K.S.R. COLLEGE OF ENGINEERING: TIRUCHENGODE - 637 215

(Autonomous)

DEPARTMENT OF COMPUTER SCIENCE AND ENIGNEERING

M.E. - COMPUTER SCIENCE AND ENGINEERING

(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: (Computer Science and Engineering)

DV	To produce globally competent researchers and innovators in Computer Science and Engineering, committed to ethical values and sustainable development.

Mission of the Department / Programme: (Computer Science and Engineering)

DM 1	Provide high-quality learner-centric education in computer science and engineering through experiential learning and modern pedagogy.
DM 2	Enhance holistic, value-driven education through state-of-the-art laboratory facilities to meet global industry demand.
DM 3	Promote interdisciplinary innovation and research committed to sustainable development.

Program Educational Objectives (PEOs): (Computer Science and Engineering)

The graduates of the programme will be able to	
PEO 1	**Engineering knowledge:** Apply the necessary mathematical tools and fundamental and advanced knowledge of computer science and engineering.
PEO 2	**Development of solutions:** Develop computer/software/network systems understanding the importance of social, business, technical, environmental and human context in which the systems would work.

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PEO 3	**Individual and Teamwork:** Contribute effectively as a team member/leader, using common tools and environment, in computer science and engineering projects, research or education.

Program Outcomes (POs) of M.E. - Computer Science and Engineering

PO1	**M.E Computer Science and Engineering graduates will be able to attain:** An ability to independently carry out research /investigation and development work to solve practical problems.
PO2	An ability to write and present a substantial technical report/document.
PO3	Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program.
PO4	Apply the knowledge of computer system design principles in building system software and hardware components.
PO5	Apply the theoretical foundations of computer science in modeling and developing solutions to the real-world problems.

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	K. S. R COLLEGE OF ENGINEERING An Autonomous Institution Approved by AICTE and Affiliated to Anna University, Chennai Accredited by NAAC ('A++' Grade)	Curriculum PG R - 2024
Department	Department of Computer Science and Engineering	
Programme	M.E. Computer Science and Engineering	

SEMESTER I

S. No.	Course Code	Course Title	Category	Periods / Semester					Credit	Max. Marks		
				L	T	P	SL	Tot	C = T/30	CA	ES	Tot
Induction Programme			-	-	-	-	-	-	-	-	-	
THEORY COURSES												
1	MA24T16	Operations Research	FC	45	0	0	45	90	3	40	60	100
2	CS24T16	Advanced Data Structures and Algorithms	PCC	45	0	0	45	90	3	40	60	100
3	CS24T17	Database Practices	PCC	45	0	0	45	90	3	40	60	100
4	CS24T18	Network Technologies	PCC	45	0	0	45	90	3	40	60	100
5		Professional Elective - I	PEC	45	0	0	45	90	3	40	60	100
6		Professional Elective - II	PEC	45	0	0	45	90	3	40	60	100
LABORATORY COURSES												
7	CS24P16	Advanced Data Structures and Algorithms Laboratory	PCC	0	0	60	0	60	2	60	40	100
8	CS24P11	Database Practices Laboratory	PCC	0	0	60	0	60	2	60	40	100
			TOTAL	**270**	**0**	**120**	**270**	**660**	**22**	**800**		

SEMESTER II

S. No.	Course Code	Course Title	Category	Periods / Semester					Credit	Max. Marks		
				L	T	P	SL	Tot	C = T/30	CA	ES	Tot
THEORY COURSES												
1	RM24T09	Research Methodology and IPR	RMC	45	0	0	45	90	3	40	60	100
2	BD24T26	Big Data Mining and Analytics	PCC	45	0	0	45	90	3	40	60	100
3	CS24T27	Cloud Computing	PCC	45	0	0	45	90	3	40	60	100
4	BD24E08	Internet of Things	PCC	45	0	0	45	90	3	40	60	100
5		Professional Elective - III	PEC	45	0	0	45	90	3	40	60	100
6		Professional Elective - IV	PEC	45	0	0	45	90	3	40	60	100
LABORATORY COURSES												

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7	BD24P26	Big Data Mining and Analytics Laboratory	PCC	0	0	60	0	60	2	60	40	100
8	CS24P26	Cloud Computing Laboratory	PCC	0	0	60	0	60	2	60	40	100
9	CS24P21	Technical Presentation	EEC	0	0	60	0	60	2	60	40	100
TOTAL				270	0	180	270	720	24	900		

SEMESTER III

S. No.	Course Code	Course Title	Category	Periods / Semester					Credit	Max. Marks		
				L	T	P	SL	Tot	C = T/30	CA	ES	Tot
THEORY COURSES												
1	CS24T31	Security Practices	PCC	45	0	0	45	90	3	40	60	100
2	CS24T36	Soft Computing	PCC	45	0	0	45	90	3	40	60	100
3	CS24T37	Artificial Intelligence Techniques	PCC	45	0	0	45	90	3	40	60	100
4		Professional Elective - V	PEC	45	0	0	45	90	3	40	60	100
5		Audit courses	AC	30	0	0	0	30	0	100	-	100
LABORATORY COURSES												
6	CS24P31	Project Phase – I	EEC	0	0	180	0	180	6	60	40	100
TOTAL				210	0	180	180	570	18	600		

SEMESTER IV

S. No.	Course Code	Course Title	Category	Periods / Semester					Credit	Max. Marks		
				L	T	P	SL	Tot	C = T/30	CA	ES	Tot
LABORATORY COURSES												
1	CS24P41	Project Phase – II	EEC	0	0	360	0	360	12	60	40	100
TOTAL				0	0	360	0	360	12	100		
TOTAL CREDITS									76			

TOTAL NUMBER OF CREDITS TO BE EARNED FOR AWARD OF THE DEGREE = 76

Note: FC - Foundation Courses, PCC - Professional Core Courses, RMC - Research Methodology Courses, PEC - Professional Elective Courses, EEC - Employability Enhancement Courses and AC - Audit Courses.

FOUNDATION COURSES (FC)

S. No.	Course Code	Course Title	Semester	Periods / Semester					Credit	Max. Marks		
				L	T	P	SL	Tot	C=T/30	CA	ES	Tot
1	MA24T16	Operations Research	I	45	0	0	45	90	3	40	60	100
TOTAL				45	0	0	45	90	3	-	-	-

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PROFESSIONAL CORE COURSES (PCC)

S. No.	Course Code	Course Title	Semester	Periods / Semester					Credit	Max. Marks		
				L	T	P	SL	Tot	C=T/30	CA	ES	Tot
1	CS24T16	Advanced Data Structures and Algorithms	I	45	0	0	45	90	3	40	60	100
2	CS24T17	Database Practices	I	45	0	0	45	90	3	40	60	100
3	CS24T18	Network Technologies	I	45	0	0	45	90	3	40	60	100
4	CS24P16	Advanced Data Structures and Algorithms Laboratory	I	0	0	60	0	60	2	60	40	100
5	CS24P11	Database Practices Laboratory	I	0	0	60	0	60	2	60	40	100
6	BD24T26	Big Data Mining and Analytics	II	45	0	0	45	90	3	40	60	100
7	CS24T27	Cloud Computing	II	45	0	0	45	90	3	40	60	100
8	BD24E08	Internet of Things	II	45	0	0	45	90	3	40	60	100
9	BD24P26	Big Data Mining and Analytics Laboratory	II	0	0	60	0	60	2	60	40	100
10	CS24P26	Cloud Computing Laboratory	II	0	0	60	0	60	2	60	40	100
11	CS24T31	Security Practices	III	45	0	0	45	90	3	40	60	100
12	CS24T36	Soft Computing	III	45	0	0	45	90	3	40	60	100
13	CS24T37	Artificial Intelligence Techniques	III	45	0	0	45	90	3	40	60	100
TOTAL				**405**	**0**	**240**	**405**	**1050**	**35**	-	-	-

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

S. No.	Course Code	Course Title	Semester	Periods / Semester					Credit	Max. Marks		
				L	T	P	SL	Tot	C=T/30	CA	ES	Tot
1	CS24P21	Technical Presentation	II	0	0	60	0	60	2	60	40	100
2	CS24P31	Project Phase – I	III	0	0	180	0	180	6	60	40	100
3	CS24P41	Project Phase – II	IV	0	0	360	0	360	12	60	40	100
TOTAL				**0**	**0**	**600**	**0**	**600**	**20**	-	-	-

RESEARCH METHODOLOGY COURSES(REC)

S. No.	Course Code	Course Title	Semester	Periods / Semester					Credit	Max. Marks		
				L	T	P	SL	Tot	C=T/30	CA	ES	Tot
1	RM24T09	Research Methodology and IPR	II	45	0	0	45	90	3	40	60	100
TOTAL				**45**	**0**	**0**	**45**	**90**	**3**	-	-	-

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PROFESSIONAL ELECTIVE COURSES (PEC) PROFESSIONAL ELECTIVES – I and II (SEMESTER – I)													
S. No.	Course Code	Course Title	Semester	Periods / Semester					Credit	Max. Marks		
				L	T	P	SL	Tot	C=T/30	CA	ES	Tot
1	CS24E01	Data Mining Techniques	I	45	0	0	45	90	3	40	60	100
2	CS24E02	Advanced Operating System	I	45	0	0	45	90	3	40	60	100
3	CS24E03	Mobile and Pervasive Computing	I	45	0	0	45	90	3	40	60	100
4	BD24T16	Foundations of Data Science	I	45	0	0	45	90	3	40	60	100
5	BD24E04	Agile Methodologies	I	45	0	0	45	90	3	40	60	100
6	CS24E04	Object Oriented Software Engineering	I	45	0	0	45	90	3	40	60	100
7	CS24E05	Wireless Sensor Networks	I	45	0	0	45	90	3	40	60	100
8	CS24E06	Multicore Architectures	I	45	0	0	45	90	3	40	60	100
9	CS24E07	Human Computer Interaction	I	45	0	0	45	90	3	40	60	100
10	BD24E05	Web Services and API Design	I	45	0	0	45	90	3	40	60	100

PROFESSIONAL ELECTIVE COURSES (PEC) PROFESSIONAL ELECTIVES – III and IV (SEMESTER – II)												
S. No.	Course Code	Course Title	Semester	Periods / Semester					Credit	Max. Marks		
				L	T	P	SL	Tot	C=T/30	CA	ES	Tot
1	BD24T27	Machine Learning Techniques	II	45	0	0	45	90	3	40	60	100
2	CS24E08	Software Quality Assurance	II	45	0	0	45	90	3	40	60	100
3	CS24E09	Full Stack Web Application Development	II	45	0	0	45	90	3	40	60	100
4	CS24E10	Deep Learning	II	45	0	0	45	90	3	40	60	100
5	CS24E11	Natural Language Processing	II	45	0	0	45	90	3	40	60	100
6	BD24E09	Blockchain Technologies	II	45	0	0	45	90	3	40	60	100
7	BD24E10	Cyber Physical Systems	II	45	0	0	45	90	3	40	60	100
8	CS24E12	GPU Computing	II	45	0	0	45	90	3	40	60	100
9	CS24E13	Quantum Computing	II	45	0	0	45	90	3	40	60	100
10	BD24E12	Information Retrieval Techniques	II	45	0	0	45	90	3	40	60	100

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PROFESSIONAL ELECTIVE COURSES (PEC) PROFESSIONAL ELECTIVES – V (SEMESTER – III)												
S. No.	Course Code	Course Title	Semester	Periods / Semester					Credit	Max. Marks		
				L	T	P	SL	Tot	C=T/30	CA	ES	Tot
1	BD24E14	DevOps and Microservices	III	45	0	0	45	90	3	40	60	100
2	CS24E14	Augmented Reality and Virtual Reality	III	45	0	0	45	90	3	40	60	100
3	CS24E15	Software Industrialization	III	45	0	0	45	90	3	40	60	100
4	CS24E16	Digital Image Processing	III	45	0	0	45	90	3	40	60	100
5	BD24E17	Social Network Analysis	III	45	0	0	45	90	3	40	60	100

AUDIT COURSES (SEMESTER – III)												
S. No.	Course Code	Course Title	Semester	Periods / Semester					Credit	Max. Marks		
				L	T	P	SL	Tot	C=T/30	CA	ES	Tot
1	AX24A01	Disaster Management	III	30	0	0	0	30	0	100	-	100
2	AX24A02	Value Education	III	30	0	0	0	30	0	100	-	100
3	AX24A03	Constitution of India	III	30	0	0	0	30	0	100	-	100
4	AX24A04	Indian Knowledge System	III	30	0	0	0	30	0	100	-	100

Summary						
Name of the Programme: M.E Computer science and Engineering						
CATEGORY	I	II	III	IV	TOTAL CREDITS	%
FC	3	-	-	-	3	3.94
PCC	13	13	9	-	35	46.05
REC	-	3	-	-	3	3.94
PEC	6	6	3	-	15	19.73
EEC	-	2	6	12	20	26.31
AC	-	-	✓	-	-	-
Total	22	24	18	12	76	100

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MA24T16	OPERATIONS RESEARCH	Category	L	T	P	SL	C
		FC	45	0	0	45	3

SEMESTER - I (M.E. : Common to CSE, BDA and M.Tech IT)

PREREQUISITE :

For Effective learning and applying resource management technique students must have a foundational understanding of optimization technique like linear programming and integer programming, basic knowledge of network programming, Queuing model.

