaton, Dirk DeRoos, Tom Deutsch, George Lapis, Paul Zikopoulos, Understanding Big Data Analytics for Enterprise Class Hadoop and Streaming Data, McGraw Hill Publishing, United States First Edition, 2020.

3	Michael Berthold, David J. Hand, Intelligent Data Analysis, Springer, Germany, Second revised and extended Edition, 2020
4	Franks, Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics, John Wiley & sons, Reprinted, 2021
5	Jiawei Han, Micheline Kamber, Data Mining Concepts and Techniques, Elsevier, Second Edition Reprinted 2019.
6	Da Ruan, Guoqiang Chen, Etienne E.Kerre, Geert Wets, Intelligent Data Mining, Springer, Second Edition, 2017.

Mapping of Cos with Pos and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	2	-	-	1	-	-	2
CO2	3	2	-	-	1	-	-	3
CO3	3	3	2	-	1	-	-	2
CO4	3	3	2	-	1	-	-	3
CO5	3	3	2	-	1	-	-	2

CA24T33	SOFTWARE TESTING & QUALITY ASSURANCE	Category	L	T	P	SL	C
		PCC	45	0	0	45	3

PREREQUISITE:
Learning the purpose of software testing, which is to find defects or bugs in the software, ensure it meets requirements, and provide confidence in its quality.

COURSE OBJECTIVES:
To develop expertise in software testing techniques and quality assurance practices to ensure reliable and high-quality software products.

UNIT-I	TESTING FUNDAMENTALS	(9)

Principles of Testing- Testing, Verification and Validation – Process Model to represent Different Phases – Software Development Life Cycle Models.

UNIT- II	TESTING TYPES	(9)

Types of Testing – White Box Testing – Black Box Testing – Integration Testing – System and Acceptance Testing – Performance Testing – Regression Testing - Internalization Testing – Ad Hoc Testing.

UNIT- III	SPECIALIZED TESTING	(9)

Testing of Objects Oriented Systems – Difference In OO Testing – Tools for Testing of OO Systems – Usability and Accessibility Testing – Testing for Usability.

UNIT- IV	ORGANIZATIONAL ISSUES IN TESTING	(9)

Common People Issues – Comparison between Testing and Development Functions – Organization Structures for Testing Team – Testing Services Organizations.

UNIT-V	TESTING MANAGEMENT AND AUTOMATION	(9)

Introduction – Test Planning – Test Management – Test Execution – Software Test Automation – Scope of Automation – Test Automation Tools – Generic Requirement for Test Tool/Framework – Selecting a Test Tool – Challenges in Automation.

L:45, SL: 45 TOTAL: 90 PERIODS

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

Cos	*Course Outcomes*	Cognitive Level
CO1	Explain the basic principles of software testing, such as verification, validation, and different types of testing.	Understand
CO2	Construct detailed, well-structured test cases; executing manual tests; and analyzing test results to ensure proper functionality.	Understand
CO3	Apply the advanced testing techniques tailored for specific domains, platforms, or technologies to ensure comprehensive software quality.	Apply
CO4	Demonstrate the industry-standard QA practices to ensure that software is defect-free, meets requirements, and is reliable.	Apply
CO5	Determine the ability to manage testing processes and implement automation tools for efficient and effective software testing.	Apply

Reference Books:

1	Gopalswamy R and Srinivasan D, Software Testing: Principles and Practices, Pearson Education, New Delhi, 2021.
2	JJ Shen, Software Testing Techniques, Principles, and Practices, Tata McGraw Hill Publishing, Nev Delhi, Second Edition, 2019.
3	Glenford J M, Corey S, Tom Badgett and Todd M Thomas, The Art of Software Testing, Wiley, USA, 2021.
4	Ilene B, Practical Software Testing, Springer – Verlag, New Delhi, 2019.

5	John D Mr. and David A S, A Practical Guide to Testing Object-Oriented Software, Addison-Wesley, New Delhi,2021.
6	William E Perry, Effective Methods for Software Testing, Wiley, New York, 2021

Mapping of Cos with Pos and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	2	-	-	1	-	-	2
CO2	3	2	-	-	1	-	-	3
CO3	3	3	2	-	1	-	-	2
CO4	3	3	2	-	1	-	-	3
CO5	3	3	2	-	1	-	-	2

CA24T34	CRYPTOGRAPHY AND NETWORK SECURITY	Category	L	T	P	SL	C
		PCC	45	0	0	45	3

PREREQUISITE:
The students should have basic knowledge in Discrete mathematics, Probability and statistics, Data structures, Algorithms, Basic security concepts, Operating system and Networking basics.

COURSEOBJECTIVES:
To understand the principles and techniques of cryptography and network security for protecting information and communication systems.

UNIT-I	INTRODUCTION TO SECURITY CONCEPTS, CRYPTOGRAPHY CONCEPTS AND TECHNIQUES	(9)

Security Concepts: Introduction, The need for security, Security approaches, Principles of security, Types of Security attacks, Security services, Security Mechanisms, A model for Network Security

Cryptography Concepts and Techniques: Introduction, plain text and cipher text, substitution techniques, transposition techniques, encryption and decryption, symmetric and asymmetric key cryptography, stenography, key range and key size, possible types of attacks.

UNIT- II	KEY CIPHERS	(9)

Symmetric key Ciphers: Block Cipher principles, DES, AES, Blowfish, RC5, IDEA, Block cipher operation, Stream ciphers, RC4.

Asymmetric key Ciphers: Principles of public key cryptosystems, RSA algorithm, Elgamal Cryptography, Diffie-Hellman Key Exchange, and Knapsack Algorithm

UNIT- III	CRYPTOGRAPHIC HASH FUNCTIONS AND KEY MANAGEMENT	(9)

Cryptographic Hash Functions: Message Authentication, Secure hash algorithm (SHA-512)**Message Authentication Codes**: Authentication requirements, HMAC, CMAC, ElGamal Digital signatures

Key Management and Distribution: Symmetric Key Distribution Using
Symmetric & Asymmetric Encryption, Distribution of Public Keys, Kerberos, X.509 Authentication Service, Public – Key Infrastructure.

UNIT- IV	TRANSPORT-LEVEL SECURITY AND WIRELESS NETWORK SECURITY	(9)

Transport-level Security: Web security considerations, Secure Socket Layer and Transport Layer Security, HTTPS, Secure Shell (SSH)

Wireless Network Security: Wireless Security, Mobile Device Security, IEEE 802.11 Wireless LAN, IEEE 802.11i Wireless LAN Security.

UNIT-V	SECURITY	(9)

E-Mail Security: Pretty Good Privacy, S/MIME

IP Security: IP Security overview, IP Security architecture, Authentication Header, Encapsulating security payload, Combining security associations, Internet Key Exchange.

Case Studies on Cryptography and security: Secure Multiparty Calculation, Virtual Elections, Single sign On, Secure Inter-branch Payment Transactions, Cross site Scripting Vulnerability.

L:45, SL: 45, TOTAL: 90 PERIODS

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

Cos	*Course Outcomes*	Cognitive Level
CO1	Describe the importance of information security and security mechanisms in real world applications.	Understand
CO2	Explain the foundational concepts of cryptography and network security to protect data and communication systems.	Understand
CO3	Demonstrate various methods to calculate authentication codes using Message Authenticate Code.	Apply
CO4	Demonstrate various methods to calculate authentication codes using Hash Functions.	Apply

CO5	Describe the comprehensive understanding of security principles, cryptographic techniques, and network security measures to safeguard information systems.	Apply

Text Books

1	Cryptography and Network Security : William Stallings, Pearson Education,4"' Edition
2	Cryptography and Network Security : Atul Kahate, Mc Graw Hill Edition

Reference Books:

1	Cryptography and Network Security: C K Shyamala, N Harin i, Dr T R Padmanabhan, Wiley India, **1"** Edition.
2	Cryptography and Network Security: Forouzan Mukhopadhyay, MC Graw Hill, 2"" Edition
3	Information Security, Principles and Practice: Mark Stamp, Wiley India. Principles of Computer Security: WM. Arthur Conklin, Greg White, TMH.
4	Introduction to Network Security: Neal Krawetz, CENGAGE Learning

Mapping of Cos with Pos and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	2	-	-	1	-	-	2
CO2	3	2	-	-	1	-	-	3
CO3	3	3	2	-	1	-	-	2
CO4	3	3	2	-	1	-	-	3
CO5	3	3	2	-	1	-	-	2

CA24P31	CLOUD COMPUTING LABORATORY	Category	L	T	P	SL	C
		PCC	0	0	60	0	2

PREREQUISITE

A basic understanding of computer networks, operating systems, virtualization, databases, programming skills and fundamental knowledge of security concepts.

COURSEOBJECTIVES:

To gain hands-on experience with cloud platforms and tools for deploying, managing, and scaling cloud-based applications.

LIST OF EXPERIMENTS

1. Install Virtual box /VMware Workstation with different flavours of Linux or windows OS on top of windows7 or 8.
2. Install a C compiler in the virtual machine created using virtual box and execute Simple Programs.
3. Install Google App Engine. Create *hello world* app and other simple web applications using python/java.
4. Use GAE launcher to launch the web applications.
5. Simulate a cloud scenario using Cloud Sim and run a scheduling algorithm that is not present in Cloud Sim.
6. Find a procedure to transfer the files from one virtual machine to another virtual machine.
7. Find a procedure to launch virtual machine using try stack (Online Open stack Demo Version)
8. Install Hadoop single node cluster and run simple applications like word count.
9. Create and use a repository using git hub
10. Create a blog to show the profile of our MCA department

P:60, TOTAL: 60 PERIODS

COURSE OUT COMES: At the end of the course, the students will be able to:

COs	Course Outcome	Cognitive Level
CO1:	Describe the core principles and challenges of distributed computing systems and their applications.	Understand
CO2:	Compare the create, configure, and manage virtual machines and templates for efficient virtualization and resource optimization.	Understand
CO3:	Classify the cloud platforms leveraging virtual machines for scalable and flexible computing resources.	Understand
CO4:	Determine the various cloud computing business models to identify optimal strategies for different organizational needs.	Apply
CO5:	Develop foundational programming and software development skills to build efficient and scalable applications.	Apply

Mapping of Cos with Pos and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	2	-	-	1	-	-	2
CO2	3	2	-	-	1	-	-	3
CO3	3	2	-	-	1	-	-	2
CO4	3	3	2	-	1	-	-	3
CO5	3	3	2	-	1	-	-	2

CA24P32	BIG DATA ANALYTICS LABORATORY	Category	L	T	P	SL	C
		PCC	0	0	60	0	2

PREREQUISITE

To possess a strong foundation in programming, data structures, Cloud Computing and algorithms, as well as familiarity with database concepts and operating systems.

COURSEOBJECTIVES:

To develop practical skills in using big data tools and techniques for processing and analyzing large datasets.

LIST OF EXPERIMENTS

1. Write a Program to Implement a Variable Assignment Operation using Student Details.
2. Write a Program to Implement a Vector Manipulation using Employee Details.
3. Write a Program to Implement a List Manipulation using Calendar Details of particular Year.
4. Write a Program to Implement a Matrix Manipulation using Addition, Subtraction &Multiplication.
5. Create an array with two elements which are 3x3 matrices.
6. Write a Program to Visualize a Patient Dataset Using Data frame.
7. Write a Program to Implement a Statistical Operation.
8. Write a Program to Implement a Data Visualization Operation using a Rainfall Distribution by Year.
9. Implement a R Script to perform Normal, Binomial distributions.
10. Create a Non-Tabular Data Types: Time series, spatial data, Network data.

P:60, TOTAL: 60 PERIODS

COURSE OUT COMES: At the end of the course, the students will be able to:

COs	Course Outcome	Cognitive Level
CO1	Implement standard statistical and visualization tools to effectively analyze and interpret data sets.	Apply
CO2	Compute the data manipulation techniques to clean, transform, and prepare data for effective analytics.	Apply
CO3	Demonstrate data frame techniques to organize, manipulate, and analyze datasets efficiently for data-driven insights.	Apply
CO4	Design statistical operation techniques to summarize, analyze, and interpret data for informed decision-making.	Apply
CO5	Determine the data visualizations to effectively communicate insights from complex datasets.	Apply

Mapping of Cos with Pos and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	2	1	1	-	-	2
CO2	3	3	2	1	1	-	-	3
CO3	3	3	2	1	1	-	-	2
CO4	3	3	2	1	1	-	-	3
CO5	3	3	2	1	1	-	-	2

CA24P33	MOBILE APPLICATION DEVELOPMENT LABORATORY	Category	L	T	P	SL	C
		PCC	0	0	60	0	2

PREREQUISITE

Mobile app development requires a clear concept, precise design, a competent development team, proper programming languages and tools, relevant APIs, thorough testing, and a strong marketing plan.