OBJECTIVES :

To determine the most effective way to allocate the best value of linear programming, minimize the total transportation cost and to find the optimal way to assign a set of tasks, the optimal quantity of inventory to hold the balancing between excess and shortage , analyze the basic components and behavior of queuing systems , shortest path in PERT/CPM , Network design.

UNIT - I	LINEAR PROGRAMMING	(9)

Formation of LPP – Graphical method – Simplex method – Big M Method – Dual simplex method.

UNIT - II	TRANSPORTATION AND ASSIGNMENT PROBLEMS	(9)

Transportation Models (Minimizing and Maximizing Problems) – Balanced and unbalanced Problems – Initial Basic feasible solution by North West Corner Rule, Least cost and Vogel's approximation methods – Optimum solution by MODI Method –Assignment Models (Minimizing and Maximizing Problems) – Hungarian method - Balanced and Unbalanced Problems.

UNIT - III	INVENTORY MODELS	(9)

Types of Inventory - Deterministic inventory models: Purchasing problem with no shortage and with shortages - Production problem with and without shortages - Purchase problem with price breaks - Probabilistic inventory model (excluding proof).

UNIT - IV	QUEUING MODELS	(9)

Characteristics of Queuing Models – Kendall's notations - Little's formula - (M/M/1): $^{(\infty/FIFO)}$ Single Server with infinite capacity – (M/M/C) : $^{(\infty/FIFO)}$ Multi Server with infinite capacity - (M/M/1) : $^{(N/FIFO)}$ Single Server with finite capacity - (M/M/C) : $^{(N/FIFO)}$ Multi server with finite capacity .

UNIT - V	PERT/CPM	(9)

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

Lecture = 45, Tutorial = 0 , Self Learning = 45 ; Total = 90 Periods

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

COs	Course Outcome	Cognitive Level
CO1	Apply the concepts of linear programming approach to solve the uncertain situations.	Apply
CO2	Analyze the transportation models and solve Assignment problems to minimize the costs.	Analyze
CO3	Apply the inventory models using EOQ and EBQ with and without shortage.	Apply
CO4	Analyze and interpret the key features of various queuing systems	Analyze
CO5	Perform optimistic and pessimistic analysis using PERT/CPM networks.	Apply

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TEXT BOOKS :

1. Taha H.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. Hira and 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
CO1	3	-	2	-	2
CO2	3	-	2	-	2
CO3	3	-	2	-	2
CO4	3	-	2	-	2
CO5	3	-	2	-	2

1 - Low, 2 - Medium, 3- High .

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CS24T16	ADVANCED DATA STRUCTURES AND ALGORITHMS	Category	L	T	P	SL	C
		PCC	45	0	0	45	3

(Common to M.E CSE and M.E BDA)

PREREQUISITE

Familiarity with basic data structures like arrays, linked lists, stacks, and queues is essential for understanding advanced topics. This foundational knowledge helps in grasping how more complex data structures and algorithms build upon these basics to address intricate problems.

OBJECTIVES:

To equip students with the knowledge and skills to analyze algorithm efficiency, implement advanced data structures, apply graph algorithms, utilize dynamic programming and greedy techniques, and understand computational complexity including NP-completeness and approximation methods.

UNIT – I	ROLE OF ALGORITHMS IN COMPUTING	(9)

Algorithms – Algorithms as a Technology – Time and Space complexity of algorithms – Asymptotic analysis – Average and Worst-case analysis – Asymptotic notation – Importance of efficient algorithms – Program performance measurement – Recurrences: The Substitution Method – The Recursion– Tree Method.

UNIT – II	HIERARCHICAL DATA STRUCTURES	(9)

Binary Search Trees – Red Black trees – B-Trees – B+ Trees – AVL Tree – Multi-way Search Trees – Heap: Heap Operations – Min/Max heaps – Fibonacci Heaps: Structure – Mergeable-heap operations– Decreasing a key and deleting a node– Bounding the maximum degree.

UNIT – III	GRAPH	(9)

Graph: Representations of Graphs – Breadth-First Search – Depth-First Search – Topological Sort – Minimum Spanning Trees: Growing a Minimum Spanning Tree – Kruskal and Prim's – Single-Source Shortest Paths: The Bellman-Ford algorithm – Dijkstra's Algorithm – All-Pairs Shortest Paths: Shortest Paths and Matrix Multiplication – The Floyd -Warshall Algorithm.

UNIT – IV	ALGORITHM DESIGN TECHNIQUES	(9)

Dynamic Programming: Matrix-Chain Multiplication – Optimal binary search trees – Elements of Dynamic Programming – Longest Common Subsequence – Greedy Algorithms: An Activity – Selection Problem – Elements of the Greedy Strategy – Huffman Codes and Trees.

UNIT – V	NP COMPLETE AND NP HARD	(9)

NP Completeness: Polynomial Time – Polynomial Time Verification – NP Completeness and Reducibility – Proof of NP hardness and NP completeness – Approximation algorithms – Randomized Algorithms.

L:45, T:0, P:0, SL:45, TOTAL: 90 PERIODS

COURSE OUTCOMES:

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

COs	Course Outcome	Cognitive Level

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CO1	Summarize the fundamental concepts of algorithm efficiency and apply complexity analysis methods.	Understand
CO2	Describe and implement advanced hierarchical data structures for effective data management.	Understand
CO3	Apply graph algorithms to solve shortest paths and spanning trees and analyze their results.	Apply
CO4	Identify dynamic programming and greedy strategies and synthesize these techniques for optimization.	Understand
CO5	Demonstrate NP-complete problems and develop solutions using approximation and randomized algorithms.	Apply

REFERENCES:

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction to Algorithms", MIT Press, London, 4th Edition, 2022.
2. Reema Thareja, "Data Structures Using C", Oxford University Press, England, 3rd Edition, 2023.
3. Weiss, "Data Structures and Algorithm Analysis in C", Pearson Education, India, 2nd Edition, 2015.
4. Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman, "Data Structures and Algorithms", Pearson Education, India, Reprint 2006.
5. S.Sridhar, "Design and Analysis of Algorithms", Oxford University Press, England, 1st Edition, 2014.

Mapping of COs with POs and PSOs

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

1-low, 2-medium, 3-high

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CS24T17	DATABASE PRACTICES	Category	L	T	P	SL	C
		PCC	45	0	0	45	3

(Common to M.E CSE and M.E BDA)

PREREQUISITE

Students should have a foundation in SQL, relational algebra and basic database design principles. Knowledge of distributed databases, XML, and introductory NoSQL systems is also needed.

OBJECTIVES:

To provide students with a comprehensive understanding of relational and advanced database concepts, including SQL, database design, distributed and active databases, XML data management and emerging technologies such as NoSQL and big data storage systems.

UNIT – I	RELATIONAL DATA MODEL	(9)

Introduction to the Relational Model – Relational Algebra – Introduction to SQL – Intermediate SQL – Advanced SQL.

UNIT – II	DATABASE DESIGN	(9)

Database Design Using the E-R Model: Overview of the Design Process – The Entity-Relationship Model – Complex Attributes – Mapping Cardinalities – Removing Redundant Attributes in Entity Sets – Reducing E-R Diagrams to Relational Schemas – Extended E-R Features – Entity-Relationship Design Issues – Alternative Notations for Modeling Data – Relational Database Design: Features of Good Relational Designs – Functional Dependencies – Non-loss Decomposition – First, Second and Third Normal Forms, Dependency Preservation – Boyce/Codd Normal Form – Multi-valued Dependencies and Fourth Normal Form – Join Dependencies and Fifth Normal Form.

UNIT – III	DISTRIBUTED DATABASES, ACTIVE DATABASES AND OPEN DATABASE CONNECTIVITY	(9)

Distributed Database Architecture – Distributed Data Storage – Distributed Query Processing – Distributed Transaction Processing – Active Database Concepts and Triggers – Design and Implementation Issues for Active Databases – Open Database Connectivity.

UNIT – IV	XML DATABASES	(9)

Structured, Semi structured and Unstructured Data – XML Hierarchical Data Model – XML Documents – Document Type Definition – XML Schema – Storing and Extracting XML Documents from Databases – XML Languages – Extracting XML Documents from Relational Databases – XML/SQL: SQL Functions for Creating XML Data.

UNIT – V	NOSQL DATABASES AND BIG DATA STORAGE SYSTEMS	(9)

Introduction to NOSQL Systems – CAP Theorem – Document-Based NoSQL Systems and MongoDB – NoSQL Key-Value Stores – Dynamo DB Overview – Voldemort Key-Value Distributed Data Store – Column-Based or Wide Column NoSQL Systems – NoSQL Graph Databases and Neo4j – Big Data – MapReduce – Hadoop – YARN.

L:45, T:0, P:0, SL:45, TOTAL: 90 PERIODS

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

COs	Course Outcome	Cognitive Level
CO1	Describe the key concepts of the relational model, relational algebra operations, and SQL commands used in relational database systems.	Understand
CO2	Develop relational database designs by applying E-R modeling and normalization principles to meet specific data storage requirements.	Apply
CO3	Summarize the concepts and architecture of distributed databases, active databases, and Open Database Connectivity to support effective data management.	Understand
CO4	Apply XML technologies to manage structured, semi-structured, and unstructured data, and integrate XML documents with relational databases.	Apply
CO5	Implement NoSQL database models and big data frameworks like Hadoop and MapReduce for scalable and efficient data storage solutions.	Apply

REFERENCES:

1. Abraham Silberschatz, Henry F. Korth and S. Sudharshan, "Database System Concepts", Tata McGraw Hill, New Delhi, 7th Edition, 2019.
2. Ramez Elmasri and Shamkant B. Navathe, "Fundamentals of Database Systems", Pearson Education, New Delhi, 7th Edition, 2016.
3. S.K.Singh, "Database Systems Concepts, Design and Applications", Pearson Education, New Delhi, 2nd Edition, 2011.
4. Harrison, Guy, "Next Generation Databases, NoSQL and Big Data", Apress publishers, Pune, 1st Edition, 2015.
5. Thomas Cannolly and Carolyn Begg, "Database Systems, A Practical Approach to Design, Implementation and Management", Pearson Education, New Delhi, 6th Edition, 2015.

Mapping of COs with POs and PSOs

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

1-low, 2-medium, 3-high

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CS24T18	NETWORK TECHNOLOGIES	Category	L	T	P	SL	C
		PCC	45	0	0	45	3

(Common to M.E CSE and M.E BDA)

PREREQUISITE

Students should have a basic understanding of networking terminology, OSI model principles and network devices. Familiarity with IP addressing, wireless networks, and virtualization concepts is also needed. Basic knowledge of programming and network security.

OBJECTIVES:

To provide a comprehensive understanding of traditional and wireless networking concepts, mobile data networks (4G to 6G), Software Defined Networking (SDN), and Network Functions Virtualization (NFV), enabling students to design and analyze modern communication infrastructures.

UNIT – I	NETWORKING CONCEPTS	(9)

Peer To Peer Vs Client-Server Networks – Network Devices – Network Terminology – Network Speeds – Network throughput delay – OSI Model Packets – Frames – Headers – Collision and Broadcast Domains – LAN Vs WAN Network Adapter – Hub – Switch – Router – Firewall – IP addressing.

– UNIT – II	WIRELESS NETWORKS	(9)

Wireless access techniques – IEEE 802.11a, 802.11g, 802.11e, 802.11n/ac/ax/ay/ba/be, QoS – Bluetooth – Protocol Stack – Security – Profiles – zigbee

UNIT – III	MOBILE DATA NETWORKS	(9)

4G Networks and Composite Radio Environment – Protocol Boosters – Hybrid 4G Wireless Networks Protocols – Green Wireless Networks – Physical Layer and Multiple Access – Channel Modelling for 4G – Concepts of 5G – Channel access – Air Interface – Cognitive Radio – Spectrum Management – C-RAN Architecture – Vehicular Communications – Protocol – Network Slicing – MIMO – mmWave – Introduction to 6G.

UNIT – IV	SOFTWARE DEFINED NETWORKS	(9)

SDN Architecture – Characteristics of Software – Defined Networking – SDN and NFV Related Standards – SDN Data Plane – Data Plane Functions – Data Plane Protocols – OpenFlow Logical Network Device – Flow Table Structure – Flow Table Pipeline – Use of Multiple Tables – Group Table – OpenFlow Protocol – SDN Control Plane Architecture – Control Plane Functions – Southbound Interface – Northbound Interface – Routing – ITU-T Model.

UNIT – V	NETWORK FUNCTIONS VIRTUALIZATION	(9)

Motivation – Virtual Machines – NFV Benefits and Requirements – Architecture – NFV Infrastructure – Virtualized Network Functions – NFV Management and Orchestration – NFV Use Cases – NFV and SDN – Network virtualization – VLAN and VPN.

L:45, T:0, P:0, SL:45, TOTAL: 90 PERIODS

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

COs	Course Outcome	Cognitive Level
CO1	Identify and apply core networking concepts, devices and protocols to basic network configurations and operations.	Understand
CO2	Familiarize with and assess various wireless network technologies and standards.	Understand
CO3	Examine and critique mobile network technologies and protocols, including 4G, 5G, and emerging 6G systems.	Apply
CO4	Interpret and implement the principles and architecture of Software Defined Networking (SDN).	Apply
CO5	Outline and appraise the design and advantages of Network Functions Virtualization (NFV).	Understand

REFERENCES:

1. James Bernstein, "Networking made Easy", Independently Published, 1st Edition, 2018.
2. Houda Labiod, Costantino de Santis, Hossam Afifi, "Wi-Fi, Bluetooth, Zigbee and WiMax", Springer, Netherlands, 1st Edition, 2007.
3. Erik Dahlman, Stefan Parkvall, Johan Skold, "4G: LTE/LTE-Advanced for Mobile Broadband", Academic Press, Cambridge, 1st Edition, 2013.
4. Saad Z. Asif, "5G Mobile Communications Concepts and Technologies", CRC press, Florida, 1st Edition, 2019.
5. William Stallings, "Foundations of Modern Networking: SDN, NFV, QoE, IoT, and Cloud", Pearson Education, 1st Edition, 2016.

Mapping of COs with POs and PSOs

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

1-low, 2-medium, 3-high

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CS24P16	ADVANCED DATA STRUCTURES AND ALGORITHMS LABORATORY	Category	L	T	P	SL	C
		PCC	0	0	60	0	2

(Common to M.E CSE and M.E BDA)

PREREQUISITE

Students should have a basic understanding of programming, data structures and fundamental algorithms. Familiarity with mathematical concepts related to recursion and algorithm complexity, along with strong problem-solving skills

OBJECTIVES:

To equip students with the skills to design, implement, and analyze recursive functions, sorting algorithms, tree and graph data structures, and optimization techniques for solving a wide range of computational and real-world problems.

List of Experiments:

1. Develop recursive methods for tree traversal (In-order, Pre-order, Post-order) and for calculating Fibonacci numbers.
2. Generate solutions for Merge Sort and Quick Sort algorithms.
3. Construct a Binary Search Tree (BST) with essential operations like insertion, deletion, and search.
4. Design and build a Red-Black Tree, ensuring it maintains its balancing properties.
5. Construct a Heap (Min-Heap or Max-Heap) and perform standard heap operations.
6. Assemble a Fibonacci Heap and utilize it for efficient priority queue operations.
7. Develop Prim's algorithm to determine the Minimum Spanning Tree of a graph.
8. Implementation of minimum cost spanning tree using Kruskal's algorithm.
9. Design Dijkstra's algorithm and Bellman-Ford algorithm to compute the shortest paths from a single source in a graph.
10. Write a program to compute the shortest path from a single source to all other vertices in a given graph.
11. Develop an algorithm to solve the Matrix Chain Multiplication problem, optimizing the sequence of matrix multiplications.
12. Design the Activity Selection problem using a greedy strategy and Huffman Coding Implementation.

L:0, T:0, P:60, SL:0, TOTAL: 60 PERIODS

Chairman (BoS)

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

COs	Course Outcome	Experiments	Cognitive Level
CO1	Develop recursive solutions for tree traversals and implement efficient sorting algorithms like Merge Sort and Quick Sort.	1,2	Apply
CO2	Construct and manipulate BSTs, Red-Black Trees, and Heaps for efficient data storage and retrieval.	3,4,5	Apply
CO3	Implement Fibonacci Heaps and apply Prim's and Kruskal's algorithms for minimum spanning tree construction.	6,7,8	Apply
CO4	Design and apply Dijkstra's and Bellman-Ford algorithms for single-source shortest path problems.	9,10	Apply
CO5	Apply dynamic programming and greedy algorithms to solve optimization problems.	11,12	Apply

LIST OF EQUIPMENTS

Sl.No	Name of the Equipment's	Qty.
1.	A computer with a modern processor, RAM and Windows or Linux.	10 Nos.
2.	Turbo C software or any standard C/C++ compiler (e.g., GCC, Code Blocks)	10 Nos.
3.	Text editor/IDE such as Notepad or Turbo C IDE	10 Nos.

REFERENCES:

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction to Algorithms", MIT Press, London, 4th Edition, 2022.
2. Reema Thareja, "Data Structures Using C", Oxford University Press, England, 3rd Edition, 2023.

Mapping of COs with POs and PSOs

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

1-low, 2-medium, 3-high

Chairman (BoS)

CS24P11	DATABASE PRACTICES LABORATORY	Category	L	T	P	SL	C
		PCC	0	0	60	0	2

PREREQUISITE

Students should have basic knowledge of SQL and relational databases, including table creation and data manipulation. Familiarity with programming languages for database access and understanding XML and NoSQL databases.

OBJECTIVES:

To enable students to design, implement, and manipulate relational and non-relational databases using SQL, XML, and NoSQL technologies, and to develop real-time database applications by applying data definition, manipulation and querying techniques through programming interfaces.

List of Experiments:

1. Develop and execute SQL Data Definition Commands to perform the following for real-time applications:
    i. Create, Alter, Rename, Truncate and Drop Table
    ii. Enforce Primary Key, Foreign Key, Check, Unique and Not Null Constraint
2. Formulate and execute SQL Data Manipulation Language statements to perform Select, Insert, Update, and Delete operations in the real-time database.
3. Construct and execute database queries involving Set operations, Aggregate functions, String operations, and Joins in the real-time database.
4. Design and implement SQL Views for real-time applications.
5. Create and apply Triggers for real-time databases.
6. Develop and implement solutions to access a Relational Database using Java, Python, PHP, or R for a real-time application.
7. Generate XML Documents, Document Type Definitions, and XML Schemas for real-time applications.
8. Execute operations to store XML documents as text in a Relational Database for real-time applications.
9. Extract XML Documents from Relational Databases for real-time applications.
10. Compose and run queries to access databases created using MongoDB, DynamoDB, Voldemort Key-Value Distributed Data Store, HBase, and Neo4j.

L:0, T:0, P:60, SL:0, TOTAL: 60 PERIODS

Chairman (BoS)

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

COs	Course Outcome	Experiments	Cognitive Level
CO1	Develop and execute DDL and DML commands to create and manage relational database tables for real-time applications.	1,2	Apply
CO2	Construct and run SQL queries using set operations, aggregates, string functions, and joins for data analysis.	3,4	Apply
CO3	Implement SQL views and triggers to enhance data access control and automate operations in real-time database systems.	5,6	Apply
CO4	Generate and manage XML documents, DTDs and XML schemas for organizing and validating semi-structured data.	7,8	Apply
CO5	Extract XML data from relational databases and perform NoSQL operations using tools like MongoDB and HBase.	9,10	Apply

LIST OF EQUIPMENTS

Sl.No	Name of the Equipment's	Qty.
1.	Computer system with modern processor, RAM and Windows or Linux	10 Nos.
2.	RDBMS (MySQL/PostgreSQL) and NoSQL tools (MongoDB, HBase, Neo4j)	10 Nos.
3.	IDE or text editor (VS Code, MySQL Workbench) with Java/Python support	10 Nos.

REFERENCES:

1. Abraham Silberschatz, Henry F. Korth and S. Sudharshan, "Database System Concepts", Tata McGraw Hill, New Delhi, 7th Edition, 2019.
2. Ramez Elmasri and Shamkant B. Navathe, "Fundamentals of Database Systems", Pearson Education, New Delhi, 7th Edition, 2016.

Mapping of COs with POs and PSOs

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

1-low, 2-medium, 3-high

Chairman (BoS)

RM24T09	RESEARCH METHODOLOGY AND IPR	Category	L	T	P	SL	C
		RMC	45	0	0	45	3

(Common to ALL)

PREREQUISITE:

Basic understanding of research methodology and general awareness of legal and innovation-related frameworks.

OBJECTIVE:

- To equip learners with the knowledge and skills to design and conduct research, analyze data effectively, and understand the fundamentals of intellectual property rights and patent processes.

UNIT - I	RESEARCH DESIGN	(9)

Overview of research process and design – Use of secondary and exploratory data to answer the research question, Qualitative research, Observation studies – Experiments and surveys.

UNIT - II	DATA COLLECTION AND SOURCES	(9)

Measurements: Measurement scales – Questionnaires and instruments – Sampling and Methods. Data – Preparing, Exploring, Examining and Displaying.

UNIT - III	DATA ANALYSIS AND REPORTING	(9)

Overview of multivariate analysis – Hypotheses testing and measures of association – Presenting insights and findings using written reports and oral presentation.

UNIT - IV	INTELLECTUAL PROPERTY RIGHTS	(9)

Intellectual Property – The concept of IPR, Evolution and development of the concept of IPR, IPR development process, Trade secrets, Utility models, IPR & Biodiversity, Role of WIPO and WTO in IPR establishments, Right of property, Common rules of IPR practices, Types and features of IPR agreement, Trademark, Functions of UNESCO in IPR maintenance.

UNIT - V	PATENTS	(9)

Patents – objectives and benefits of patent – Concept, features of patent, Inventive step, Specification – Types of patent application, process E-filling – Examination of patent – Grant of patent, Revocation, Equitable Assignments. Licenses – Licensing of related patents – Patent agents – Registration of patent agents.

LECTURE: 45, SELF LEARNING: 45, TOTAL: 90 PERIODS

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COURSE OUTCOMES:		
At the end of the course, the students will be able to:		
COs	Course Outcome	Cognitive Level
CO1	Develop a suitable research process to solve real-time problems.	Apply
CO2	Apply appropriate methods to collect qualitative and quantitative data for analysis.	Apply
CO3	Apply appropriate statistical tools to analyze data and solve research problems.	Apply
CO4	Describe the types and features of intellectual property and its role in IPR establishment.	Understand
CO5	Illustrate the patent procedures, E-filling, register of patents, and licensing of patents.	Understand

TEXT BOOKS:	
1	Cooper Donald, R., Schindler Pamela, S., and Sharma, J.K., "Business Research Methods", Tata McGraw Hill Education, Eleventh Edition, 2012.
2	Catherine J. Holland, Intellectual Property: Patents, Trademarks, Copyrights, Trade Secrets, Entrepreneur Press, 2007.
REFERENCES:	
1	David Hunt, Long Nguyen, Matthew Rodgers, Patent Searching: Tools & Techniques, Wiley, 2007.
2	The Institute of Company Secretaries of India, Statutory body under an Act of Parliament, Professional Programme Intellectual Property Rights, Law and Practice, September 2013.