COURSE OBJECTIVES:

To build practical skills in designing, developing, and deploying mobile applications across various platforms.

LIST OF EXPERIMENTS

1. Develop an application that uses Layout Managers.
2. Develop an application that uses event listeners.
3. Develop an application that uses Adapters, Toast.
4. Develop an application that makes use of database.
5. Develop an application that makes use of RSS Feed.
6. Implement an application that implements Multi-threading.
7. Develop a native application that uses GPS location information.
8. Implement an application that writes data to the SD card.
9. Implement an application that creates an alert upon receiving a message.
10. Develop a game application

P:60, TOTAL: 60 PERIODS

COURSE OUT COMES: At the end of the course, the students will be able to:

COs	Course Outcome	Cognitive Level
CO1	Demonstrate the proficiency in setting up and configuring Android development tools to build and debug mobile applications.	Apply
CO2	Develop user interfaces tailored for the Android platform to enhance app usability and user experience.	Apply
CO3	Apply core Java programming concepts effectively in the development of Android applications.	Apply
CO4	Compute the current technology and business trends shaping the development and adoption of mobile applications.	Apply
CO5	Apply the competence in understanding the characteristics and architecture of mobile applications for effective design and development.	Apply

Mapping of Cos with Pos and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	2	1	1	-	-	2
CO2	3	3	2	1	1	-	-	3
CO3	3	3	2	1	1	-	-	2
CO4	3	3	2	1	1	-	-	3
CO5	3	3	2	1	1	-	-	2

MA24E01	PROBABILITY AND STATISTICS (ELECTIVE I)	Category	L	T	P	SL	C
		PEC	45	0	0	45	3

PREREQUISITE:

The students should have basic knowledge in data collection, data analysis, data interpretation and research design.

OBJECTIVES:

To introduce students to the fundamental concepts of probability and statistics for analyzing data and making informed decisions.

UNIT - I	EXPLORATORY DATA ANALYSIS	(9)

Definition of Statistics – applications - data types and measurements, graphical representation of data using histogram, line diagram, bar diagram, measures of central tendency and dispersion; coefficient of skewness and kurtosis.

UNIT - II	PROBABILITY AND RANDOM VARIABLES	(9)

Random experiment, sample space and events. Definitions of probability, addition and multiplication rules of probability, conditional probability. Random variables: pmf and pdf of random variables; Mathematical expectation: mean, variance, covariance, mgf and cgf of a random variable.

UNIT - III	SAMPLING DISTRIBUTIONS	(9)

Concepts of population, sample, parameter, statistic, and sampling distribution. Probability distributions: Binomial, Poisson and Normal distributions with their important characteristics.

UNIT - IV	TESTING OF HYPOTHESIS	(9)

Statistical hypotheses-Simple and composite, Statistical tests, Critical region, Type I and Type II errors, Testing of hypothesis – null and alternative hypothesis, level of significance. Test of significance using z, t, F and Chi-Square distributions.

UNIT - V	ADVANCED STATISTICAL METHODS	(9)

Analysis of one-way, two-way classifications and Latin Square Design. Correlation and regression analysis.

L:45, SL: 45 TOTAL: 90 PERIODS

COURSE OUTCOMES: At the end of the course, the students will be able to:

COs	Course Outcome	Cognitive Level
CO1	Illustrate the exploratory data analysis techniques to summarize, visualize, and uncover patterns in datasets for informed decision-making.	Understand
CO2	Apply the principles of probability and random variables to model uncertainty and analyze random phenomena in real-world scenarios.	Apply
CO3	Apply the concept of sampling distributions to make statistical inferences about population parameters.	Apply
CO4	Determine the hypothesis testing to draw valid conclusions about population parameters based on sample data.	Apply
CO5	Develop the advanced statistical methods for data analysis, including regression, ANOVA, and multivariate techniques.	Apply

TEXT BOOKS:

1. Gupta S.C & Kapoor V.K, “Fundamentals of Mathematical statistics”, Sultan Chand & sons, New Delhi, 2nd Edition, 2015.
2. Douglas C Montgomery, George C Runger, “Applied Statistics and Probability for Engineers”, Wiley student edition, Chennai, 2014.

REFERENCES:

1. Freund J.E, "Mathematical statistics", Prentice Hall, New Delhi, 3rd Edition, 2016.

2. Levine, David M, Berenson, L Mark, Stephen, David, "Statistics for Managers Using Microsoft Excel", PHI, New Delhi, 2nd Edition, 2016.

3. Murray Spiegel, John Schiller, and R. Alu Srinivasan, "Schaum's Outline of Probability and Statistics", 3rd Edition, 2016.

4. Sheldon M. Ross, "Introduction to Probability and Statistics for Engineers and Scientists", 4th Edition, 2016.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	-	-	1	-	-	3
CO2	3	3	2	-	1	-	-	2
CO3	3	3	2	-	1	-	-	3
CO4	3	3	2	-	1	-	-	2
CO5	3	3	2	-	1	-	-	3

CA24E01	TCP/IP (ELECTIVE I)	Category	L	T	P	SL	C
		PEC	45	0	0	45	3

PREREQUISITE:
Networking fundamentals familiarity with basic networking terms like IP addresses, ports, protocols, and packet switching.

OBJECTIVES:
To provide students with a comprehensive understanding of the TCP/IP protocol suite and its role in enabling reliable network communication.

UNIT - I	INTRODUCTION	(9)

History –Standards–Internet–-OSImodel–Protocolsuite–Addressing–TransmissionMedia–LocalArea and Wide Area Networks–Switching–Connecting devices–IP Addressing.

UNIT - II	INTERNET PROTOCOL	(9)

Sub netting–Super netting–IP Packets–Delivery and Forwarding of IP Packets–Datagram–Fragmentation–Options - Checksum–ARP–RARP-InternetControlMessageProtocol–InternetGroupManagementProtocol.

UNIT - III	TCP&UDP	(9)

TCPServices–Features-Segmentation-TCPConnection-StateTransitionDiagram-WindowsinTCP-Flowcontrol – Error Control–Congestion Control–Timers-Package-User Datagram protocol-Services-Applications-Package.

UNIT - IV	APPLICATION LAYER AND CLIENT SERVER MODEL	(9)

Concurrency–BOOTP–DHCP–DomainNameSystem–NameSpace–Distribution–Resolution–Messages– Telnet – Rlogin–NetworkVirtualTerminal–CharacterSet–ControllingtheServer–RemoteLogin.

UNIT - V	APPLICATION PROTOCOLS	(9)

File Transfer Protocol–Connections–Communication–SimpleMailTransferProtocol–SimpleNetwork Management Protocol–Hyper Text Transfer Protocol–Transaction–Request and Response messages.

L:45, SL: 45, TOTAL: 90 PERIODS

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

COs	Course Outcome	Cognitive Level
CO1	Classify Recognize the network components, categories, topology and IP address and compare the ISO/OSI model with TCP/IP protocol suite.	Understand
CO2	Illustrate the functionality of various internet protocols and gain the knowledge of the different routing protocols and algorithms.	Understand
CO3	Demonstrate differentiate between TCP and UDP protocols and analyze their use in reliable and fast data communication.	Apply
CO4	Implement the knowledge of congestion control and QOS techniques and purpose of DNS and client - server model.	Apply
CO5	Implement the common application layer protocols such as HTTP, FTP, SMTP, and DNS in network communications.	Apply

REFERENCES:

1. BehrouzA.Forouzan, TCP/IP Protocol Suite, TataMcGrawHill Edition, New Delhi, Third Edition, 2015.
2. Richard Stevens W. and Gabrani G., TCP/IP Illustrated Volume I, Pearson Education, New Delhi, 2019.
3. Douglas E. Comer, David L. Stevens, Internetworking with TCP/IP – Volume I,II,III, PHI Pvt. Ltd., Second Edition, 2015.
4. Tim Parker, Mark A., Sportack, TCP/IP Unleashed, TechMedia, New Delhi, Second Edition, 2016.
5. Douglas E. Comex, Internetworking with TCP/IP, Principles, protocols and architecture, PHI, New Delhi, Fifth Edition, 2016.
6. Behrouz A. Forouzan, TCP/IP Protocol Suite, Tata McGraw Hill, New Delhi, Third Edition, 2016.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	2	-	-	1	-	-	3
CO2	3	2	-	-	1	-	-	2
CO3	3	3	2	-	1	-	-	3
CO4	3	3	2	-	1	-	-	2
CO5	3	3	2	-	1	-	-	3

CA24E02	UNIX AND NETWORK PROGRAMMING (ELECTIVE I)	Category	L	T	P	SL	C
		PEC	45	0	0	45	3

PREREQUISITE:

Proficiency in C is crucial for Unix and network programming. Many Unix systems and network applications are developed using C due to its close interaction with system-level operations.

COURSE OBJECTIVES:

Equip students with knowledge and practical skills in UNIX operating system concepts and network programming using sockets.

UNIT - I	INTRODUCTION&FILESYSTEM	(9)

Overview of UNIX OS – File I/O–File Descriptors–File Sharing-Files and Directories–File Types – File Access Permissions – File Systems–Symbolic Links-Standard I/O library–Streams and File Objects–Buffering-System Data Files and Information - Password File–Group File–Login Accounting–System Identification.

UNIT - II	PROCESSES	(9)

Environment of a UNIX Process – Process Termination – Command Line Arguments – Process Control – Process Identifiers - Process Relationships Terminal Logins – Signals –Threads.

UNIT - III	INTERPROCESSCOMMUNICATION	(9)

Introduction-Message Passing (SVR4)-Pipes–FIFO–Message Queues–Synchronization (SVR4)–Mutexes– Condition Variables–Read– Write Locks–File Locking–Record Locking–Semaphores–Shared Memory (SVR4).

UNIT - IV	SOCKETS	(9)

Introduction–Transport Layer–Socket Introduction-TCP Sockets–UDP Sockets-Raw Sockets–Socket Options-I/O Multiplexing-Name and Address Conversions.

UNIT - V	APPLICATIONS	(9)

Debugging Techniques-TCP Echo Client Server-UDP EchoClientServer-Ping-Trace Route-Client Server Applications Like File Transfer and Chat

L:45, SL: 45, TOTAL: 90 PERIODS

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

COs	Course Outcomes	Cognitive Level
CO1	Summarize the basic concepts of operating systems and analyze the structure and functions of file systems.	Understand
CO2	Illustrate Unix process concepts and demonstrate process creation, management, and communication.	Understand
CO3	Demonstrate the purpose of inter process communication system and locking procedure.	Apply
CO4	Apply the socket programming concepts and develop network-based applications using client-server communication.	Apply
CO5	Demonstrate and implement real-time applications using Unix system calls and network programming techniques.	Apply

REFERENCES:

1. W.Richard Stevens, Advanced programming in the UNIX environment, Addison Wesley, New Delhi, 2015.
2. W.Stevens, Bill Fenner, Andrew Rudoff, Unix Network Programming, Volume 1,The Sockets Networking API, Pearson education, New Delhi, Third Edition, 2013.
3. W. Stevens, Bill F, A R, Unix Network Programming, V1, The Sockets Networking API, PE, New Delhi, Third Edition, 2017.
4. Meeta G, Tilak S and Rajiv S The C Odyssey Unix –The open Boundless C, BPB Publications, New Delhi, First Edition, 2015.
5. W. Richard Stevens, Advanced Programming in The UNIX Environment, Addison Wesley, New Delhi 2015.
6. S. J. Leffler, M. K. Mckusick, M. J. Karels and J. S. Quarterman., The Design and Implementation of the 4.3 BSD Unix Operating System, Addison Wesley, New Delhi, 2015.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	2	-	-	1	-	-	3
CO2	3	2	-	-	1	-	-	2
CO3	3	3	2	-	1	-	-	3
CO4	3	3	2	-	1	-	-	2
CO5	3	3	2	-	1	-	-	3

CA24E03	WEB PROGRAMMING ESSENTIAL (ELECTIVE I)	Category	L	T	P	SL	C
		PEC	45	0	0	45	3

PREREQUISITE:
Familiarity with using a computer, keyboard, and mouse. Understanding of basic software installation and management. Basic understanding of programming concepts.

COURSE OBJECTIVES:

To introduce students to the essential concepts and technologies for designing and developing dynamic, interactive web applications.

UNIT - I	WEBSITE BASICS	(9)

Internet Overview – Fundamental computer network concepts – Web Protocols – URL – Domain Name- Web Browsers and Web Servers- Working principle of a Website –Creating a Website – Client-side and server-side scripting

UNIT - II	WEB DESIGNING	(9)

HTML – Form Elements – Input types and Media elements – CSS3 – Selectors, Box Model, Backgrounds and Borders, Text Effects, Animations, Multiple Column Layout, User Interface.

UNIT - III	CLIENT-SIDE PROCESSING AND SCRIPTING	(9)

JavaScript Introduction – Variables and Data Types-Statements – Operators – Literals-Functions Objects-Arrays-Built-in Objects- Regular Expression, Exceptions, Event handling, Validation – JavaScript Debuggers.

UNIT - IV	SERVERSIDE PROCESSING AND SCRIPTING – PHP	(9)

PHP – Working principle of PHP – PHP Variables – Constants – Operators – Flow Control and Looping – Arrays – Strings – Functions – File Handling – File Uploading – Email Basics – Email with attachments – PHP and HTML – Simple PHP scripts – Databases with PHP.

UNIT - V	SERVLETS AND DATABASE CONNECTIVITY	(9)

Servlets: Java Servlet Architecture – Servlet Life cycle- Form GET and POST actions -Sessions – Cookies–Database connectivity–JDBC Creation of simple interactive applications – Simple database applications

L:45, SL: 45, TOTAL: 90 PERIODS

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

COs	Course Outcome	Cognitive Level
CO1	Classify the fundamentals of website structure and design, including HTML, CSS, and basic web technologies.	Understand
CO2	Describe the interactive web pages using client-side scripting languages such as JavaScript for dynamic content and user interaction.	Understand
CO3	Summarize the client-side scripting techniques using languages like JavaScript to enhance web page interactivity and functionality.	Understand
CO4	Demonstrate the dynamic web applications by implementing server-side processing and scripting using PHP.	Apply
CO5	Choose the web applications using servlets and integrate them with databases for dynamic data management.	Apply

REFERENCES:	
1.	Robin Nixon, “Learning PHP, MySQL, JavaScript, CSS & HTML5” Third Edition, O’Reilly publishers, 2022.
2.	Paul Deitel, Harvey Deitel, Abbey Deitel, “Internet & World Wide Web – How to Program”, 5th edition, Pearson Education, 2019.
3.	Jeffrey C. Jackson, “Web Technologies–A Computer Science Perspective”, Pearson Education, 2016.
4.	James F. Kurose, “Computer Networking: A Top-Down Approach”, Sixth Edition, Pearson Education, 2012.
5.	Steven Holzemer, “PHP – The Complete Reference”, 1st Edition, Mc-Graw Hill, 2017.
6.	Fritz Schneider, Thomas Powell, “JavaScript – The Complete Reference”, 3rd Edition, McGraw Hill Publishers, 2017.

Mapping of COs with POs and PSOs

COs/ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
CO1	3	2	-	-	1	-	-	2
CO2	3	2	-	-	1	-	-	3
CO3	3	3	-	-	1	-	-	2
CO4	3	3	2	-	1	-	-	3
CO5	3	3	2	-	1	-	-	2

CA24E04	MIDDLEWARE TECHNOLOGY (ELECTIVE I)	Category	L	T	P	SL	C
		PEC	45	0	0	45	3

PREREQUISITE:

Programming Fundamentals: Proficiency in at least one programming language (e.g., Java, C#, Python) to understand middleware components and their integration.

COURSE OBJECTIVES:

To provide students with an understanding of middleware technologies that enable seamless integration and communication between distributed software applications.

UNIT - I	INTRODUCTION CLIENT/ SERVER & MIDDLEWARE TECHNOLOGY	(9)

Client/Server-Server Types-Middleware–Client, Server and Operating System-Introduction to Distribute Object Technology-Middleware–Client/Server Building Blocks–Peer-to Peer Communications–RPC-Messaging-Java RMI- Overview of CORBA and DCOM.

UNIT - II	EJB ARCHITECTURE	(9)

EJB – EJB Architecture – Overview of EJB Software Architecture – View of EJB –Conversation – Building and Deploying EJBs – Roles in EJB.

UNIT - III	EJB APPLICATIONS	(9)

Types of Enterprise beans –Lifecycle of Beans-Steps in Developing an application using EJB Framework, EJB Deployment-EJB Session Beans– EJB Entity Beans–EJB Clients– Building an Application with EJB.

UNIT - IV	CORBA	(9)

Introduction and Concepts-CORBA Components-Architectural Features-Method Invocations-Static and Dynamic CORBA-Structure of CORBA IDL-Self Describing Data types-Building an application using CORBA-Advanced CORBA- CORBA Object Service-Object Location Service-Message Service-CORBA Component Model.

UNIT - V	COM	(9)

Evolution of DCOM, COM Client and Server, COMIDL, COM Interface-COM threading Model, Marshalling, Comparison of RMI, CORBA and DCOM. Programming Examples of RMI, CORBA and DCOM.

L:45, SL: 45 TOTAL: 90 PERIODS

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

COs	Course Outcomes	Cognitive Level
CO1	Describe the concepts of client/server architecture and middleware technologies for distributed computing.	Understand
CO2	Classify structure and components of Enterprise JavaBeans (EJB) architecture for building scalable enterprise applications.	Understand
CO3	Implement the enterprise-level applications using Enterprise JavaBeans (EJB) technology.	Apply
CO4	Determine the CORBA concepts for enabling interoperability in distributed object-oriented systems.	Apply
CO5	Demonstrate the Component Object Model (COM) architecture and develop component-based software for Windows environments.	Apply

Reference Books:

1	Herbert Schildt, The Complete Reference JAVA, Tata McGraw Hill, New Delhi, Tenth Edition, 2023.

2	Gavin King, Java Persistence with Hibernate, Manning Publications, New Delhi, Second Edition,2016.
3	Herbert Schildt, The Complete Reference, Tata McGraw Hill, New Delhi, Eighth Edition, 2016.
4	Kogent, Java 6 Programming Black Book, Kogent Learning Solutions, New Delhi, Second Edition, 2015,
5	Steven Holzner, Java 2 (JDK 5) Programming, PHI, New Delhi, Second Edition, 2017.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	2	-	-	1	-	-	3
CO2	3	2	-	-	1	-	-	3
CO3	3	3	2	-	1	-	-	2
CO4	3	3	2	-	1	-	-	3
CO5	3	3	2	-	1	-	-	2

CA24E05	DEVOPS (ELECTIVE I)	Category	L	T	P	SL	C
		PEC	45	0	0	45	3

PREREQUISITE:

To effectively work in a Devops environment, having a strong foundation in several key areas is crucial. Understanding how to use Git for version control, including branching, merging, and pull requests.

COURSE OBJECTIVES:

Equip learners with the skills to automate, integrate, and streamline software development and IT operations for faster, reliable delivery.

UNIT - I	INTRODUCTION TO MICROSERVICES	(9)

Definition of Micro services – Characteristics - Micro services and Containers – Interacting with Other Services – Monitoring and Securing the Services – Containerized Services – Deploying on Cloud

UNIT - II	MICROSERVICES ARCHITECTURE	(9)

Monolithic architecture- Micro service architectural style- Benefits - Drawbacks of Micro service architectural style - decomposing monolithic applications into Micro services.

UNIT - III	BASICS OF DEVOPS	(9)

History of Devops- Devops and software development life cycle- water fall model – agile model – Devops life cycle – Devops tools: distributed version control tool –Git- automation testing tools – Selenium - reports generation – TestNG - User Acceptance Testing – Jenkins.

UNIT - IV	MICROSERVICES IN DEVOPS ENVIRONMENT	(9)

Evolution of Micro services and Devops – Benefits of combining Devops and Micro services working of Devops and Micro services in Cloud environment - Devops Pipeline representation for a Node JS based Micro services.

UNIT - V	VELOCITY AND CONTINUOUS DELIVERY	(9)

Velocity - Delivery Pipeline- test stack - Small/Unit Test – medium /integration testing – system testing- Job of Development and Devops - Job of Test and Devops – Job of Op and Devops Infrastructure and the job of Ops.

L:45, SL: 45, TOTAL: 90 PERIODS

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

COs	Course Outcomes	Cognitive Level
CO1	Summarize the principles and architecture of micro services for building scalable and maintainable applications.	Understand
CO2	Interpret the distributed applications using micro services architecture for improved scalability and flexibility.	Understand
CO3	Determine the fundamental principles and practices of DevOps for efficient software development and delivery.	Apply
CO4	Implement micro services within a DevOps environment to enable continuous delivery and scalable deployments.	Apply
CO5	Apply velocity metrics and continuous delivery practices to enhance software development speed and quality.	Apply

Reference Books:

1	James A Scott, A Practical Guide to Microservices and Containers, Map R Data Technologies e–book.
2	Joyner Joseph, Devops for Beginners, Mihails Konoplovs publisher, First Edition, 2015.
3	Gene Kim, Kevin Behr, George Spafford, The Phoenix Project, A Novel about IT, DevOps, IT Revolution Press, 5th Edition, 2018.

4	Michael Hüttermann, DevOps for Developers, A Press, e-book, First Edition, 2012.
5	Jennifer Davis and Katherine Daniels, Effective DevOps: Building a Culture of Collaboration, Affinity, and Tooling at Scale, O'Reilly Media Inc, First Edition, 2016.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	2	-	-	1	-	-	3
CO2	3	2	-	-	1	-	-	3
CO3	3	3	2	-	1	-	-	2
CO4	3	3	2	-	1	-	-	3
CO5	3	3	2	-	1	-	-	2

BA24E51	HEALTH CARE INFORMATION SYSTEMS (ELECTIVE I)	Category	L	T	P	SL	C
		PEC	45	0	0	45	3

PREREQUISITE: The students should have basic knowledge on the concepts of healthcare, information system, information technology and related basic laws.

OBJECTIVES:

To enable learners to understand and apply information technology solutions for effective management of healthcare data and services.

UNIT - I	**INTRODUCTION**	**(9)**

Introduction to Healthcare Information – Health Care Data Quality - Healthcare Information Regulations, Laws and Standards

UNIT - II	**HEALTHCARE INFORMATION SYSTEMS**	**(9)**

History and Evolution of Healthcare Information Systems - Current and Emerging use of Clinical Information Systems - System Acquisition - System Implementation and Support.

UNIT - III	**INFORMATION TECHNOLOGY**	**(9)**

Information Architecture and Technologies that Support Health Care Information Systems - Health Care Information Systems Standards - Security of Healthcare Information Systems.

UNIT - IV	**MANAGEMENT OF IT CHALLENGES**	**(9)**

Organizing Information Technology Services - IT Alignment and Strategic Planning - IT Governance and Management.

UNIT - V	**IT INITIATIVES**	**(9)**

Management's Role in Major IT Initiatives - Assessing and Archiving Value in Healthcare Information Systems.

L:45, SL: 45, TOTAL: 90 PERIODS

COURSE OUTCOMES: At the end of the course, the students will be able to:

COs	Course Outcomes	Cognitive Level
CO1	Understand the fundamentals of healthcare information, data quality, and key regulations governing healthcare data management.	Understand
CO2	Summarize the history, evolution, and key processes involved in healthcare information systems, including acquisition, implementation, and support.	Understand
CO3	Grasping concepts of IT, architecture, standards, and security principles.	Understand
CO4	Learners are expected to comprehend planning, governance, and strategic alignment concepts.	Understand
CO5	Apply management principles to assess and demonstrate the value of major IT initiatives in healthcare information systems.	Apply

REFERENCES:

1.Aswathappa.K, Organizational Behavior, Himalaya Publishing House, Chennai, Tenth Edition, 2015.
2.Stephen P. Robins, Organizational Behavior, PHI Learning / Pearson Education, New Delhi, Eleventh edition, 2016.
3.Stephen P Robbins, Organizational Behavior, PHI, New York, Thirteen Edition, 2014
4.MohiniSukhapure&UdayN.Limaye Organizational Behavior, Himalaya Publishing Private Limited, Pune, 2015
5.P.Subba Rao, Organizational Behavior, Himalaya Publishing (P) Ltd, Pune, Fifth Edition, 2016
6.Schermerhorn, Hunt and Osborn, Organizational behavior, John Wiley, New Delhi, Ninth Edition, 2015

Mapping of COs with POs and PSOs								
COs/ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
CO1	1	2	1	1	1	1	2	2
CO2	1	2	1	2	1	2	1	3
CO3	2	2	1	3	1	2	3	3
CO4	1	2	2	1	2	3	2	3
CO5	1	2	2	1	1	3	2	2

MA24E02	RESOURCE MANAGEMENT TECHNIQUES (ELECTIVE II)	Category	L	T	P	SL	C
		PEC	45	0	0	45	3

PREREQUISITE:

Students should understand optimization techniques (linear & integer programming), basic network programming, and replacement models for effective resource management.