Mapping of COs with POs and PSOs					
COs/ POs	PO 1	PO 2	PO 3	PO 4	PO 5
CO1	3	3	-	-	3
CO2	3	3	-	-	3
CO3	3	3	-	-	3
CO4	3	3	-	-	3
CO5	3	3	-	-	3
1 - Low, 2 - Medium, 3 - High					

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BD24T26	BIG DATA MINING AND ANALYTICS	Category	L	T	P	SL	C
		PCC	45	0	0	45	3

(Common to M.E CSE and M.E BDA)

PREREQUISITE

Basic knowledge of data processing, statistical modeling and machine learning is required. Familiarity with clustering algorithms and Hadoop is also helpful. Understanding data stream processing and analytics tools will aid in comprehension.

OBJECTIVES

To provide students with comprehensive knowledge of big data analytics by exploring statistical modeling, machine learning, data stream processing, clustering techniques and Hadoop ecosystem tools for managing and integrating structured and unstructured data at scale.

UNIT – I	LARGE SCALE FILES AND MAPREDUCE	(9)

Statistical Modeling – Machine Learning – Computational Approaches to Modeling – Summarization – Feature Extraction – Statistical Limits on Data Mining – Distributed File Systems – MapReduce – Algorithms Using MapReduce – Extensions to MapReduce.

UNIT – II	MINING DATA STREAMS	(9)

Stream Data Model – Sampling Data in a Stream – Filtering Streams – Counting Distinct Elements in a Stream – Estimating Moments – Counting Ones in a Window – Decaying Windows.

UNIT – III	CLUSTER ANALYSIS AND METHODS	(9)

Cluster Analysis – Partitioning Methods – Hierarchical Methods – Density-Based Methods – Grid-Based Methods – Evaluation of Clustering.

UNIT – IV	HADOOP AND ITS ECOSYSTEM	(9)

Explaining Hadoop – Hadoop Distributed File System – Hadoop MapReduce – Building Hadoop Ecosystem – Managing Resources and Applications with Hadoop YARN – Storing Big Data with HBase – Mining Big Data with Hive.

UNIT – V	ANALYTICS AND BIG DATA	(9)

Defining Big Data Analytics – Exploring Unstructured data – Understanding Text Analytics – Analysis and Extraction Techniques – Putting results together with structured data – Putting Big data to use – Text Analytics tools for Big Data.

L:45, T:0, P:0, SL:45, TOTAL: 90 PERIODS

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

COs	Course Outcome	Cognitive Level

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CO1	Outline statistical modeling, machine learning and MapReduce for large-scale data processing.	**Understand**
CO2	Summarize key concepts of stream data processing, such as distinct counting, moment estimation, and decaying window techniques.	**Understand**
CO3	Compare various clustering methods and develop effective models using partitioning, hierarchical, and density-based techniques.	**Apply**
CO4	Utilize Hadoop's file system and tools, and manage big data with Hadoop YARN.	**Apply**
CO5	Analyze and integrate unstructured and structured data, and apply text analytics tools for insights.	**Analyze**

REFERENCES:

1. Jure Leskovec, Anand Rajaraman, Jeffrey David Ullman, "Mining of Massive Datasets", Cambridge University Press, UK, 3rd Edition, 2020.
2. Jiawei Han, Micheline Kamber, Jian Pei, "Data Mining Concepts and Techniques", Morgan Kaufman Publications, USA, 3rd Edition, 2012.
3. Judith Hurwitz, Alan Nugent, Dr. Fern Halper, and Marcia Kaufman, "Big Data for Dummies", John Wiley and Sons, Inc. New Jersey, 2013.
4. Ian H.Witten, Eibe Frank, "Data Mining – Practical Machine Learning Tools and Techniques", Morgan Kaufman Publications, San Francisco, 3rd Edition, 2011.
5. Seema Acharya, Subhashini Chellappan, "Big Data and analytics", Wiley Publications, India, 1st edition, 2015.

Mapping of COs with POs and PSOs

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

1-low, 2-medium, 3-high

Chairman (BoS)

CS24T27	CLOUD COMPUTING	Category	L	T	P	SL	C
		PCC	45	0	0	45	3

(Common to M.E CSE and M.E BDA)

PREREQUISITE

A basic understanding of cloud computing concepts and deployment models is needed. Familiarity with security principles and privacy concerns in IT is also required. Knowledge of major cloud platforms and their applications will be beneficial.

OBJECTIVES:

To provide students with a thorough understanding of cloud computing concepts, deployment models, architectural designs, security and privacy issues, regulatory considerations, and the use of major industrial cloud platforms for real-world applications.

UNIT – I	CLOUD PLATFORM ARCHITECTURE	(9)

Cloud Computing: Definition, Characteristics – Cloud deployment models: public, private, hybrid, community – Categories of cloud computing – Everything as a service: Infrastructure, platform, software – A Generic Cloud Architecture Design – Layered cloud Architectural Development – Architectural Design Challenges.

UNIT – II	CLOUD DEPLOYMENT MODELS AND SECURITY ISSUES	(9)

Key Drivers to Adopting the Cloud – The Impact of Cloud Computing on Users – Governance in the Cloud – Barriers to Cloud Computing Adoption in the Enterprise. Infrastructure Security: Network Level – Host Level – Application Level – Data Security and Storage – Aspects of Data Security – Data Security Mitigation Provider Data and Security.

UNIT – III	PRIVACY ISSUES	(9)

Privacy Issues – Data Life Cycle – Key Privacy Concerns in the Cloud – Protecting Privacy – Changes to Privacy Risk Management and Compliance in Relation to Cloud Computing – Legal and Regulatory Implications – U.S. Laws and Regulations – International Laws and Regulations.

UNIT – IV	INDUSTRIAL PLATFORMS AND APPLICATIONS	(9)

Amazon web services – Google App Engine – Microsoft Azure – Scientific applications – Business and consumer applications.

UNIT – V	CLOUD SECURITY	(9)

Cloud Infrastructure security: network, host and application level – Aspects of data security, provider data and its security, Identity and access management architecture, IAM practices in the cloud, SaaS, PaaS, IaaS availability in the cloud – Key privacy issues in the cloud – Cloud Security and Trust Management

L:45, T:0, P:0, SL:45, TOTAL: 90 PERIODS

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

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COs	Course Outcome	Cognitive Level
CO1	Identify core concepts, service models, and architectural challenges in cloud computing.	Understand
CO2	Summarize deployment models and address infrastructure and data security issues.	Understand
CO3	Infer the privacy, compliance, and legal concerns in global cloud environments.	Understand
CO4	Utilize cloud platforms like AWS, Azure, and Google Cloud for practical applications.	Apply
CO5	Implement basic cloud security practices across SaaS, PaaS, and IaaS layers	Apply

REFERENCES:

1. Rajkumar Buyya, Christian Vacchiola, S.Thamarai Selvi, "Mastering Cloud Computing", MCGraw Hill Education, India, 1st Edition, 2013.
2. John W.Ritting house and James F.Ransome, "Cloud Computing: Implementation, Management, and Security", CRC Press, Florida, 2010.
3. Tim Mather, "Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance (Theory in Practice)", O'Reilly Media, California, 2nd Edition, 2009.
4. John Rhoton, "Cloud Computing Explained: Implementation Handbook for Enterprises", Saint Louis, New York, 1st, 2009.
5. Tom White, "Hadoop: The Definitive Guide", Yahoo Press, New York, 3rd Edition, 2012.

Mapping of COs with POs and PSOs

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

1-low, 2-medium, 3-high

Chairman (BoS)

BD24E08	INTERNET OF THINGS	Category	L	T	P	SL	C
		PCC	45	0	0	45	3

(Common to M.E CSE and M.E BDA)

PREREQUISITE

Basic knowledge of computer networking, familiarity with Python programming, and experience with microcontroller platforms like Arduino or Raspberry Pi. Understanding of web technologies and cloud computing fundamentals.

OBJECTIVES:

To provide students with a foundational understanding of the Internet of Things (IoT), including its core technologies, system development using hardware and software tools, communication protocols, cloud integration and industrial applications.

UNIT – I	INTRODUCTION TO INTERNET OF THINGS	(9)

Basic computer networking to Internet of things: Network Types – Layered network models – Addressing – TCP/IP transport Layer. Definition and Characteristics of IoT – Physical Design of IoT – Logical Design of IoT – IoT Enabling Technologies – IoT Levels and Deployment Templates – IoT and M2M.

UNIT – II	BUILDING IOT SYSTEMS	(9)

IoT Physical devices and Endpoints: Basic building blocks of IoT Device – Raspberry Pi – Linux on Raspberry Pi – Interfaces – Programming Raspberry Pi with Python – Python packages for IOT: JSON – XML – HTTPLib – URLLib – SMTPLib – XMPP – Contiki OS – Other IoT Platform: Arduino – Intel Galileo and Beaglebone boards.

UNIT – III	IOT PROTOCOLS	(9)

Introduction to IoT Protocols – 6LoWPAN – IEEE 802.11 – WiFi – 802.15 Bluetooth – 802.15.4 – Zigbee – CoAP.

UNIT – IV	CLOUD OFFERINGS AND IOT CASE STUDIES	(9)

Cloud Storage Models and Communication APIs for IoT– WAMP – Xively Cloud – Python Web Application framework – Designing a RESTful Web API – Amazon Web Services for IoT – MQTT – Case studies for IoT Design: Home automation – Smart Agriculture.

UNIT – V	INDUSTRIAL INTERNET OF THINGS (IIOT)	(9)

Introduction – Industrial Process – The Computer Integrated Manufacturing Pyramid (CIM) – IIoT data flow – Understanding the IIoT edge: Features of the edge – Architecture and implementations. Implementing IOT industrial solution with cloud services.

L:45, T:0, P:0, SL:45, TOTAL: 90 PERIODS

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

COs	Course Outcome	Cognitive Level
CO1	Describe the fundamental concepts, architecture, and technologies underlying the Internet of Things.	Understand
CO2	Build simple IoT systems using Raspberry Pi, sensors, actuators, and Python programming.	Apply
CO3	Outline the IoT communication protocols like 6LoWPAN, Zigbee, Bluetooth, and CoAP.	Understand
CO4	Develop cloud platforms and APIs to develop integrated IoT applications with real-time capabilities.	Apply
CO5	Apply IIoT concepts to industrial use cases involving edge computing and cloud-based solutions.	Apply

REFERENCES:

1. Arshdeep Bahga, Vijay Madisetti, "Internet of Things: A hands-on Approach", University Press, UK, 1st Edition, 2015.
2. Giacomo Veneri, Antonio Capasso, "Hands-On Industrial Internet of Things Create a Powerful Industrial IoT Infrastructure Using Industry 4.0", Packt Publishing Ltd, UK, 1st Edition, 2018.
3. Adrian McEwen Hakim Cassimally, "Designing the Internet of Things", Wiley, India, 1st Edition, 2013.
4. Olivier Hersent, David Boswarthick, Omar Elloum, "The Internet of Things – Key applications and Protocols", Wiley, India, 1st Edition, 2012.
5. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stamatis, Karnouskos, Stefan Avesand, David Boyle, "From Machine - to-Machine to the Internet of Things - Introduction to a New Age of Intelligence", Academic Press, Elsevier Science, 1st Edition, 2014.