OBJECTIVES:

The course will enable learners to:

To teach students how to efficiently plan, allocate, and optimize resources using analytical and computational techniques.

UNIT - I	LINEAR PROGRAMMING PROBLEMS	(9)

Introduction–Scope and role of OR–Phases of OR–Limitations of OR–Linear Programming Problem–Formulation of Linear Programming Problem–Optimum Solution by Graphical Method–Simplex Method(Using Slack Variables).

UNIT - II	TRANSPORTATION AND ASSIGNMENT PROBLEMS	(9)

Transportation Models (Minimizing and Maximizing Cases)-Balanced and Unbalanced Cases–Initial Basic Feasible Solution by North West Corner Rule, Least Cost and Vogel's Approximation Methods. Check for Optimality by Modified Method Assignment Models.

UNIT - III	NETWORK MODELS	(9)

Network – Fulkerson's Rule – Construction of a Network – Critical Path Method (CPM) – Optimistic, Pessimistic and Most Likely Time Estimates – Project Scheduling by PERT Analysis.

UNIT - IV	INVENTORY MODEL	(9)

Types of Inventory – Deterministic Inventory Models – EOQ and EBQ Models with and without Shortages – Quantity Discount Models - Price Breaks.

UNIT - V	REPLACEMENT MODELS AND SEQUENCING	(9)

Replacement of items that Deteriorate with Time – Value of Money Changing with Time–Not Changing with Time– Optimum Replacement Policy – Individual and Group Replacement. Sequencing Problem–Assumptions – Processing of 'n' Jobs with two Machines 'n' Jobs with 'm' Machines.

L:45, SL: 45, TOTAL: 90 PERIODS

COURSE OUTCOMES: At the end of the course, the students will be able to:

COs	Course Outcomes	Cognitive Level
CO1	Demonstrate the linear programming problems to optimize objective functions subject to linear constraints.	Apply
CO2	Simulate the transportation and assignment problems to optimize resource allocation and minimize costs in logistics and operations.	Apply
CO3	Apply the concepts of network models to solve optimization problems related to routing, flow, and project scheduling in complex systems.	Apply
CO4	Compute the inventory models to optimize stock levels, minimize costs, and improve supply chain efficiency.	Apply
CO5	Choose the replacement models and sequencing techniques to optimize equipment maintenance strategies.	Apply

TEXT BOOKS:

1. TahaH.A, "Operation Research", Pearson Education, Noida , 9th Edition, 2013

2.Vohra N D, "Quantitative Techniques in Management", Tata Mc Graw Hill, New Delhi, 6th Edition, 2021.

REFERENCES:

1.P.K.Gupta and Man Mohan, "Problems in Operations Research", S.Chand and Co, New Delhi, 12th Edition, 2014

2. Wayne. L. Winston, "Operations research applications and algorithms", Thomson learning, United States, 4th Edition, 2016.

3. Kalavathy S, "Operations Research", Vikas Publishing House, Ahmedabad, 6th Edition, 2019.

4. Hiraand Gupta, "Problems in Operations Research", S.Chand and Co, New Delhi, 2nd Edition, 2012.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	3	-	1	-	-	2
CO2	3	3	3	-	1	-	-	3
CO3	3	3	3	-	1	-	-	2
CO4	3	3	3	-	1	-	-	3
CO5	3	3	3	-	1	-	-	2

CA24E06	SOFTWARE PROJECT MANAGEMENT (ELECTIVE II)	Category	L	T	P	SL	C
		PEC	45	0	0	45	3

PREREQUISITE:

Understand the phases of software development, including planning, analysis, design, implementation, testing, and maintenance.

COURSE OBJECTIVES:

To equip students with skills to plan, execute, and control software projects effectively, ensuring timely delivery and quality outcomes.

UNIT - I	INTRODUCTION TO SOFTWARE PROJECT MANAGEMENT	(9)

Product Life Cycle: Introduction-Idea Generation -Prototype Development Phase-Alpha Phase - Beta Phase - Production Phase-Maintenance and Obsolescence Phase. Product Life Cycle Models: The Waterfall Model - The Prototyping Model - The Rapid Application Development (RAD) Model - Spiral Model and Its Variants. Process Models: The ISO-9001 Model - The Capability Maturity Model.

UNIT - II	SOFTWARE METRICS & SOFTWARE CONFIGURATION MANAGEMENT	(9)

Software Metrics: Introduction - The Metrics Roadmap - A Typical Metrics Strategy - What To Measure - Set Targets and Track Them - Understanding and Trying to Minimize Variability - Act on Data - People and Organizational Issues in Metrics Programs - Common Pitfalls to watch out for in Metrics Programs – Metrics Implementation Checklists and Tools. Software Configuration Management: Introduction - Definitions and Terminology

UNIT - III	SOFTWARE QUALITY ASSURANCE & RISKMANAGEMENT	(9)

Software Quality Assurance: Software Quality - Quality Important in Software - Quality Control and Quality Assurance -Cost and Benefits of Quality - Software Quality Analyst's Functions - Misconceptions about the SQA Role - Software Quality Assurance Tools- Organizational Structures - Profile of a Successful SQA - Measure of SQA Success - Pitfalls of SQA. Risk Management: Introduction

UNIT - IV	PROJECT MANAGEMENT PROCESS AND ACTIVITIES	(9)

Project Life Cycle: In-Stream Activities-Project Initiation: Activities During Project Initiation - Outputs, Quality Record and Project Initiation Phase – Interface to the Process Database. Project Planning and Tracking: Components of Project Planning and Tracking - Project Closure: Issues and Metrics for Project Closure.

UNIT - V	ENGINEERING ACITIVITIES IN PROJECTS	(9)

Estimation: Phases of Estimation - Estimation Methodology - Size Estimation Effort and Schedule Estimates. Project Management In Testing Phase - What Is Testing? – What are the Activities That Make Up Testing - Test Scheduling & Types of Tests - Project Management In the Maintenance Phase - Activities During the Maintenance Phase - Management Issues in the Maintenance Phase?

L:45, SL: 45, TOTAL: 90 PERIODS

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

COs	Course Outcome	Cognitive Level
CO1	Summarize the basic idea about the software project management and it's planning activities.	Understand
CO2	Compare the software metrics and configuration management techniques to monitor, control, and improve software quality and development processes.	Understand
CO3	Describe the role of software developers in getting exposure on software quality and risk management.	Understand
CO4	Interpret the project management processes and activities to plan, execute, and control software projects effectively.	Understand
CO5	Develop a software projects, including requirements analysis, design, development, testing, and maintenance.	Apply

REFERENCES:

1. Gopalaswamy Ramesh, Managing Global Software Projects, Tata McGraw Hill, New Delhi, Third Edition,2018
2. Pankaj Jalote, Software Project Management in Practice, Pearson Education, New Delhi, Second Edition 2018
3. Bob Hughes, Mike Cotterell, Rajib Mall, Software Project Management, Fifth Edition, TataMcGrawHill,2011.
4. Walker Royce, Software Project Management, Pearson Education, New Delhi, Second Edition 2017.
5. Pankoj Jalote, Software Project Management in Practice, Pearson Education, Chennai,2018.
6. Jim Highsmith, Agile Project Management, Pearson education, New Delhi, 2018.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	2	-	-	2	-	-	3
CO2	3	2	-	-	2	-	-	2
CO3	3	2	-	-	2	-	-	3
CO4	3	2	-	-	2	-	-	2
CO5	3	3	2	-	2	-	-	3

CA24E07	ADVANCED OPERATING SYSTEMS (ELECTIVE II)	Category	L	T	P	SL	C
		PEC	45	0	0	45	3

PREREQUISITE:

Understanding core concepts such as processes, threads, scheduling, memory management, and file systems. Familiarity with system calls and how operating systems interact with hardware and applications.

COURSE OBJECTIVES:

To deepen students' understanding of modern operating system concepts, architectures, and advanced management techniques.

UNIT - I	DISTRIBUTED OPERATING SYSTEMS	(9)

Architectures of Distributed Systems-System Architecture Types-Issues in Distributed Operating Systems-Communication Networks-Communication Primitives. Distributed Dead Lock Detection-Introduction-Deadlock Handling Strategies in Distributed Systems-Issues in Deadlock Detection and Resolution–Control Organizations for Distributed Deadlock Detection.

UNIT - II	DISTRIBUTED RESOURCE MANAGEMENT	(9)

Distributed File Systems–Mechanisms for Building Distributed File Systems–Design Issues – Distributed Shared Memory–Design Issues: Distributed Scheduling–Issues in Load Distributing–Components of a Load Distributing Algorithm–Load Distributing Algorithms–Selecting a Suitable Load Sharing Algorithm–Requirements for Load Distributing.

UNIT - III	FAIL URE RECOVERY AND FAULT TOLERANCE	(9)

Recovery–Basic Concepts–Classification of Failures–Backward and Forward Error Recovery–Backward-Error Recovery: Basic Approaches–Recovery in Concurrent Systems–Fault Tolerance–Issues–Atomic Actions and Committing–Commit Protocols–Non blocking Commit Protocols–Voting Protocol

UNIT - IV	PROTECTION AND SECURITY	(9)

Protection and Security-Preliminaries, The Access Matrix Model and its implementations. -Safety in Matrix Model-Advanced Models of Protection

UNIT - V	MULTI PROCESSOR OPERATING SYSTEMS	(9)

Multiprocessor Operating Systems-Basic Multiprocessor System Architectures –Inter Connection Networks for Multiprocessor Systems-Caching-Hyper cube Architecture-Structures of Multiprocessor Operating System-Operating System Design Issues.

L:45, SL: 45, TOTAL: 90 PERIODS

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

COs	Course Outcomes	Cognitive Level
CO1	Illustrate principles and architecture of distributed operating systems and analyze their role in managing distributed resources and processes.	Understand
CO2	Compare the techniques for managing resources in distributed systems to ensure efficiency, reliability, and scalability.	Understand
CO3	Determine the knowledge of failure recovery and fault tolerance, to know the security issues and protection mechanisms for distributed environments.	Apply
CO4	Implement the protection and security mechanisms to safeguard system resources and ensure data integrity in computing environments.	Apply
CO5	Apply the architecture and functioning of multiprocessor operating systems and analyze their role in parallel processing and performance optimization.	Apply

REFERENCES:

1. Mukesh Singhal, Niranjan Shivaratri, Advanced concepts in operating systems: Distributed, Database and multiprocessor operating systems, Tata McGraw Hill, New Delhi, Second Edition, 2017.
2. Abraham Silberschatz; Peter Baer Galvin; Greg Gagne, Operating System Concepts, John Wiley and Sons, New York, Seventh Edition, , 2014

3. Andrews. Tanenbaum, Modern operating system, PHI, New York,2015
4. PradeepK.Sinha, Distributed operating system Concepts and design, PHI, New Delhi,2015.
5. Andrews. Tanenbaum, Distributed operating system, Pearson education, New York, 2015.
6. S. Tanenbaum and A. S. Woodhull, Operating Systems Design and Implementation, Prentice Hall, London, Third Edition, 2016.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	2	-	-	1	-	-	3
CO2	3	2	-	-	1	-	-	2
CO3	3	3	2	-	1	-	-	3
CO4	3	3	2	-	1	-	-	2
CO5	3	3	2	-	1	-	-	3

CA24E08	E-LEARNING TECHNIQUES (Elective II)	Category	L	T	P	SL	C
		PEC	45	0	0	45	3

PREREQUISITE:

Understanding of fundamental instructional design theories and models, such as Analysis, Design, Development, Implementation, Evaluation. Proficiency with using computers, operating systems.

COURSE OBJECTIVES:

To enable learners to design, implement, and evaluate effective digital learning experiences using modern e-learning tools and methods.

UNIT - I	INTRODUCTION	(9)

What is E-Learning – E-Learning Evolution – Advantages and Disadvantages of E-Learning – Instructional Design Models for E-Learning – Applying User – Centered Design to E-Learning – Rapid E-Learning.

UNIT - II	KEEPING THE E-LEARNING STRATEGY FORWARD	(9)

Learning Strategy – Process for Developing the E-Learning Strategy – Doomed to Failure – Keeping Focused on the Strategy – Instructional Strategies for E-Learning.

UNIT - III	DELIVERING E-LEARNING &E-LEARNING EVALUATION	(9)

Delivering E-Learning – Instructional Game Characteristics – Educational Podcasting - Gaming at Work – Delivering E-Learning Synchronously – E-Learning Education – Four Levels of Evaluating Learning – Learning Analytics - Evaluation Models.

UNIT - IV	WEB STANDARDS	(9)

Resources for Guidance on Web Standards - Web Standards for Designers – Validators - W3C Keeping it Simple.

UNIT - V	E-LEARNING TOOLS	(9)

E-learning Tools – E-learning Authoring Tools – Wikis and E-Learning.

L:45, SL: 45 TOTAL: 90 PERIODS

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

COs	Course Outcomes	Cognitive Level
CO1	Describe the fundamentals of E-Learning, including its models, tools, and impact on modern education.	Understand
CO2	Classify the effective strategies to advance and sustain E-Learning initiatives for continuous educational improvement.	Understand
CO3	Summarize the E-Learning content effectively and evaluate its impact on learner engagement and outcomes.	Understand
CO4	Describe the web standards to ensure accessibility, interoperability, and quality in E-Learning platforms.	Understand
CO5	Interpret the various E-Learning tools to enhance digital teaching and learning experiences.	Understand

REFERENCES:

1. Randy Garrison D ,E-Learning in the 21st century a framework for research and practice, Second edition, Taylor and Francis, 2015.
2. Robin Mason, E-Learning: the key concepts, Routledge, 2015.
3. Clark R.C and Mayer R.E, E-Learning and the science of instruction, Pfeiffer Wiley, 2015.
4. Mark J Rosenberg, E-Learning: strategies for delivering knowledge in the Digital Age, McGraw- Hill, New Delhi, 2016.
5. Kjell E. (Erik) Rudest am, Judith Schoenholtz - Read, Handbook of Online Learning, Sage Publications Inc., London, Second Edition, 2019.
6. John Gardner, Bryn Holems, E-Learning: Concepts and practice, SAGE Publications, New Delhi 2016.

Mapping of COs with POs and PSOs								
COs/ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
CO1	3	2	-	-	1	-	-	3
CO2	3	2	-	-	1	-	-	2
CO3	3	2	-	-	1	-	-	3
CO4	3	2	-	-	1	-	-	2
CO5	3	2	-	-	1	-	-	3

A24E09	SOFT COMPUTING (ELECTIVE II)	Category	L	T	P	SL	C
		PEC	45	0	0	45	3

PREREQUISITE:

Programming Fundamentals: Knowledge of fundamental algorithms and data structures is essential for implementing and understanding soft computing methods.

COURSE OBJECTIVES:

To introduce students to intelligent computational techniques for solving complex, real-world problems with uncertainty and imprecision.

UNIT - I	INTRODUCTIONTO SOFT COMPUTING AND NEURAL NETWORKS	(9)

Evolution of Computing-Soft Computing Constituents–From Conventional AI to Computational Intelligence -Machine Learning Basics.

UNIT - II	GENETIC ALGORITHMS	(9)

Introduction to Genetic Algorithms (GA) – Applications of GA in Machine Learning - Machine Learning Approach to Knowledge Acquisition.

UNIT - III	NEURAL NETWORKS	(9)

Machine Learning using Neural Network, Adaptive Networks –Feed Forward Networks Supervised Learning Neural Networks–Radial Basis Function Networks-Reinforcement Learning–Unsupervised Learning Neural Networks– Adaptive Resonance Architectures–Advances in Neural networks.

UNIT - IV	FUZZY LOGIC	(9)

Fuzzy Sets–Operations on Fuzzy Sets–Fuzzy Relations–Membership Functions –Fuzzy Rules and Fuzzy Reasoning –Fuzzy Inference Systems–Fuzzy Expert Systems–Fuzzy Decision Making.

UNIT - V	NEURO-FUZZY MODELING	(9)

Adaptive Neuro - Fuzzy Inference Systems–Coactive Neuro - Fuzzy Modeling–Classification and Regression Trees– Data Clustering Algorithms–Rule Base Structure Identification–Neuro – Fuzzy Control.

L:45, SL: 45 TOTAL: 90 PERIODS

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

COs	Course Outcomes	Cognitive Level
CO1	Classify the fundamentals of soft computing and neural networks and apply them to solve complex, real-world problems.	Understand
CO2	Describe the genetic algorithms for optimization and problem-solving in diverse computational scenarios.	Understand
CO3	Apply the architecture and learning algorithms of neural networks and apply them to pattern recognition and data modeling tasks.	Apply
CO4	Apply fuzzy logic principles for reasoning and decision-making in uncertain or imprecise environments.	Apply
CO5	Develop the neural networks and fuzzy logic to develop neuro-fuzzy models for intelligent system design and problem-solving.	Apply

Reference Books:

1	Jyh-Shing Roger Jang, Chuen-Tsai Sun, Eiji Mizutani, Neuro-Fuzzy and Soft Computing, PHI, New Delhi 2023.
2	James A., Freeman & David M,Skapura, Neural Networks Algorithms Applications & Prg. Tech., PE,Chennai 2016

3	Mitchell Melanie, An Introduction to Genetic Algorithm, Prentice Hall, New Delhi2013.
4	Sivanandam, S. N., Sumathi, S., and Deepa, S.N., Introduction to Fuzzy Logic using MATLAB, Springer, 2017.
5	Sivanandam, S.N., Deepa, S.N., Introduction to Genetic Algorithms, Springer, 2017.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	2	-	-	1	-	-	3
CO2	3	2	-	-	1	-	-	2
CO3	3	3	2	-	1	-	-	3
CO4	3	3	2	-	1	-	-	2
CO5	3	3	2	-	1	-	-	3

CA24E10	OBJECT ORIENTED ANALYSIS AND DESIGN (ELECTIVE II)	Category	L	T	P	SL	C
		PEC	45	0	0	45	3

PREREQUISITE:

Understanding at least one object-oriented programming language is crucial. Familiarity with concepts like classes, objects, inheritance, encapsulation, and polymorphism will be beneficial.

COURSE OBJECTIVES:

To teach students how to analyze, model, and design software systems using object-oriented principles and methodologies.

UNIT - I	UNIFIED PROCESS AND USE CASE DIAGRAMS	(9)

Introduction to OOAD with OO Basics - Unified Process – UML diagrams – Use Case –Case study - the Next Gen POS system, Inception -Use case Modeling – Relating Use cases – include, extend and generalization – When to use Use-cases.

UNIT - II	STATIC UML DIAGRAMS	(9)

Class Diagram–– Elaboration – Domain Model – Finding conceptual classes and description classes – Associations – Attributes – Domain model refinement – Finding conceptual class Hierarchies – Aggregation and Composition - Relationship between sequence diagrams and use cases – When to use Class Diagrams.

UNIT - III	DYNAMIC AND IMPLEMENTATION UML DIAGRAMS	(9)

Dynamic Diagrams – UML interaction diagrams - System sequence diagram – Collaboration diagram – When to use Communication Diagrams - State machine diagram and Modeling –When to use State Diagrams - Activity diagram – When to use activity diagrams - Implementation Diagrams - UML package diagram - When to use package diagrams - Component and Deployment Diagrams – When to use Component and Deployment diagrams.

UNIT - IV	DESIGN PATTERNS	(9)

GRASP: Designing objects with responsibilities – Creator – Information expert – Low Coupling – High Cohesion – Controller - Design Patterns – creational – factory method – structural – Bridge – Adapter – behavioral – Strategy – observer – Applying GoF design patterns – Mapping design to code.

UNIT - V	TESTING	(9)

Object Oriented Methodologies – Software Quality Assurance – Impact of object orientation on Testing – Develop Test Cases and Test Plans.

L:45, SL: 45, TOTAL: 90 PERIODS

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

COs	Course Outcomes	Cognitive Level
CO1	Summarize the Unified Process methodology and create use case diagrams to model system requirements effectively.	Understand
CO2	Explain about the static UML diagrams to represent the structural aspects of software systems.	Understand
CO3	Illustrate the dynamic and implementation UML diagrams to model system behavior and deployment effectively.	Understand
CO4	Summarize the common design patterns to create reusable and maintainable software solutions.	Understand
CO5	Apply the various software testing techniques to identify defects and ensure the quality and reliability of software products.	Apply

Reference Books:	
1	Craig Larman, Applying UML and Patterns: An Introduction to Object-Oriented Analysis and Design and Iterative Development, Pearson Education, , Third Edition, 2015.
2	Ali Bahrami - Object Oriented Systems Development - McGraw Hill International Edition – Re-Print 2018.
3	Erich Gamma, and Richard Helm, Ralph Johnson, John Vlissides, —Design patterns: Elements of Reusable Object-Oriented Software, Addison-Wesley, 2015.
4	Martin Fowler, UML Distilled: A Brief Guide to the Standard Object Modeling Language , Addison Wesley, Third Edition, 2013.
5	Deital& Deital, Internet and World ide W eb–Howtoprogram, Pearson,2011
6	Margaret Levine Young and Doug Muder, Internet: The Complete Reference McGraw Hill International Edition, First Edition, 2011.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	2	-	-	1	-	-	3
CO2	3	2	-	-	1	-	-	2
CO3	3	2	-	-	1	-	-	3
CO4	3	2	-	-	1	-	-	2
CO5	3	3	2	-	1	-	-	3

BA24E52	ORGANIZATIONAL BEHAVIOR (ELECTIVE II)	Category	L	T	P	SL	C
		PEC	45	0	0	45	3

PREREQUISITE:

The students should have the basic knowledge on the concept of organizational behavior, workplace, personality, group behavior, leadership style, delegation of power and work life balance.

OBJECTIVES:

To help students understand and analyze human behavior within organizations to improve workplace effectiveness and culture.

UNIT - I	INTRODUCTION	(9)

Organizational behavior: Definition – Meaning – Scope & Importance of OB – OB Model. Management and Managers: Functions – Skills – Roles – Types of Managers.

UNIT - II	INDIVIDUAL BEHAVIOUR	(9)

Personality: Theories – Types. Learning: Meaning and Definition – Theories of Learning. Attitudes: Nature – Components – Formation – Functions – Measurement. Perception: Factors Influencing Perception. Motivation: Importance – Theories (Maslow's Hierarchy Theory & Herzberg Theory) – Types – Effects on Work Behavior

UNIT - III	GROUP BEHAVIOUR	(9)

Nature – Types – Group Development – Group behavior – Structuring. Group Decision Making Techniques. Team Dynamics: Nature of Teams – Teams Vs Groups – Benefits From Teams – Types of Teams – Team Issues – Effective Team Work.

UNIT - IV	LEADERSHIP AND POWER	(9)

Leadership: Meaning – Importance – Leadership Styles – Theories. Power: Power Dynamics – Sources of Power – Effective Use of Power.

UNIT - V	DYNAMICS OF ORGANIZATIONAL BEHAVIOUR	(9)

Resistance of Change – Managing Change. Job Satisfaction: Determinants – Measurements. Stress: Prevention and Management of Stress – Balancing Work and Life.

L:45, SL: 45 TOTAL: 90 PERIODS

COURSE OUTCOMES: At the end of the course, the students will be able to:

COs	Course Outcome	Cognitive Level
CO1	Explain the fundamental concepts of organizational behavior and management functions, roles, and models.	Understand
CO2	Learners need to explain, compare, and interpret behavioral theories and relate them to workplace behavior	Understand
CO3	Apply concepts of group behavior and team dynamics to enhance decision-making and teamwork effectiveness.	Apply
CO4	Implement leadership theories and power dynamics to influence behavior and decision-making in organizations	Apply
CO5	Manage organizational behavior dynamics including change resistance, job satisfaction, and stress for work-life balance.	Apply

REFERENCES:

1. Aswathappa.K, Organizational Behavior, Himalaya Publishing House, Chennai, Tenth Edition, 2015.
2.Stephen P. Robins, Organizational Behavior, PHI Learning / Pearson Education, New Delhi, Eleventh edition, 2016.
3.MohiniSukhapure&UdayN.Limaye Organizational Behavior, Himalaya Publishing Private Limited, Pune, 2015
4. P.Subba Rao, Organizational Behavior, Himalaya Publishing (P) Ltd, Pune, Fifth Edition, 2016
5. Schermerhorn, Hunt and Osborn, Organizational behavior, John Wiley, New Delhi, Ninth Edition, 2015

Mapping of COs with POs and PSOs								
COs/ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
CO1	1	2	1	1	2	1	1	2
CO2	1	2	1	1	2	1	1	2
CO3	1	2	2	1	3	2	1	2
CO4	1	2	2	1	3	2	2	3
CO5	1	2	2	1	2	2	1	3

CA24E11	M – COMMERCE (ELECTIVE III)	Category	L	T	P	SL	C
		PEC	45	0	0	45	3

PREREQUISITE:
Understanding of fundamental Concept of mobile device with internet connectivity allowing users to access online shopping platforms

OBJECTIVES:
To understand the concepts, technologies, and applications of mobile commerce for conducting business transactions via mobile devices.