Mapping of COs with POs and PSOs

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

1-low, 2-medium, 3-high

Chairman (BoS)

BD24P26	BIG DATA MINING AND ANALYTICS LABORATORY	Category	L	T	P	SL	C
		PCC	0	0	60	0	2

(Common to M.E CSE and M.E BDA)

PREREQUISITE

Students should have a basic understanding of big data concepts, programming skills (Java or Python), familiarity with data analysis tools (R) and knowledge of NoSQL databases (HBase, MongoDB). Additionally, they should be acquainted with distributed computing frameworks, particularly Apache Spark.

OBJECTIVES:

To equip students with hands-on skills in setting up big data platforms like Hadoop and Spark, developing MapReduce applications, applying machine learning and clustering techniques using R, visualizing data, and integrating NoSQL databases such as HBase or MongoDB for scalable big data processing.

List of Experiments:

1. Install, configure and run Hadoop and HDFS.
2. Develop and execute MapReduce programs to count word frequencies.
3. Create a MapReduce program to process weather data.
4. Implement SVM and clustering techniques using R.
5. Visualize data using any plotting framework.
6. Build an application that stores big data in HBase or MongoDB using Hadoop or R.
7. Set up and configure an Apache Spark cluster, and run an application using Apache Spark

L:0, T:0, P:60, SL:0, TOTAL: 60 PERIODS

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

COs	Course Outcome	Experiments	Cognitive Level
CO1	Demonstrate the ability to install, configure, and effectively manage Hadoop and HDFS for big data environments.	1	Apply
CO2	Develop and execute MapReduce programs for efficient data processing.	2,3	Apply

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CO3	Apply SVM and clustering techniques in R and visualize data effectively.	4,5	Apply
CO4	Implement and manage storage solutions for large datasets using HBase or MongoDB, integrating them with Hadoop or R.	6	Apply
CO5	Deploy and use Apache Spark for distributed data processing applications.	7	Apply

LIST OF EQUIPMENTS

Sl.No	Name of the Equipment's	Qty.
1.	High-performance computer systems, RAM, Linux OS or virtual environment, and Java installed.	10 Nos.
2.	Big Data tools and platforms including Hadoop, HDFS, MapReduce, Apache Spark, R with relevant packages and NoSQL databases like MongoDB or HBase.	10 Nos.
3.	Development and visualization tools such as VS Code, RStudio, Python with plotting libraries, and internet access for setup and resources.	10 Nos.

REFERENCES:

1. Jure Leskovec, Anand Rajaraman, Jeffrey David Ullman, "Mining of Massive Datasets", Cambridge University Press, UK, 3rd Edition, 2020.
2. Seema Acharya, Subhashini Chellappan, "Big Data and analytics", Wiley Publications, India, 1st edition, 2015.

Mapping of COs with POs and PSOs

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

1-low, 2-medium, 3-high

Chairman (BoS)

CS24P26	CLOUD COMPUTING LABORATORY	Category	L	T	P	SL	C
		PCC	0	0	60	0	2

(Common to M.E CSE and M.E BDA)

PREREQUISITE

A basic understanding of virtualization, network protocols, and client-server architecture is required. Familiarity with network design tools and cloud computing concepts is also necessary.

OBJECTIVES:

To provide students with practical knowledge in virtualization, network configuration, protocol implementation, and cloud resource management by working with hypervisors, virtual machines, network virtualization tools, and simulation environments.

List of Exercise/Experiments:

1. a) Installation of various hypervisors and instantiation of VMs with image file using open source hypervisors such as Virtual Box, VMWare Player, Xen and KVM.
   b) Client server communication between two virtual machine instances, execution of chat application.
2. Creation of simple network topology using open source network virtualization tools (like mini net and others).
3. Implementation of simple network protocols using open source network controllers (like Open Daylight).
4. Implementation of various scheduling mechanisms using open source cloud simulator.
5. Familiarization and usage of the following cloud services with open source cloud tools (like Eucalyptus, Open stack, Open Nebula and others)
   a. Scheduling mechanisms
   b. Load balancing mechanisms
   c. Hashing and encryption mechanisms
6. Familiarization and usage of collaborative applications (SaaS).
7. Implementing applications using Google App Engine (PaaS).
   a. Develop MapReduce application (example-URL Pattern count and others) using Hadoop cluster set up (Single node and multi node).

L:0, T:0, P:60, SL:0, TOTAL: 60 PERIODS

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

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COs	Course Outcome	Cognitive Level
CO1	Set up virtual machines and enable communication, and create simple network topologies using virtualization tools.	Apply
CO2	Implement network protocols using controllers and analyze scheduling mechanisms with cloud simulation tools.	Apply
CO3	Utilize open-source cloud platforms to explore scheduling, load balancing, and security mechanisms like hashing and encryption.	Apply
CO4	Explore and use collaborative applications offered as Software as a Service (SaaS) in cloud environments.	Apply
CO5	Develop cloud applications using Google App Engine and implement MapReduce programs on single and multi-node Hadoop clusters.	Apply

LIST OF EQUIPMENTS

Sl.No	Name of the Equipment's	Qty.
1.	Computer systems with minimum RAM, running Linux or virtualized environments.	10 Nos.
2.	Tools: VirtualBox, VMware, OpenStack, OpenDaylight, Mininet, CloudSim, Hadoop, Google App Engine.	10 Nos.
3.	Internet access for cloud services, software installation, and collaborative SaaS tools.	10 Nos.

REFERENCES:

1. Rajkumar Buyya, Christian Vacchiola, S.Thamarai Selvi, "Mastering Cloud Computing", MCGraw Hill Education, India, 1st Edition, 2013.
2. John W.Rittinghouse and James F.Ransome, "Cloud Computing: Implementation, Management, and Security", CRC Press, Florida, 2010.

Mapping of COs with POs and PSOs

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

1-low, 2-medium, 3-high

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CS24P21	TECHNICAL PRESENTATION	Category	L	T	P	SL	C
		EEC	0	0	60	0	2

PREREQUISITE

Students should start by conducting thorough research on their chosen topic, reviewing recent journals and conference papers. They must select their topic with guidance from faculty to ensure relevance. Additionally, students need to develop strong presentation skills to clearly and effectively communicate their findings, using appropriate visual aids.

OBJECTIVES:

To enable students to explore and understand recent advancements in their field of study by selecting a current technical topic, engaging in faculty-guided research and effectively presenting their findings with originality and clarity.

Guidelines:

1. Students should refer to recently published journals and conference proceedings to select a relevant and up-to-date topic.
2. A technical topic must be chosen in consultation with the faculty, based on the student's area of interest.
3. Students must present their findings and understanding through a final technical presentation.

L:0, T:0, P:60, SL:0, TOTAL: 60 PERIODS

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

COs	Course Outcome	Cognitive Level
CO1	Outline a deep understanding of the topic and its relevance to current research trends.	Understand
CO2	Communicate technical content effectively with clarity and confidence.	Understand
CO3	Conduct independent research and compile findings into a structured, coherent report.	Understand
CO4	Infer existing research and identify potential areas for future exploration.	Understand
CO5	Incorporate feedback to enhance research quality and presentation skills.	Understand

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Mapping of COs with POs and PSOs					
COs/ POs	PO1	PO2	PO3	PO4	PO5
CO1	3	1	3	3	2
CO2	3	1	3	3	2
CO3	3	1	3	3	2
CO4	3	1	3	3	2
CO5	3	1	3	3	2
1-low, 2-medium, 3-high					

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CS24T31	SECURITY PRACTICES	Category	L	T	P	SL	C
		PCC	45	0	0	45	3

PREREQUISITE

Students should have a basic understanding of programming skills, Basic Mathematical background, Networking Fundamentals, cybersecurity knowledge, networking systems and security protocols.

OBJECTIVES:

This course aims to provide foundational knowledge in system, network and storage security. It covers cryptography, intrusion detection, cyber forensics and privacy protection. Students will learn to manage and secure IT systems across various environments.

UNIT – I	SYSTEM SECURITY	(9)

Building A Secure Organization – Cryptography Primer – Detecting System – Intrusion Preventing System – Intrusion – Fault Tolerance and Resilience in Cloud Computing Environments – Security Web Applications, Services and Servers.

UNIT – II	NETWORK SECURITY	(9)

Internet Security – Botnet Problem – Intranet security – Local Area Network Security – Wireless Network Security – Wireless Sensor Network Security – Cellular Network Security Optical Network Security – Optical wireless Security.

UNIT – III	SECURITY MANAGEMENT	(9)

Information security essentials for IT Managers – Security Management System – Policy Driven System Management – IT Security – Online Identity and User Management System – Intrusion and Detection and Prevention System.

UNIT – IV	CYBER SECURITY AND CRYPTOGRAPHY	(9)

Cyber Forensics – Cyber Forensics and Incidence Response – Security e-Discovery – Network Forensics –Data Encryption – Satellite Encryption – Password based authenticated Key establishment Protocols.

UNIT – V	PRIVACY AND STORAGE SECURITY	(9)

Privacy on the Internet – Privacy Enhancing Technologies – Personal Privacy Policies – Detection of Conflicts in security policies – Privacy and Security in environment monitoring systems. Storage Area Network Security – Storage Area Network Security Devices – Risk Management – Physical Security Essentials.

L:45, T:0, P:0, 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	Describe the concepts of secure system design, cryptography, and intrusion prevention mechanisms in modern computing environments.	Understand

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CO2	Summarize the security challenges in different types of networks, including LAN, wireless and optical networks.	Understand
CO3	Apply security management principles and user identity control mechanisms in IT systems	Apply
CO4	Demonstrate the use of encryption methods and forensic tools in handling cyber incidents and data protection	Apply
CO5	Elucidate the concepts of internet privacy, policy conflicts and storage area network security	Understand

REFERENCES:

1. John R.Vacca, "Computer and Information Security Handbook", 2nd Edition, Elsevier 2017.
2. Michael E. Whitman, Herbert J. Mattord, "Principal of Information Security", 4th Edition, Cengage Learning, 2018.
3. Richard E.Smith, "Elementary Information Security", 2nd Edition, Jones and Bartlett Learning, 2016.

WEB REFERENCES:

1. https://nptel.ac.in/courses/106/106/106106129/
2. https://swayam.gov.in/nd2_cec20_cs09/preview

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5
CO1	3	3	3	2	2
CO2	3	3	3	2	2
CO3	3	3	3	2	2
CO4	3	3	3	2	2
CO5	3	3	3	2	2

1-low, 2-medium, 3-high

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CS24T36	SOFT COMPUTING	Category	L	T	P	SL	C
		PCC	45	0	0	45	3

(Common to M.E CSE and M.E BDA)

PREREQUISITE

Basic knowledge of mathematics, programming and fundamentals of AI or machine learning is required. Understanding of logic and algorithms is also helpful.

OBJECTIVES:

To introduce the fundamentals of soft computing and its key techniques such as fuzzy logic, neural networks, and genetic algorithms. It focuses on the application of these techniques in solving complex, real-world problems. Students will also explore hybrid models like neuro-fuzzy systems and their practical use cases.

UNIT – I	INTRODUCTION TO SOFT COMPUTING	(9)

Introduction to soft computing – Evolution of Computing – Soft computing vs. Hard computing – Types of soft computing techniques – From Conventional AI to Computational Intelligence: Machine Learning Basics.

UNIT – II	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 – 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	GENETIC ALGORITHMS	(9)

Genetic Algorithms: Basic Concepts – Basic Operators for Genetic Algorithms – Crossover and Mutation Properties – Genetic Algorithm Cycle – Fitness Function – Applications of Genetic Algorithm.

UNIT – V	NEURO-FUZZY MODELING	

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

L:45, T:0, P:0, 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	Identify the key characteristics of soft computing techniques and differentiate them from hard computing approaches	Understand
CO2	Apply fuzzy logic and reasoning to handle uncertainty and solve various engineering problems.	Apply

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CO3	Discuss the structure and functioning of various neural networks and their role in machine learning	Understand
CO4	Use genetic algorithm operators and fitness functions to perform optimization tasks.	Apply
CO5	Describe the components and working of neuro-fuzzy systems used in classification and control applications.	Understand

REFERENCES:

6. S. N. Sivanandam & S. N. Deepa, "Principles of Soft Computing", 3rd edition, Wiley India,2018
7. N.P. Padhy, S.P. Simon, Soft Computing with MATLAB Programming, 1st Edition, Oxford Higher Education, 2015.
8. Samir Roy, Udit Chakraborty, Introduction to Soft Computing - Neuro – Fuzzy and Genetic Algorithms, 1st Edition, Pearson, 2013.
9. D. K. Pratihar, Soft Computing: Fundamentals and Applications, Alpha Science International Ltd, 1st Edition, 2013.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5
CO1	3	2	2	2	2
CO2	3	2	2	2	2
CO3	3	2	2	2	2
CO4	3	2	2	2	2
CO5	3	2	2	2	2

1-low, 2-medium, 3-high

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CS24T37	ARTIFICIAL INTELLIGENCE TECHNIQUES	Category	L	T	P	SL	C
		PCC	45	0	0	45	3

(Common to M.E CSE and M.E BDA)

PREREQUISITE

The AI course requires basic knowledge of data structures, algorithms, and probability. Understanding logic and reasoning is essential. Programming skills, preferably in Python, are also needed.

OBJECTIVES:

To equip students with the foundational concepts, problem-solving techniques, reasoning methods, and ethical considerations essential for designing intelligent systems.

UNIT – I	INTRODUCTION AND PROBLEM SOLVING	(9)

Artificial Intelligence – Introduction – Problem-solving – Solving Problems by Searching – Uninformed Search Strategies – Informed (Heuristic) Search Strategies – Local Search – Search in Partially Observable Environments

UNIT – II	ADVERSARIAL SEARCH AND CONSTRAINT SATISFACTION PROBLEMS	(9)

Game Theory – Optimal Decisions in Games – Heuristic Alpha – Beta Tree Search – Monte Carlo Tree Search – Stochastic Games – Partially Observable Games – Limitations of Game Search Algorithms Constraint Satisfaction Problems (CSP) – Examples – Constraint Propagation – Backtracking Search for CSPs – Local Search for CSPs

UNIT – III	KNOWLEDGE, REASONING AND PLANNING	(9)

First Order Logic – Inference in First Order Logic – Using Predicate Logic – Knowledge Representation – Issues – Ontological Engineering – Categories and Objects – Reasoning Systems for Categories – Planning – Definition – Algorithms – Heuristics for Planning – Hierarchical Planning

UNIT – IV	UNCERTAIN KNOWLEDGE AND REASONING	(9)

Quantifying Uncertainty – Probabilistic Reasoning – Probabilistic Reasoning over Time Probabilistic Programming – Making Simple Decisions – Making Complex Decisions – Case Based Reasoning – Explanation-Based Learning – Evolutionary Computation

UNIT – V	PHILOSOPHY, ETHICS AND SAFETY OF AI	

The Limits of AI – Knowledge in Learning – Statistical Learning Methods – Reinforcement Learning – Introduction to Machine Learning and Deep Learning – Can Machines Really Think? – Distributed AI Artificial Life –The Ethics of AI – Interpretable AI- Future of AI – AI Components – AI Architectures.

L:45, T:0, P:0, SL:45, TOTAL: 90 PERIODS

COURSE OUTCOMES:

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

COs	Course Outcome	Cognitive Level

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CO1	Identify the core principles of AI and use search methods to solve problems.	Understand
CO2	Apply adversarial search and constraint satisfaction methods to solve AI problems.	Apply
CO3	Use logic-based techniques for knowledge representation, reasoning, and planning.	Apply
CO4	Implement probabilistic methods to support decisions in uncertain environments.	Apply
CO5	Discuss AI ethics, safety, and emerging trends like machine learning and interpretable AI.	Understand

REFERENCES:

1. Stuart Russell, Peter Norvig, "Artificial Intelligence: A Modern Approach", Pearson, 4th Edition, 2020.
2. Zhongzhi Shi "Advanced Artificial Intelligence", World Scientific; 2019.
3. Kevin Knight, Elaine Rich, Shivashankar B. Nair, "Artificial Intelligence", McGraw Hill Education; 3rd edition, 2017
4. Richard E. Neapolitan, Xia Jiang, "Artificial Intelligence with an Introduction to Machine Learning", Chapman and Hall/CRC; 2nd edition, 2018 50 51
5. Dheepak Khemani, "A first course in Artificial Intelligence", McGraw Hill Education Pvt Ltd., New Delhi, 2013.
1. 6. Nils J. Nilsson, "Artificial Intelligence: A New Synthesis", Morgan Kaufmann Publishers Inc; Second Edition, 2003.

Mapping of COs with POs and PSOs

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

1-low, 2-medium, 3-high

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CS24P31	PROJECT PHASE – I	Category	L	T	P	SL	C
		PCC	0	0	180	0	6

PREREQUISITE

Students should have a strong foundation in core computer science subjects such as programming, databases, algorithms and system design. Prior exposure to research methodologies, technical writing and project-based learning is essential.

OBJECTIVES:

The project work aims to enhance students' ability to apply theoretical knowledge to real-world problems through research, design, and development. It encourages innovation, critical thinking and technical proficiency in solving domain-specific challenges. The objective also includes strengthening independent learning, teamwork and professional communication skills.

GUIDELINES:

1. Each student can undertake the project individually or group.
2. The project must be related to the student's area of specialization.
3. The project can focus on software, hardware, applications, research, innovation, industry, or societal impact.
4. Students must refer to reputed journals and articles.
5. Each project will be guided by a faculty member from the same specialization.
6. Students should carry out a detailed literature survey.
7. Contact hours will be provided in the timetable for guidance, library work, lab work, and computer-based analysis.
8. The goal is to apply theoretical knowledge to solve new or practical problems.
9. Students must design, implement, and evaluate systems using appropriate methods.
10. Project progress will be monitored through at least three formal review sessions.
11. Students are encouraged to publish a paper related to their project work in reputed journals or conferences.
12. Students must prepare and submit the final project report as per academic rules.

L:0, T:0, P:180, SL:0, TOTAL: 180 PERIODS

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

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COs	Course Outcome	Cognitive Level
CO1	Apply the principles of computer science and engineering to design solutions for real-world problems.	Apply
CO2	Analyze research literature to identify relevant methods, models and tools for solving the defined problem	Analyze
CO3	Design and develop a system or model using appropriate techniques, tools, and technologies.	Apply
CO4	Evaluate the performance and effectiveness of the developed solution through testing and validation.	Evaluate
CO5	Create technical reports and research articles and present findings effectively for academic or industrial dissemination.	Create

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5
CO1	3	3	3	3	3
CO2	3	3	3	2	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3

1-low, 2-medium, 3-high

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CS24P41	PROJECT PHASE – II	Category	L	T	P	SL	C
		PCC	0	0	360	0	12

PREREQUISITE

Students should have a strong foundation in core computer science subjects such as programming, databases, algorithms and system design. Prior exposure to research methodologies, technical writing and project-based learning is essential.

OBJECTIVES:

The project work aims to enhance students' ability to apply theoretical knowledge to real-world problems through research, design, and development. It encourages innovation, critical thinking and technical proficiency in solving domain-specific challenges. The objective also includes strengthening independent learning, teamwork and professional communication skills.

GUIDELINES:

1. Each student can undertake the project individually or group.
2. The project must be related to the student's area of specialization.
3. The project can focus on software, hardware, applications, research, innovation, industry, or societal impact.
4. Students must refer to reputed journals and articles.
5. Each project will be guided by a faculty member from the same specialization.
6. Students should carry out a detailed literature survey.
7. Contact hours will be provided in the timetable for guidance, library work, lab work, and computer-based analysis.
8. The goal is to apply theoretical knowledge to solve new or practical problems.
9. Students must design, implement, and evaluate systems using appropriate methods.
10. Project progress will be monitored through at least three formal review sessions.
11. Students are encouraged to publish a paper related to their project work in reputed journals or conferences.
12. Students must prepare and submit the final project report as per academic rules.

L:0, T:0, P:360, SL:0, TOTAL: 360 PERIODS

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

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COs	Course Outcome	Cognitive Level
CO1	Apply the principles of computer science and engineering to design solutions for real-world problems.	Apply
CO2	Analyze research literature to identify relevant methods, models and tools for solving the defined problem	Analyze
CO3	Design and develop a system or model using appropriate techniques, tools, and technologies.	Apply
CO4	Evaluate the performance and effectiveness of the developed solution through testing and validation.	Evaluate
CO5	Create technical reports and research articles and present findings effectively for academic or industrial dissemination.	Create

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3

1-low, 2-medium, 3-high

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CS24E01	DATA MINING TECHNIQUES (PROFESSIONAL ELECTIVES – I and II)	Category	L	T	P	SL	C
		PEC	45	0	0	45	3

PREREQUISITE

Basic knowledge of statistics, programming, and databases is needed. Data warehousing requires understanding of databases and data modeling. Classification methods need basics of statistics, databases, and machine learning. Clustering and association rule mining require statistics, machine learning and programming skills.

OBJECTIVES:

To provide comprehensive knowledge of data mining and warehousing by exploring data preprocessing, classification, clustering, association rule mining, and visualization techniques for effective data analysis and decision-making.

UNIT – I	DATA MINING AND DATA PREPROCESSING	(9)

Introduction to Data Mining – Kinds of Data – Kinds of Patterns – Technologies – Kinds of Applications – Major Issues in Data Mining – Data Preprocessing: An Overview – Data Cleaning – Data Integration – Data Reduction – Data Transformation and Data Discretization.

UNIT – II	BASICS OF DATA WAREHOUSE	(9)

Basic Concepts – Data Warehouse Modeling – Data Warehouse Design and Usage – Data Warehouse Implementation – Data Generalization by Attribute Oriented Induction.

UNIT – III	CLASSIFICATIONS	(9)

Classifications – Basic Concepts – Decision Tree induction – Bayes Classification Methods – Rule Based Classification – Model Evaluation and Selection – Techniques to Improve Classification Accuracy – Classification: Advanced concepts – Bayesian Belief Networks – Classification by Back Propagation – Support Vector Machine – Classification using frequent patterns.

UNIT – IV	CLUSTER ANALYSIS	(9)

Cluster Analysis: Basic concepts and Methods – Cluster Analysis – Partitioning methods – Hierarchical methods – Density Based Methods – Grid Based Methods – Evaluation of Clustering – Advanced Cluster Analysis: Probabilistic model-based clustering – Clustering High – Dimensional Data – Clustering Graph and Network Data – Clustering with Constraints.

UNIT – V	ASSOCIATION RULE MINING AND VISUALIZATION	(9)

Basic Concepts – Frequent Itemset Mining Methods – Pattern Evaluation Methods – Pattern Mining – Pattern Mining in Multilevel, Multidimensional Space – Constraint-Based Frequent Pattern Mining – C Mining High-Dimensional Data and Colossal Patterns – Mining Compressed or Approximate Patterns – Pattern Exploration and Application – Data Visualization – Case Study: WEKA.

L:45, T:0, P:0, SL:45, TOTAL: 90 PERIODS

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

COs	Course Outcome	Cognitive Level
CO1	Interpret fundamental concepts of data mining and apply basic data preprocessing techniques like cleaning, integration, and transformation.	Understand
CO2	Describe the architecture, modeling, and implementation of data warehouses and generalization techniques.	Understand
CO3	Identify various classification techniques such as decision trees, Bayesian methods, and support vector machines to build predictive models.	Understand
CO4	Discover different clustering methods including partitioning, hierarchical, density-based, and advanced clustering techniques for data grouping.	Apply
CO5	Discover association rule mining techniques and utilize data visualization tools to discover and interpret patterns in large datasets.	Understand

REFERENCES:

1. Jaiwei Han, Micheline Kamber and Jian Pei, "Data Mining Concepts and Techniques", Morgan Kauffman, 3 rd Edition, 2012.
2. K.P. Soman, Shyam Diwakar and V. Ajay, "Insight into Data mining Theory and Practice", PHI/Eastern Economy, 5th Edition, 2014.
3. Alex Berson and Stephen J.Smith, "Data Warehousing, Data Mining & OLAP", Tata McGraw – Hill, 5th Edition, 2016.
4. G. K. Gupta, "Introduction to Data Mining with Case Studies", Prentice Hall of India, 3 rd Edition, 2014.
5. Ian H.Witten and Eibe Frank, Mark A. Hall, "Data Mining: Practical Machine Learning Tools and Techniques", Elsevier, 3 rd Edition, 2011.