UNIT-I	ELECTRONIC COMMERCE	(9)

Introduction -The e-commerce environment - The e-commerce marketplace -Focus on portals, Location of trading in the marketplace - Commercial arrangement for transactions - Focus on auctions - Business models for e-commerce - Revenue models - Focus on internet start-up companies - the dot-com - E-commerce versus E-business.

UNIT- II	MOBILE COMMERCE	(9)

Introduction – Infrastructure Of M– Commerce – Types of Mobile Commerce Services – Technologies of Wireless Business – Benefits and Limitations, Support, Mobile Marketing & Advertisement, non– Internet Applications In M– Commerce – Wireless/Wired Commerce Comparisons.

UNIT- III	MOBILE COMMERCE :TECHNOLOGY	(9)

A Framework For The Study Of Mobile Commerce – NTT Docomo's I– Mode – Wireless Devices For Mobile Commerce – Towards A Classification Framework For Mobile Location Based Services – Wireless Personal And Local Area Networks –The Impact Of Technology Advances On Strategy Formulation In Mobile Communications Networks

UNIT- IV	MOBILE COMMERCE: THEORY AND APPLICATIONS	(9)

User Interface Screen elements, Designing User Interfaces with Layouts, Drawing and Working with Animation. Playing Audio and Video, Recording Audio and Video, Using the Camera to Take and Process Pictures

UNIT-V	BUSINESS– TO– BUSINESS MOBILE E-COMMERCE	(9)

Enterprise Enablement – Email And Messaging – Field Force Automation (Insurance, Real Estate, Maintenance, Healthcare) – Field Sales Support (Content Access, Inventory) – Asset Tracking And Maintenance/Management – Remote IT Support –Customer Retention (B2C Services, Financial, Special Deals) – Warehouse Automation – Security.

L:45, SL: 45 TOTAL: 90 PERIODS

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

COs	Course Outcome	Cognitive Level
CO1	Describe the principles, technologies, and applications of electronic commerce for conducting business online efficiently.	Understand
CO2	Classify the concepts, technologies, and practices enabling commercial transactions via mobile devices.	Understand
CO3	Determine the key technologies that support and drive mobile commerce, including wireless communication, mobile apps, and secure payment systems.	Apply
CO4	Develop a theoretical foundations and practical applications of mobile commerce in modern business environments.	Apply
CO5	Implement the processes, technologies, and benefits of business-to-business mobile commerce for enhancing inter-company transactions.	Apply

REFERENCES:

1. Dave Chaffey, "E-Business and E-Commerce Management", Third Edition, 2009, Pearson Education
2. 2. Brian E. Mennecke, Troy J. Strader, "Mobile Commerce: Technology, Theory and Applications", Idea Group Inc., IRM press, 2003.
3. P. J. Louis, "M-Commerce Crash Course", McGraw- Hill Companies February 2001.
4. Paul May, "Mobile Commerce: Opportunities, Applications, and Technologies of Wireless Business" Cambridge University Press March 2001.
5. Michael P. Papazoglou, Peter M.A. Ribbers, 'e-business organizational and Technical foundation ',Wiley India 2009

Mapping of Cos with Pos and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	2	-	-	1	-	-	3
CO2	3	2	-	-	1	-	-	2
CO3	3	3	2	-	1	-	-	3
CO4	3	3	2	-	1	-	-	2
CO5	3	3	2	-	1	-	-	3

CA24E12	BLOCK CHAIN TECHNOLOGY (ELECTIVE III)	Category	L	T	P	SL	C
		PEC	45	0	0	45	3

PREREQUISITE:

Learning its core concepts, use cases, and implementation processes. To understand foundational knowledge in various domains and skills.

COURSE OBJECTIVES:

To understand the fundamentals and applications of block chain for secure, transparent, and decentralized digital transactions.

UNIT-I	INTRODUCTION TO BLOCKCHAIN TECHNOLOGY	(9)

Introduction to Block chain-Trusted Third party for transactions - Difference between centralized - decentralized and distributed peer to peer networks -Types of Block chain - Permission Block chain vs. Permission less Block chain - History of Bit coins.

UNIT- II	FUNDAMENTAL CONCEPTS OF BLOCKCHAIN	(9)

Concepts of Block - Transactions, Hashes - Consensus. Hashes: Hash cryptography - Encryption vs. hashing -Transactions: Recording transactions - Digital Signature - Verifying and confirming transactions - Blocks and block chain

UNIT- III	MINING AND SIMULATING BLOCKCHAIN	(9)

Mining and simulating block chain: Game theory behind competitive mining. Incentives: mining and transaction fees, Energy expended in mining.

UNIT- IV	BITCOIN AD SECURITY	(9)

Bit coin: Bit coin creation - exchanges. Wallets – security - Protecting block chain from attackers - Forks – soft and hard, Block chain security - Key Management in Bit coin - Case studies.

UNIT-V	PLATFORMS AND APPLICATIONS	(9)

Introduction to Block chain platform: Ethereum - Hyper ledger, IOTA, EOS, Multichain, Big chain, CORDA, SOLIDITY - Designing a new block chain - Distributed Application. Applications: E-Governance - Elections - File sharing - Micropayments Challenges and Research Issues in block chain.

L:45, SL: 45 TOTAL: 90 PERIODS

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

Cos	*Course Outcomes*	Cognitive Level
CO1	Classify the intermediaries (like banks or clearinghouses), reducing costs and increasing efficiency.	Understand
CO2	Demonstrate the every transaction is visible on a public ledger (in public block chains), fostering accountability.	Apply
CO3	Determine the quicker and cheaper international transfers compared to traditional systems like SWIFT.	Apply
CO4	Apply the Products can be tracked from origin to consumer, useful in industries like food, pharmaceuticals, and luxury goods.	Apply
CO5	Develop the platforms and applications that facilitate mobile commerce and drive digital business growth.	Apply

Reference Books:

01	Arshdeep Bahga, Vijay Madisetti, Blockchain Applications: A Hands-On Approach, VPT Publisher. New Delhi, First edition,2018.
02	Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, and Steven Goldfeder, Bitcoin and Crypto currency technologies: a comprehensive introduction, Princeton University Press, Chennai, First edition, 2016.
03	Imran Bashir, Mastering Blockchain, Packet Publishing, London, Second Edition, 2018.
04	Daniel Drescher, Blockchain Basics, A press, Washington, 2017.

05	Alan Wright, Daniel Dresher, Blockchain, Google Books, 2017.
06	Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, and Steven Goldfeder, Bitcoin and cryptocurrency technologies: a comprehensive introduction. Princeton University Press, New Delhi, 2016.

Mapping of Cos with Pos and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	2	-	-	1	-	-	3
CO2	3	3	2	-	1	-	-	2
CO3	3	3	2	-	1	-	-	3
CO4	3	3	2	-	1	-	-	2
CO5	3	3	2	-	1	-	-	3

CA24E13	ROBOTIC PROCESS AUTOMATION (ELECTIVE III)	Category	L	T	P	SL	C
		PEC	45	0	0	45	3

PREREQUISITE:
Basic Programming Concepts

OBJECTIVES:
To learn how to design, develop, and implement software robots that automate repetitive business processes.

UNIT-I	INTRODUCTION TO ROBOTIC PROCESS AUTOMATION:	(9)

Scope and techniques of automation, Robotic process automation –What can RPA do? Benefits of RPA, Components of RPA, RPA platforms, The future of automation.

UNIT- II	RPA TOOL INTRODUCTION AND BASICS:	(9)

Introduction to RPA Tool - The User Interface - Variables - Managing Variables - Naming Best Practices - The Variables Panel - Generic Value Variables - Text Variables - True or False Variables - Number Variables - Array Variables - Date and Time Variables - Data Table Variables - Managing Arguments - Naming Best Practices - The Arguments Panel - Using Arguments - About Imported Namespaces - Importing New Namespaces- Control Flow - Control Flow Introduction

UNIT- III	ADVANCED AUTOMATION CONCEPTS & TECHNIQUES:	(9)

Recording Introduction - Basic and Desktop Recording - Web Recording - Input/Output Methods - Screen Scraping - Data Scraping - Scraping advanced techniques - Selectors - Defining and Assessing Selectors - Customization - Debugging - Dynamic Selectors - Partial Selectors - RPA Challenge - Image, Text & Advanced Citrix Automation - Introduction to Image & Text Automation - Image based automation - Keyboard based automation .

UNIT- IV	HAND LING USER EVENTS & ASSISTANT BOTS, EXCEPTION HANDLING:	(9)

What are assistant bots? - Monitoring system event triggers - Hotkey trigger - Mouse trigger - System trigger – Monitoring image and element triggers –An example of monitoring email Example of monitoring a copying event and blocking it - Launching an assistant bot on a keyboard event.

UNIT-V	DEPLOYING AND MAINTAINING THE BOT:	(9)

Publishing using publish utility – Creation of Server – Using Server to control the bots – Creating a provision Robot from the Server – Connecting a Robot to Server – Deploy the Robot to Server – Publishing and managing updates - Managing packages - Uploading packages - Deleting packages.

L:45, SL: 45 TOTAL: 90 PERIODS

REFERENCES:

1	Alok Mani Tripathi, *"Learning Robotic Process Automation"*, PacktPublishing,2018.
2	Frank Casale, Rebecca Dilla, Heidi Jaynes, Lauren Livingston, "Introduction to Robotic Process Automation: a Primer", Institute of Robotic Process Automation,1st Edition 2015.
3	Richard Murdoch, Robotic Process Automation: Guide To Building Software Robots, Automate Repetitive Tasks &Become An RPA Consultant", Independently Published, 1st Edition2018.
4	Srikanth Merianda,"Robotic Process Automation Tools, Process Automation and their benefits: Understanding RPA and Intelligent Automation", Consulting Opportunity Holdings LLC, 1st Edition2018.
5	Lim Mei Ying, "Robotic Process Automation with Blue Prism Quick Start Guide: Creates of the ware robots and automate business processes", Packet Publishing, 1st Edition 2018.

WEB REFERENCES:

1. https://www.uipath.com/rpa/robotic-process-automation
2. https://www.academy.uipath.com

COURSE OUTCOMES: At the end of the course, the students will be able to:		
COs	**Course Outcome**	**Cognitive Level**
CO1	Describe fundamentals, tools, and benefits of Robotic Process Automation for streamlining repetitive business tasks.	Understand
CO2	Demonstrate the different types of variables, Control Flow and data manipulation techniques.	Apply
CO3	Implement the advanced automation methods and techniques for optimizing complex business processes and workflows.	Apply
CO4	Determine the handling user events, designing assistant bots, and implementing exception handling for robust automated systems.	Apply
CO5	Implement the processes involved in deploying, monitoring, and maintaining bots for sustained and efficient automation performance.	Apply

Mapping of Cos with Pos and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	2	-	-	1	-	-	3
CO2	3	3	2	-	1	-	-	2
CO3	3	3	2	-	1	-	-	3
CO4	3	3	2	-	1	-	-	2
CO5	3	3	2	-	1	-	-	3

CA24E14	DATA VISUALIZATION TECHNIQUES (ELECTIVE III)	Category	L	T	P	SL	C
		PEC	45	0	0	45	3

PREREQUISITE: Computer Graphics, and Image Processing.

OBJECTIVES:

To develop skills in creating effective visual representations of data for clearer insights and decision-making.

UNIT-I	INTRODUCTION TO DATA VISUALIZATIONS AND PERCEPTION:	(9)

Introduction of visual perception, visual representation of data, Gestalt principles, Information overloads.

UNIT- II	VISUAL REPRESENTATIONS:	(9)

Creating visual representations, visualization reference model, visual mapping, visual analytics, Design of visualization applications.

UNIT- III	CLASSIFICATION OF VISUALIZATION SYSTEMS:	(9)

Classification of visualization systems, Interaction and visualization techniques misleading, Visualization of one, two and multi-dimensional data, text and text documents.

UNIT- IV	VISUALIZATION OF GROUPS:	(9)

Visualization of groups, trees, graphs, clusters, networks, software, Metaphorical visualization. Various visualization techniques, data structures used in data visualization.