Mapping of COs with POs and PSOs

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

1-low, 2-medium, 3-high

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CS24E02	ADVANCED OPERATING SYSTEM (PROFESSIONAL ELECTIVES – I and II)	Category	L	T	P	SL	C
		PEC	45	0	0	45	3

PREREQUISITE

Students should have a solid understanding of basic operating system concepts, proficiency in programming languages like C or C++, and familiarity with computer architecture. Experience with data structures, algorithms and system-level programming is also essential.

OBJECTIVES:

To provide students with a deep understanding of advanced operating system concepts, including multiprocessor and distributed OS design, resource management strategies, database and transaction handling, as well as real-time and mobile OS architectures.

UNIT – I	MULTIPROCESSOR SYSTEM ARCHITECTURES	(9)

Multiprocessor Operating Systems: Motivation for multiprocessor Systems – Multiprocessor System Architectures – Operating system Design Issues – Threads – Process Synchronization – Processor Scheduling and Allocation – memory management.

UNIT – II	DISTRIBUTED OPERATING SYSTEMS	(9)

Architectures of Distributed Systems: System Architecture – Issues in Distributed Operating Systems – Communication Primitives. Theoretical Foundations: Inherent Limitations of a Distributed System – Lamport's Logical Clocks – Vector Clocks – Causal Ordering of Messages – Distributed Deadlock Detection: Centralized, Distributed and Hierarchical Deadlock Detection Algorithms.

UNIT – III	DISTRIBUTED RESOURCE MANAGEMENT	(9)

Distributed File Systems: Architecture – Mechanisms for Building Distributed File Systems – Design Issues. Distributed Shared Memory: Architecture and Motivation – Algorithms for Implementing DSM – Memory Coherence – Coherence Protocols. Distributed Scheduling: Issues in Load Distributing – Components of a Load Distributed Algorithm – Stability – Load Distributing Algorithms – Requirements for Load Distributing – Task Migration – Issues in task Migration.

UNIT – IV	DATABASE OPERATING SYSTEMS	(9)

Database Operating Systems: Requirements of Database OS – Transaction process model – Synchronization primitives – Concurrency control algorithms.

UNIT – V	MOBILE AND REAL TIME OPERATING SYSTEMS	(9)

Basic Model of Real Time Systems – Characteristics – Applications of Real Time Systems – Real Time Task Scheduling – Handling Resource Sharing – Mobile Operating Systems – Architecture – Layers – Microkernel Design – Kernel Extensions – Processes and Threads – Memory Management – File system – Android – iOS.

L:45, T:0, P:0, SL:45, TOTAL: 90 PERIODS

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

COs	Course Outcome	Cognitive Level
CO1	Describe the design principles, synchronization, and scheduling techniques in multiprocessor operating systems.	Understand
CO2	Examine the architectural models, communication mechanisms, and deadlock detection strategies in distributed operating systems.	Understand
CO3	Summarize resource management techniques in distributed systems including file systems, shared memory and load distribution algorithms.	Understand
CO4	Outline database OS models and implement transaction processing and concurrency control.	Understand
CO5	Apply the concepts of real-time systems and mobile operating system architectures to analyze and compare platforms like Android and iOS.	Apply

REFERENCES:

1. Mukesh Singhal, Niranjan Shivaratri, "Advanced Concepts in Operating Systems – Distributed, Database and Multiprocessor Operating Systems", Tata McGraw-Hill, 1st Edition, 2011.
2. Andrew S. Tanenbaum and Herbert Bos, "Modern Operating Systems", Prentice Hall, 4th Edition, 2014
3. A S Tanenbaum, "Distributed Operating Systems", Pearson Education, India, 5th Edition, 2008.
4. Rajib Mall, "Real-Time Systems: Theory and Practice", Prentice Hall, 2nd Edition, 2006.
5. Neil Smyth, "iPhone iOS 4 Development Essentials – Xcode", Payload Media, 4th Edition, 2011.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5
CO1	3	2	3	3	2
CO2	3	2	3	3	2
CO3	3	2	3	3	2
CO4	3	2	3	3	2
CO5	3	2	3	3	2

1-low, 2-medium, 3-high

Chairman (BoS)

CS24E03	MOBILE AND PERVASIVE COMPUTING (PROFESSIONAL ELECTIVES – I and II)	Category	L	T	P	SL	C
		PEC	45	0	0	45	3

PREREQUISITE

It requires programming skills, knowledge of networking and operating systems, and familiarity with mobile app development. Understanding distributed systems is also important for grasping pervasive computing concepts.

OBJECTIVES:

To provide students with a comprehensive understanding of wireless and mobile communication technologies, pervasive computing architectures, and context-aware systems, including their evolution, implementation, and emerging trends.

UNIT – I	INTRODUCTION TO WIRELESS ENVIRONMENT	(9)

Introduction to wireless communication – Wireless Transmission – Medium Access Control – Wireless MAC protocols – Comparison of 2G, 3G, 4G looking ahead 5G systems.

UNIT – II	MOBILE COMMUNICATION	(9)

GSM – Bluetooth – Mobile network layer – Mobile transport layer – File system support for mobility support – Mobile execution environments and applications.

UNIT – III	PERVASIVE COMMUNICATION	(9)

Past, Present, Future – Application Examples – Device Technology – WAP and Beyond – Pervasive Web Application Architecture: Example Application.

UNIT – IV	CONTEXT AWARE COMPUTING	(9)

Structure and Elements of Context-aware Pervasive Systems: Abstract architecture – Infrastructures – Middleware and toolkits. Context-aware mobile services: Context for mobile device users – Location-based services – Ambient service – Enhancing Context – Aware mobile services and Context aware artifacts.

UNIT – V	CONTEXT AWARE PERVASIVE SYSTEM	(9)

Context-aware sensor networks – A framework for Context aware sensors – Context-aware security systems – Constructing Context-aware pervasive system – Future of Content aware systems.

L:45, T:0, P:0, SL:45, TOTAL: 90 PERIODS

COURSE OUTCOMES:

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

Chairman (BoS)

COs	Course Outcome	Cognitive Level
CO1	Summarize the core concepts of wireless communication and compare the evolution of wireless technologies from 2G to 5G.	Understand
CO2	Describe mobile communication technologies like GSM and Bluetooth, and evaluate system and network support for mobile computing.	Understand
CO3	Explore the development and components of pervasive communication, and design basic web applications using pervasive architectures.	Understand
CO4	Infer the structure of context-aware systems and implement services such as location-based and ambient-aware mobile applications.	Understand
CO5	Investigate the role of context-aware sensor networks and predict future directions in pervasive and intelligent systems.	Understand

REFERENCES:

1. Schiller Jochen, "Mobile Communication", PHI/Pearson Education, India, 2nd Edition, 2009.
2. Burkhardt Jochen, Henn Horst and Hepper Stefan, Schaec Thomas and Rindtorff Klaus, "Pervasive Computing Technology and Architecture of Mobile Internet Applications", Addison Wesley Reading, India, 2007.
3. Seng Loke, "Context-Aware Pervasive Systems: Architectures for a New Breed of Applications", Auerbach Publications, New York, 1st Edition, 2006.
4. Natalia Silvis, "Pervasive Computing Engineering Smart Systems", Springer, Netherland, 1st Edition, 2017.
5. Frank Adelstein, "Fundamentals of Mobile and Pervasive Computing", TMH, India, 1st Edition, 2005.

Mapping of COs with POs and PSOs

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

1-low, 2-medium, 3-high

Chairman (BoS)

BD24T16	FOUNDATIONS OF DATA SCIENCE (PROFESSIONAL ELECTIVES – I and II)	Category	L	T	P	SL	C
		PEC	45	0	0	45	3

(Common to M.E CSE and M.E BDA)

PREREQUISITE

To succeed in a Foundations of Data Science course, students should have basic programming skills in languages like Python or R, a foundational understanding of statistics and mathematics (including linear algebra and calculus), and familiarity with data manipulation and databases.

OBJECTIVES:

To equip students with foundational knowledge and practical skills in data science by covering data analysis, statistical methods, data wrangling using Python libraries, and effective data visualization techniques for insightful decision-making.

UNIT – I	BASICS OF DATA SCIENCE	(9)

Data Science: Benefits and uses – Facets of data – Data Science Process: Overview – Defining research goals – Retrieving data – Data preparation – Exploratory Data analysis – Build the model – Presenting findings and building applications – Data Mining – Data Warehousing – Basic Statistical descriptions of Data.

UNIT – II	DESCRIBING DATA	(9)

Types of Data – Types of Variables – Describing Data with Tables and Graphs – Describing Data with Averages Variability – Normal Distributions and Standard (z) Scores.

UNIT– III	DESCRIBING RELATIONSHIP	(9)

Correlation – Scatter plots – Correlation coefficient for quantitative data – Computational formula for correlation coefficient – Regression – Regression line – Least squares regression line – Standard error of estimate – Interpretation of r2 – Multiple regression equations – Regression towards the mean.

UNIT – IV	PYTHON LIBRARIES FOR DATA WRANGLING	(9)

Basics of Numpy arrays – Aggregations – Computations on arrays – Comparisons, Masks, Boolean logic – Fancy indexing – Structured arrays – Data manipulation with Pandas – Data indexing and selection – Operating on data – Missing data – Hierarchical indexing – Combining datasets – Aggregation and Grouping – Pivot tables.

UNIT – V	DATA VISUALIZATION	(9)

Importing Matplotlib – Line plots – Scatter plots – Visualizing errors – Density and contour plots – Histograms – Legends – Colors – Subplots – Text and Annotation – Customization – Three-Dimensional plotting – Geographic Data with Basemap – Visualization with Seaborn.

L:45, T:0, P:0, SL:45, TOTAL: 90 PERIODS

COURSE OUTCOMES:

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

Chairman (BoS)

COs	Course Outcome	Cognitive Level
CO1	Enlighten the fundamental concepts, benefits, processes and applications of data science.	Understand
CO2	Summarize and interpret different types of data using statistical measures, tables and graphical methods.	Understand
CO3	Apply correlation and regression techniques to analyze and interpret relationships between variables in data.	Apply
CO4	Use Python libraries such as NumPy and Pandas to manipulate, clean, and organize datasets for analysis.	Apply
CO5	Analyze data using visualizations with Matplotlib and Seaborn to interpret patterns effectively.	Analyze

REFERENCES:

1. David Cielen, Arno D. B. Meysman, and Mohamed Ali, "Introducing Data Science", Manning Publications, New Yark, 1st Edition, 2016.
2. Robert S. Witte and John S. Witte, "Statistics", Wiley Publications, India, 11th Edition, 2021.
3. Jake VanderPlas, "Python Data Science Handbook", O'Reilly, US, 1st Edition, 2016.
4. Allen B. Downey, "Think Stats: Exploratory Data Analysis in Python", Green Tea Press, India, 2nd Edition, 2016.
5. Sinan Ozdemir, "Principles of Data Science", Packt Publication, UK, 3rd Edition, 2024.

Mapping of COs with POs and PSOs

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

1-low, 2-medium, 3-high

Chairman (BoS)

BD24E04	AGILE METHODOLOGIES (PROFESSIONAL ELECTIVES – I and II)	Category	L	T	P	SL	C
		PEC	45	0	0	45	3

(Common to M.E CSE and M.E BDA)

PREREQUISITE

Success in this course requires a basic understanding of software development and software engineering concepts, including requirements and testing. Familiarity with traditional project management is helpful for contrasting with Agile. Experience in team collaboration and an interest in iterative development are also important.

OBJECTIVES:

To provide students with a comprehensive understanding of agile principles, methodologies, and practices, focusing on agile project management, processes, requirements engineering, knowledge management, and quality assurance in software development.