UNIT-V	VISUALIZATION OF VOLUMETRIC DATA AND EVALUATION OF VISUALIZATIONS:	(9)

Visualization of volumetric data, vector fields, processes and simulations, Visualization of maps, geographic information, GIS systems, collaborative visualizations, Evaluating visualizations

L:45, SL: 45 TOTAL: 90 PERIODS

TEXTBOOKS:

Ward, Grinstein, Keim, *Interactive Data Visualization: Foundations, Techniques, and Applications.* Natick, 2nd edition, A K Peters, Ltd 2015.

REFERENCES:

Tamara Munzner, *Visualization Analysis & Design* ,1st edition, AK Peters Visualization Series 2014

Scott Murray, *Interactive Data Visualization for the Web* ,2nd Edition, 2017

COURSEOUTCOMES: On completion of this course, the student will be able to

COs	Course Outcome	Cognitive Level
CO1	Classify the principles of data visualization and human perception for effectively communicating insights through visual representations.	Understand
CO2	Illustrate various visual representation techniques for transforming data into meaningful and interpretable graphical formats.	Understand
CO3	Summarize the classification of visualization systems based on data types, techniques, and interaction methods for effective data analysis.	Understand
CO4	Apply the various techniques for visualizing grouped data, enabling the identification of patterns, relationships, and trends within data clusters.	Apply
CO5	Demonstrate the volumetric data and assess visualization effectiveness in terms of clarity, accuracy, and user comprehension.	Apply

Mapping of Cos with Pos and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	2	-	-	1	-	-	3
CO2	3	2	-	-	1	-	-	2
CO3	3	2	-	-	1	-	-	3
CO4	3	3	2	-	1	-	-	2
CO5	3	3	2	-	1	-	-	3

CA24E15	DATA SCIENCE (ELECTIVE III)	Category	L	T	P	SL	C
		PEC	45	0	0	45	3

PREREQUISITE:
The students should have basic knowledge in mathematics and statistics, programming skills, and experience with databases

OBJECTIVES:
To equip learners with the skills to collect, analyze, and interpret complex data for informed decision-making

UNIT-I	BASICS OF DATA SCIENCE	(9)

Introduction to core concepts and technologies: Introduction –Terminology – Data science process –Data science toolkit – Types of data –Example applications.

UNIT- II	DATA COLLECTION AND MANAGEMENT	(9)

Data collection and management: Introduction – Sources of data – Data collection and APIs – Exploring and fixing data – Data storage and management – Using multiple data sources.

UNIT- III	DATA ANALYSIS	(9)

Data analysis: Introduction –Terminology and concepts – Introduction to statistics – Central tendencies and distributions – Variance – Distribution properties and arithmetic – Samples/CLT – Basic machine learning algorithms – Linear regression– SVM – Naive Bayes

UNIT- IV	DATA VISUALISATION	(9)

Data Visualization: Introduction – Types of data visualization – Data for Visualization: Data types – Data encodings – Retinal variables – Mapping variables to encodings –Visual encodings.

UNIT-V	APPLICATIONS	(9)

Applications of Data Science – Technologies for visualization – Recent trends in various data collection and analysis techniques – Various visualization techniques.

L:45, SL: 45 TOTAL: 90 PERIODS

REFERENCES:

1	Cathy O'Neil and Rachel Schutt, "Doing Data Science", Straight Talk from The Frontline. O'Reilly, 2013.
2	Jure Leskovek, Anand Rajaraman and Jeffrey Ullman, "Mining of Massive Datasets v2.1", Cambridge University Press, 2nd Edition, 2014.
3	Andrew Park, A Complete Overview to Master the Art of Data Science, Independently Published, 2020.
4	B. Uma Maheswari, R. Sujatha Introduction to Data Science: Practical Approach with R and Python, Wiley, 2021.

COURSE OUT COMES: On completion of this course, the student will be able to

COs	Course Outcome	Cognitive Level
CO1	Summarize the fundamental concepts, tools, and techniques of data science for extracting meaningful insights from data.	Understand
CO2	Explain methods for effective data collection, storage, and management to ensure data quality and accessibility for analysis.	Understand
CO3	Classify the ability to analyze data using statistical and computational techniques for informed decision-making.	Understand
CO4	Determine the key concepts in data science, including their real-world applications and the toolkit used by data scientists	Apply
CO5	Implement real-world applications of data science across various industries for solving complex problems and driving innovation.	Apply

Mapping of Cos with Pos and PSOs								
COs/ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
CO1	3	2	-	-	1	-	-	3
CO2	3	2	-	-	1	-	-	2
CO3	3	2	-	-	1	-	-	3
CO4	3	3	2	-	1	-	-	2
CO5	3	3	2	-	1	-	-	3

CA24E16	DEEP LEARNING (ELECTIVE III)	Category	L	T	P	SL	C
		PEC	45	0	0	45	3

PREREQUISITE:
The students should have basic knowledge in Mathematics, Programming, Machine Learning Basics, Algorithms & Optimization and Neural Network Basics.

OBJECTIVES:
To understand and apply deep learning models and techniques for solving complex AI problems.

UNIT-I	INTRODUCTION ENGLISH	(9)

Introduction to machine learning - Linear models (SVMs and Perceptions, logistic regression) - Intro to Neural Nets: What a shallow network computes - Training a network: loss functions, back propagation and stochastic gradient descent - Neural networks as universal function approximates.

UNIT- II	DEEP NETWORKS	(9)

History of Deep Learning - A Probabilistic Theory of Deep Learning - Back propagation and regularization, batch normalization - VC Dimension and Neural Nets - Deep Vs Shallow Networks - Convolution Networks - Generative Adversarial Networks (GAN), Semi-supervised Learning.

UNIT- III	DIMENTIONALITY REDUCTION	(9)

Linear (PCA, LDA) and manifolds, metric learning - Auto encoders and dimensionality reduction in networks - Introduction to Convent - Architectures – Alex Net, VGG, Inception, ResNet - Training a Convent: weights initialization, batch normalization, hyper parameter optimization.

UNIT- IV	OPTIMIZATION AND GENERALIZATION	(9)

Optimization in deep learning – Non-convex optimization for deep networks - Stochastic Optimization - Generalization in neural networks - Spatial Transformer Networks - Recurrent networks, LSTM - Recurrent Neural Network Language Models – Word - Level RNNs & Deep Reinforcement Learning - Computational & Artificial Neuroscience.

UNIT-V	CASE STUDY AND APPLICATIONS	(9)

Image net- Detection-Audio Wave Net-Natural Language Processing Word2Vec - Joint Detection-Bioinformatics- Face Recognition- Scene Understanding- Gathering Image Captions.

L:45, SL: 45 TOTAL: 90 PERIODS

REFERENCES:

1	Cosma Rohilla Shalizi, Advanced Data Analysis from an Elementary Point of View, Cambridge University Press, England, Second Edition, 2015.
2	Deng & Yu, Deep Learning Methods and Applications, Now Publishers, Netherlands, Second Edition, 2013.
3	Michael Nielsen, Neural Networks and Deep Learning, Determination Press, London, Third Edition, 2015.
4	Ian Goodfellow, Yoshua Bengio, Aaron Courville, Deep Learning, MIT Press, United States, 2016.
5	Aggarwal, Charu C, Neural Networks and deep learning, Springer, Germany, First Edition, 2015.
6	Michael Fullan, Joanne Quinn, Joanne Mceachen, Deep Learning engage the world change the world, SAGE Publications, United States, Second Edition, 2012

COURSE OUT COMES: On completion of this course, the student will be able to

COs	Course Outcome	Cognitive Level
CO1	Summarize the foundational understanding of deep learning concepts, architectures, and their applications in artificial intelligence.	Understand
CO2	Classify structure, training, and optimization of deep neural networks for complex pattern recognition and learning tasks.	Understand
CO3	Explain the techniques for reducing data dimensionality to simplify models while preserving essential information.	Understand

CO4	Determine the optimization techniques and generalization principles for improving the performance and robustness of machine learning models.	Apply
CO5	Implement the real-world case studies and applications to apply theoretical knowledge in practical data science and machine learning scenarios.	Apply

Mapping of Cos with Pos and PSOs								
COs/ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
CO1	3	2	-	-	1	-	-	3
CO2	3	2	-	-	1	-	-	2
CO3	3	2	-	-	1	-	-	3
CO4	3	3	2	-	1	-	-	2
CO5	3	3	2	-	1	-	-	3

CA24E17	MOBILE COMPUTING (ELECTIVE III)	Category	L	T	P	SL	C
		PEC	45	0	0	45	3

PREREQUISITE:
Understanding of operating systems, networking, and databases. Familiarity with Wi-Fi, Bluetooth, and cellular networks. Experience with mobile app development (Android/iOS).

OBJECTIVES:
To understand the principles, technologies, and challenges involved in wireless and mobile communication systems.

UNIT-I	WIRELESS COMMUNICATION FUNDAMENTALS	(9)

Introduction – Wireless Transmission – Frequencies for Radio Transmission – Signals – Antennas – Signal Propagation – Multiplexing – Modulations – Spread Spectrum – MAC – SDMA – FDMA – TDMA – CDMA – Cellular Wireless

UNIT- II	TELECOMMUNICATION SYSTEMS	(9)

GSM – System Architecture – Protocols – Connection Establishment – Handover – Security – GPRS, DECT

UNIT- III	WIRELESS NETWORKS	(9)

Wireless LAN – IEEE 802.11 Standards – Architecture – Services – HIPERLAN – Ad Hoc Network – Blue Tooth

UNIT- IV	NETWORK LAYER	(9)

Mobile IP – Dynamic Host Configuration Protocol – Routing – DSDV – DSR – AODV – ZRP – ODMR.

UNIT-V	TRANSPORT AND APPLICATION LAYERS	(9)

TCP Over Wireless Networks – Indirect TCP – Snooping TCP – Mobile TCP – Fast Retransmit / Fast Recovery – Transmission / Timeout Freezing – Selective Retransmission–Transaction Oriented TCP - WAP.

L:45, SL: 45 TOTAL: 90 PERIODS

REFERENCES:

1	Kaveh Pahlavan, Prasanth Krishnamoorthy, Principles of Wireless Networks, Pearson Education, New Delhi, Second Edition, 2013.
2	UweH, Lothar, M. MartinS. Nicklons & Thomas Principles of Mobile Computing, Springer, New York, Second Edition, 2010.
3	C.K. Toh, Ad Hoc Mobile Wireless Networks, Prentice Hall Inc., New Delhi, Second Edition, 2012.
4	William Stallings, Wireless Communications and Networks, PHl of India / Pearson Education, New Delhi, Second Edition, 2014.
5	Jochen Schiller, Mobile Communications, Prentice Hall of India – Pearson Education, New Delhi, Second Edition, 2011
6	Sivaram Murthy C & Manoj B.S., Adhoc wireless Networks, Pearson Education, New Delhi, First Edition 2012.

COURSEOUTCOMES: On completion of this course, the student will be able to

COs	Course Outcome	Cognitive Level
CO1	Explain the basic principles, technologies, and protocols underlying wireless communication systems.	Understand
CO2	Describe architecture, components, and functioning of modern telecommunication systems and networks.	Understand
CO3	Explain the design, protocols, and challenges of wireless networks for reliable and efficient communication.	Understand
CO4	Determine the functions, protocols, and algorithms of the network layer responsible for routing and forwarding data across networks.	Apply

CO5	Apply the protocols and mechanisms of the transport and application layers that ensure reliable data transfer and support network applications.	Apply

Mapping of Cos with Pos and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	2	-	-	1	-	-	3
CO2	3	2	-	-	1	-	-	2
CO3	3	2	-	-	1	-	-	3
CO4	3	3	2	-	1	-	-	2
CO5	3	3	2	-	1	-	-	3

K.S.R. COLLEGE OF ENGINEERING (Autonomous)		R 2024				
SEMESTER - I						
BC5001	**COMPUTER FUNDAMENTALS**	L	T	P	SL	C
		30	0	0	0	0

PREREQUISITE:

Basic computer literacy: Students should have basic computer skills, including typing, using a mouse, and navigating a computer desktop.

COURSE OBJECTIVES:

To provide students with a basic understanding of computer hardware, software, and fundamental computing concepts.

UNIT - I **INTRODUCTION**

Computer - Characteristics of Computers, Input, Output, Storage units, CPU, Computer System. Computer Organization Central Processing Unit - Processor Speed, Cache, Memory, RAM, ROM, Booting, Generation of Computers-Application and features of computer.

UNIT - II **MEMORY-DEVICES**

Memory- Secondary Storage Devices: Floppy and Hard Disks, Optical Disks CD-ROM, DVD, Mass Storage Devices: USB thumb drive. Managing disk Partitions, File System Input. Devices - Keyboard, Mouse, joystick, Scanner, web cam, Output Devices- Monitors, Printers – Dot matrix, inkjet, laser, Multimedia- What is Multimedia, Text, Graphics, Animation, Audio, Images, Video; Multimedia Application in Education, Entertainment, Marketing.

UNIT - III **OPERATING SYSTEM**

What is an operating system and basics of Windows-The User Interface Windows Setting

UNIT - IV **SOFTWARE TYPES**

Names of common multimedia file formats, Computer Software- Relationship between Hardware and Software; System Software, Application Software, Compiler, names of some high level languages, free domain software.

UNIT - V **COMPUTER NETWORK**

Networks-network types-web design –Applications-e-Commerce.

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

COs	Course Outcomes	Cognitive Level
CO1	Explain about foundational understanding of computer systems, their components, and basic operations.	Understand
CO2	Describe the different types of memory devices, their functions, and roles in computer systems.	Understand
CO3	Classify the core concepts, functions, and management techniques of operating systems in computer environments.	Understand
CO4	Compare the various types of software, including system, application, and utility software, and their roles in computing.	Understand
CO5	Summarize the principles, architectures, and protocols that enable communication between computers in a network.	Understand

References :	
1	Anitha Goel, Computer Fundamentals, Pearson India, New Delhi, 2010.
2	Balagurusamy E, Fundamentals of computers, TMH, New Delhi, Second Edition, 2010.
3	Rajaraman V, Fundamentals of Computer, Prentice Hall of India Pvt. Ltd., New Delhi, Third Edition, 2012
4	Ram B, Computers Fundamentals Architecture and Organization, New Age International Publishers, New Delhi, Revised Edition, 2011.
5.	Dhanpat Rai and Co, Fundamentals of Computer, Sumita Arora, New Delhi, Second Edition, 2013.
6	Sinha P.K., Computer Fundamentals, BPB Publications, New Delhi. Third Edition, 2010.

K.S.R. COLLEGE OF ENGINEERING (Autonomous)		R 2024				
SEMESTER - I						
BC5002	**PROBLEM SOLVING AND PROGRAMMING IN C**	L	T	P	SL	C
		30	0	0	30	0

PREREQUISITE:

Introduction to Programming: Students should have a basic understanding of programming concepts, including data types, variables, control structures, functions, and arrays.

COURSE OBJECTIVES:

To develop students' skills in problem-solving and programming using the C language fundamentals and techniques.

UNIT - I **INTRODUCTION TO COMPUTER PROBLEM SOLVING**

Introduction – The Problem Solving aspect – Top down design – Implementation of algorithm – Program Verification – The efficiency of algorithms – The analysis of algorithms – Fundamental Algorithms

UNIT - II **PROGRAMMING AND ALGORITHMS**

Programs and Programming – building blocks for simple programs -pseudo code representation – flow charts Programming Languages - compiler –Interpreter, Loader and Linker - Program execution – Classification of Programming Language – Structured Programming Concept – Illustrated Problems: Algorithm to check whether a given number is Armstrong number or not- Find factorial of a number.

UNIT - III **BASICS OF 'C', INPUT / OUTPUT & CONTROL STATEMENTS**

Introduction- Identifier – Keywords - Variables – Constants – I/O Statements - Operators - Initialization – Expressions – Expression Evaluation – L values and R values – Type Conversion in C –Formatted input and output functions - Specifying Test Condition for Selection and Iteration- Conditional Execution - and Selection – Iteration and Repetitive

Execution- go to Statement – Nested Loops- Continue and break statements. Programs to be implemented:

1. Write a program to find whether the given year is leap year or Not? (Hint: not every centurion year is a leap. For example 1700, 1800 and 1900 is not a leap year)
2. Write a program to perform the Calculator operations, namely, addition, subtraction, multiplication, division and square of a number.

UNIT - IV **ARRAYS, STRINGS, FUNCTIONS AND POINTERS**

Array – One dimensional Character Arrays- Multidimensional Arrays- Arrays of Strings – Two dimensional character array – functions - parameter passing mechanism scope – storage classes – recursion - comparing iteration and recursion- pointers – pointer operators - uses of pointers- arrays and pointers – pointers and strings - pointer indirection pointers to functions - Dynamic memory allocation.

1. Write a program in C to get the largest element of an array using the function.
2. Display all prime numbers between two intervals using functions.
3. Reverse a sentence using recursion.
4. Write a C program to concatenate two strings.
5. Find the frequency of a character in a string.

UNIT - V **USER-DEFINED DATATYPES & FILES**

Structures – initialization - nested structures – structures and arrays – structures and pointers - union– type def and enumeration types - bit fields - File Management in C – Files and Streams – File handling functions – Sequential access file- Random access file – Command line arguments.

1. Write a C program to Store Student Information in Structure and Display it.
2. The annual examination is conducted for 10 students for five subjects.
3. Write a program to read the data and determine the following:

(a) Total marks obtained by each student.

(b) The highest marks in each subject and the marks of the student who secured it.

(c) The student who obtained the highest total marks.

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

COs	Course Outcomes	Cognitive Level
CO1	Classify the foundational problem-solving skills using computational thinking and basic programming concepts.	Understand
CO2	Explain the fundamental programming concepts and algorithm design for effective problem solving and software development.	Understand
CO3	Summarize the basics of C programming, including input/output operations and control flow statements for building simple programs.	Understand
CO4	Illustrate programs using structures, strings, arrays, pointer and files for solving complex computational problem.	Understand
CO5	Explain the modularity using functions and pointers which permit ad hoc runtime polymorphism.	Understand

Reference Books :

1	Deitel and Deitel, C How to Program, Pearson Education, Noida, Seventh Edition, 2013.
2	Byron S Gottfried, Programming with C, Schaums Outlines, Tata McGraw-Hill, New Delhi, Second Edition, 2011.
3	Brian W. Kernighan and Dennis M. Ritchie, The C programming Language, Pearson Education India, Second Edition, 2015,
4	Dromey R. G., How to solve it by Computer, Pearson Education, New Delhi, Fifth Edition, 2012.
5	Kamthane, A.N., Programming with ANSI and Turbo C, Pearson Education, New Delhi, Third Edition, 2015.
6	Venugopal R, Sudeep R Prasad, Mastering CK, McGraw Hill Education Private Limited, New Delhi, India, Second Edition 2015.

K.S.R. COLLEGE OF ENGINEERING (Autonomous)		R 2024				
SEMESTER - II						
BC5003	**CORE JAVA PROGRAMMING**	L	T	P	SL	C
		30	0	0	0	0

PREREQUISITE: Introduction to Programming: Students should have a basic understanding of programming concepts, including data types, variables, control structures, functions, and arrays.

COURSE OBJECTIVES:

To equip students with fundamental concepts and practical skills for developing applications using Java programming language.

UNIT - I	**OVERVIEW OF OBJECT ORIENTED PROGRAMMING CONCEPTS**

Object Oriented Programming Concepts- Introduction- Methods –Method Overriding.

UNIT - II	**INTRODUCTION**

Java History-Applications-Lexical Issues- Data Types- Variables and Arrays Operators – Control Statements

UNIT - III	**PACKAGES**

Packages – Importing Packages- I/O Package – Interfaces – Exception Handling – Multithreaded Programming- String Operations. The Java I/O Classes– File – Byte Streams – The Character Streams – Serialization.

UNIT - IV	**JAVA PACKAGES: AWT, APPLET**

AWT Package: AWT Classes – Window Fundamentals – Working with Graphics– Working with Color – Working with Fonts – Applet Package: Applet Basics – Applet Architecture – Reading and Writing in Console – Print Writer class.

UNIT - V	**JAVA SWING**

Java Swing-Applet-Icons and Labels-Text Fields-Buttons-Combo Box-Tabbed Panes-Scroll Panes-Trees-Tables-Exploring Swing.

COURSE OUTCOMES: At the edd of the course, the student will be able to:

COs	Course Outcomes	Cognitive Level
CO1	Explain the basic object oriented programming concepts and know the origin of java programming.	Understand
CO2	Classify the different operations through single packages and understanding the String concepts.	Understand
CO3	Illustrate the use of Java packages for structuring code, enhancing modularity, and managing class accessibility.	Understand
CO4	Explain the role of Java AWT and Applet packages in creating graphical user interfaces and web-based applications.	Understand
CO5	Describe the platform-independent graphical user interfaces using Java Swing components and frameworks.	Understand

Reference Books :

1	Herbert Schildt, The Complete Reference JAVA, Tata McGraw Hill, New Delhi, ThirteenthEdition, 2017.
2	Joshua Bloch, Effective Java, Addison Wesley, New Delhi, Third Edition, 2016.
3	Herbert Schildt, The Complete Reference, Tata McGraw Hill, New Delhi, Eighth Edition, 2011.
4	Kogent, Java 6 Programming Black Book, Kogent Learning Solutions, New Delhi, Third Edition, 2011.
5	Steven Holzner, Java2 (JDK 5 Edition) Programming, Tata McGraw Hill, New Delhi, Fourth Edition, 2012.
6	Balagurusamy E, Programming with Java, McGraw-Hill Education, New Delhi, Sixth Edition, 2019.

K.S.R. COLLEGE OF ENGINEERING (Autonomous)		R 2024				
SEMESTER - II						
BC5004	**SOFTWARE ENGINEERING**	L	T	P	SL	C
		30	0	0	0	0

PREREQUISITE: Programming skills: Students should have proficiency in at least one programming language, such as Java, Python, C++, or JavaScript.

COURSE OBJECTIVES:

To teach students systematic approaches for designing, developing, testing, and maintaining high-quality software systems.

UNIT - I	**INTRODUCTION**

Software Engineering Paradigms – Waterfall Life Cycle Model – Spiral Model – Prototype Model – Agile Process Model – Unified Process Model - Planning – Software Project Scheduling – SRS - Case Study: Project Plan and SRS

UNIT - II	**SOFTWARE DESIGN**

Designing Concepts - Abstraction – Modularity – Software Architecture – Cohesion – Coupling – Dataflow Oriented Design - Jackson System Development - Real time and Distributed System Design – Designing for Reuse –– Case Study: Design for any Application Oriented Project.

UNIT - III	**SOFTWARE TESTING AND MAINTENANCE**

Software Testing Fundamentals – Software Testing Strategies – Black Box Testing – White Box Testing – System Testing – Object Orientation Testing – State Based Testing – Testing Tools – Test Case Management – Types of Maintenance – Case Study: Testing Techniques

UNIT - IV	**SOFTWARE METRICS**

Scope – Classification of metrics – Measuring Process and Product attributes – Direct and Indirect measures – Cost Estimation - Reliability – Software Quality Assurance – Standards – Case Study for COCOMO model.

UNIT - V	**SCM & WEB ENGINEERING**

Need for SCM – Version Control – SCM process – Software Configuration Items – Taxonomy – Re Engineering – Reverse Engineering - Web Engineering - CASE Repository – Features.

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

COs	**Course Outcomes**	**Cognitive Level**
CO1	Explain the fundamental concepts, principles, and lifecycle of software engineering for systematic software development.	Understand
CO2	Summarize the software design principles and methodologies for creating efficient, maintainable, and scalable software solutions.	Understand
CO3	Describe the techniques for effective software testing and maintenance to ensure quality, reliability, and longevity of software systems.	Understand
CO4	Classify the software metrics for measuring and improving software quality, performance, and development processes.	Understand
CO5	Construct the Software Configuration Management (SCM) and web engineering principles for efficient development and maintenance of web-based software systems.	Understand

Reference Books :

1	Roger S. Pressman, Software Engineering: A Practitioner Approach, Tata McGraw – Hill International Edition, New Delhi, Seventh Edition, 2017
2	Richard Fairley, Software Engineering Concepts, Tata McGraw Hill Edition, New Delhi, Third Edition, 2018.
3	Ali Behforroz, Frederick J. Hudson, Software Engineering Fundamentals, Oxford Indian Reprint, New Delhi, First Edition,
4	Sommerville, Software Engineering, Pearson, New Delhi, Tenth Edition, 2016.
5	PankajJalote, An Integrated approach to Software Engineering, Narosa Publications, New Delhi, Third Edition, 2011.
6	David Farley, Modern Software Engineering: Doing What Works to Build, Tata McGraw Hil, New Delhi, First Edition, 2021