UNIT – I	BASICS OF AGILE METHODOLOGY	(9)

Theories for Agile Management – Agile Software Development – Traditional Model vs. Agile Model – Classification of Agile Methods – Agile Manifesto and Principles – Agile Project Management – Agile Team Interactions – Ethics in Agile Teams – Agility in Design, Testing – Agile Documentations – Agile Drivers, Capabilities and Values.

UNIT – II	AGILE PROCESSES	(9)

Lean Production – SCRUM, Crystal, Feature Driven Development – Adaptive Software Development – Extreme Programming: Method Overview – Lifecycle – Work Products, Roles and Practices.

UNIT– III	AGILITY AND KNOWLEDGE MANAGEMENT	(9)

Agile Information Systems – Agile Decision Making – Earl's Schools of KM – Institutional Knowledge Evolution Cycle – Development, Acquisition, Refinement, Distribution, Deployment, leveraging – KM in Software Engineering – Managing Software Knowledge – Challenges of Migrating to Agile Methodologies – Agile Knowledge Sharing – Role of Story-Cards – Story-Card Maturity Model (SMM).

UNIT – IV	AGILITY AND REQUIREMENTS ENGINEERING	(9)

Impact of Agile Processes in RE – Current Agile Practices – Variance – Overview of RE Using Agile – Managing Unstable Requirements – Requirements Elicitation – Agile Requirements Abstraction Model – Requirements Management in Agile Environment – Agile Requirements Prioritization – Agile Requirements Modeling and Generation – Concurrency in Agile Requirements Generation.

UNIT – V	AGILITY AND QUALITY ASSURANCE	(9)

Agile Product Development – Agile Metrics – Feature Driven Development (FDD) – Financial and Production Metrics in FDD – Agile Approach to Quality Assurance – Test Driven Development – Agile Approach in Global Software Development.

L:45, T:0, P:0, SL:45, TOTAL: 90 PERIODS

Chairman (BoS)

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

COs	Course Outcome	Cognitive Level
CO1	Describe the fundamental concepts of Agile software development, including values, principles and differences from traditional models	Understand
CO2	Summarize Agile methodologies such as Scrum, XP, Crystal, and FDD, focusing on their lifecycles, roles and practices	Understand
CO3	Illustrate the role of knowledge management in agile environments, including knowledge sharing practices and the use of story cards.	Understand
CO4	Handle Agile requirements engineering, including elicitation, modeling, prioritization and managing changing requirements.	Apply
CO5	Apply Agile quality assurance techniques like test-driven development, Agile metrics and practices for distributed development.	Apply

REFERENCES:

1. Dingsoyr, Torgeir, Dyba, Tore, Moe, Nils Brede (Eds.), "Agile Software Development, Current Research and Future Directions", Springer-Verlag Berlin Heidelberg, UK, 1st Edition, 2010.
2. David J. Anderson; Eli Schragenheim, "Agile Management for Software Engineering: Applying the Theory of Constraints for Business Results", Prentice Hall, India, 1st Edition, 2003
3. Hazza & Dubinsky, "Agile Software Engineering, Series: Undergraduate Topics in Computer Science", Springer, UK, 8th Edition, 2009
4. Craig Larman, "Agile and Iterative Development: A managers Guide", Addison-Wesley, New York, 2nd Edition, 2004
5. Kevin C. Desouza, "Agile information systems: conceptualization, construction, and management, Butterworth-Heinemann", Penguin Books Ltd, UK, 1st Edition, 2007.

Mapping of COs with POs and PSOs

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

1-low, 2-medium, 3-high

Chairman (BoS)

CS24E04	OBJECT ORIENTED SOFTWARE ENGINEERING (PROFESSIONAL ELECTIVES – I and II)	Category	L	T	P	SL	C
		PEC	45	0	0	45	3

(Common to M.E CSE and M.E BDA)

PREREQUISITE

Students should have basic programming skills in an object-oriented language like Java or C++ and a solid understanding of software engineering principles. Familiarity with core data structures and algorithms is essential, along with experience using UML for modeling designs.

OBJECTIVES:

To equip students with fundamental software engineering concepts, including Agile methodologies, requirements engineering, software design principles, testing techniques, and project management practices such as DevOps.

UNIT – I	SOFTWARE PROCESS AND AGILE DEVELOPMENT	(9)

Introduction to Software Engineering – Software Process – Perspective and Specialized Process Models – Introduction to Agility – Agile process – Extreme programming – XP Process.

UNIT – II	REQUIREMENTS ANALYSIS AND SPECIFICATION	(9)

Requirement analysis and specification – Requirements gathering and analysis – Software Requirement Specification – Formal system specification – Finite State Machines – Petrinets – Object modelling using UML – Use case Model – Class diagrams – Interaction diagrams – Activity diagrams – State chart diagrams – Functional modelling – Data Flow Diagram – Case Tools.

UNIT – III	SOFTWARE DESIGN	(9)

Software design – Design process – Design concepts – Coupling – Cohesion – Functional independence – Design patterns – Model-view-controller – Publish-subscribe – Adapter – Command – Strategy – Observer – Proxy – Facade – Architectural styles – Layered – Client Server – Tiered Pipe and filter – User interface design.

UNIT – IV	SOFTWARE TESTING AND MAINTENANCE	(9)

Testing – Unit testing – Black box testing – White box testing – Integration and System testing – Regression testing – Debugging – Program analysis – Symbolic execution – Model Checking.

UNIT – V	PROJECT MANAGEMENT	(9)

Software Project Management – Software Configuration Management – Project Scheduling – DevOps: Motivation – Cloud as a platform – Operations – Deployment Pipeline: Overall Architecture Building and Testing – Deployment – Tools – Case Study.

L:45, T:0, P:0, SL:45, TOTAL: 90 PERIODS

Chairman (BoS)

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

COs	Course Outcome	Cognitive Level
CO1	Summarize software engineering principles, software process models, and apply Agile methodologies such as Extreme Programming.	Understand
CO2	Apply requirement analysis techniques and create formal system models using UML, FSMs, Petri Nets, and data flow diagrams.	Apply
CO3	Design software systems using appropriate design patterns and architectural styles.	Apply
CO4	Perform various testing and maintenance activities to ensure software quality.	Understand
CO5	Manage software projects, including scheduling, configuration and applying DevOps practices.	Apply

REFERENCES:

1. Bernd Bruegge and Allen H. Dutoit, "Object-Oriented Software Engineering: Using UML, Patterns and Java", Pearson Education, India, 3rd Edition, 2013.
2. Roger S. Pressman, "Object-Oriented Software Engineering: An Agile Unified Methodology", Mc Graw-Hill, 1st Edition, 2014
3. Carlo Ghezzi, Mehdi Jazayeri, Dino Mandrioli, "Fundamentals of Software Engineering", PHI Learning Pvt. Ltd, 2nd Edition, 2010.
4. Len Bass, Ingo Weber and Liming Zhu, "DevOps: A Software Architect's Perspective", Pearson Education, 2016.
5. Stephen Schach, "Object-Oriented and Classical Software Engineering", McGraw-Hill, 8th Edition, 2010

Mapping of COs with POs and PSOs

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

1-low, 2-medium, 3-high

Chairman (BoS)

CS24E05	WIRELESS SENSOR NETWORKS (PROFESSIONAL ELECTIVES – I and II)	Category	L	T	P	SL	C
		PEC	45	0	0	45	3

PREREQUISITE

Basic understanding of wireless communication principles and networking concepts. Familiarity with programming and design in embedded systems is essential. Prior knowledge of network protocols and security fundamentals is also beneficial.

OBJECTIVES:

To provide comprehensive knowledge of wireless sensor networks, covering design principles, communication protocols, QoS and transport mechanisms, security challenges and practical skills in simulation and development tools.

UNIT – I	WIRELESS SENSOR NETWORK ARCHITECTURE	(9)

Introduction to wireless sensor networks – Challenges – Comparison with ad hoc network – Node architecture and Network architecture – Design principles – Service interfaces – Gateway – Short range radio communication standards – Physical layer and transceiver design considerations.

UNIT – II	MAC AND ROUTING IN WIRELESS SENSOR NETWORKS	(9)

Introduction – Applications – Challenges – Sensor network architecture – MAC Protocols for wireless sensor networks – Low duty cycle protocols and wakeup concepts – Contention-Based protocols – Schedule-Based protocols – IEEE 802.15.4 Zig bee – Topology Control – Routing Protocols.

UNIT – III	TRANSPORT AND QOS IN WIRELESS SENSOR NETWORKS	(9)

Data-Centric and Contention-Based Networking – Transport Layer and QoS in Wireless Sensor Networks – Congestion Control – In-network processing – Operating systems for wireless sensor networks.

UNIT – IV	SECURITY IN AD HOC AND SENSOR NETWORKS	(9)

Security Attacks – Key Distribution and Management – Intrusion Detection – Software based Antitamper techniques – Watermarking techniques – Defense against routing attacks – Secure Ad hoc routing protocols – Broadcast authentication WSN protocols – TESLA – Sensor Network Security Protocols – SPINS.

UNIT – V	TOOLS FOR WSN	(9)

TinyOS – Introduction, NesC, Interfaces, modules, configuration, Programming in TinyOS using NesC, TOSSIM, Contiki – Structure, Communication Stack, Simulation environment – Cooja Simulator, Programming.

L:45, T:0, P:0, SL:45, TOTAL: 90 PERIODS

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

COs	Course Outcome	Cognitive Level

Chairman (BoS)

CO1	Describe the fundamentals of wireless sensor network design and communication standards	Understand
CO2	Analyze MAC and routing protocols, assessing their applications and performance	Analyze
CO3	Apply knowledge of transport protocols and Quality of Service (QoS) mechanisms to manage congestion control and in-network processing	Apply
CO4	Assess security challenges, including attacks and key management, to address vulnerabilities	Understand
CO5	Apply tools and programming environments to develop and simulate sensor networks effectively	Apply

REFERENCES:

1. Anna Hac, "Wireless Sensor Network Design", John Wiley & Sons, 2003.
2. Holger Karl, Andreas Willig, "Protocols and Architectures for Wireless Sensor Networks", John Wiley & Sons, Inc., 2007.
3. Erdal Çayırcı, Chunming Rong, "Security in Wireless Ad Hoc and Sensor Networks", John Wiley and Sons, 2009.
4. C.Siva Ram Murthy and B.S.Manoj, "Ad Hoc Wireless Networks – Architectures and Protocols", Pearson Education, 1 st 2006.
5. Carlos De Morais Cordeiro, Dharma Prakash Agrawal, "Ad Hoc and Sensor Networks: Theory and Application", World Scientific Publishing, 2nd Edition, 2011.

Mapping of COs with POs and PSOs

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

1-low, 2-medium, 3-high

Chairman (BoS)

CS24E06	MULTI CORE ARCHITECTURES (PROFESSIONAL ELECTIVES – I and II)	Category	L	T	P	SL	C
		PEC	45	0	0	45	3

(Common to M.E CSE and M.E BDA)

PREREQUISITE

Students should have a basic understanding of computer architecture and digital logic design. Familiarity with programming concepts and performance measurement techniques is also required. Prior knowledge of parallel computing and memory systems is beneficial.

OBJECTIVES:

To provide a strong foundation in advanced computer architecture concepts, including performance evaluation, memory hierarchy, parallel architectures, multicore systems, and modern computing paradigms such as SIMD and GPU architectures.

UNIT – I	FUNDAMENTALS OF COMPUTER DESIGN AND ILP	(9)

Fundamentals of Computer Design – Measuring and Reporting Performance – Instruction Level Parallelism and its Exploitation – Concepts and Challenges – Limitations of ILP – Multithreading – SMT and CMP Architectures – The Multicore era.

UNIT – II	MEMORY HIERARCHY DESIGN	(9)

Introduction – Optimizations of Cache Performance – Memory Technology and Optimizations – Protection: Virtual Memory and Virtual Machines – Design of Memory Hierarchies – Case Studies.

UNIT – III	MULTIPROCESSOR ISSUES	(9)

Symmetric and Distributed Shared Memory Architectures – Cache Coherence Issues – Performance Issues – Synchronization Issues – Models of Memory Consistency – Interconnection Networks – Buses, Crossbar and Multi-Stage Interconnection Networks.

UNIT – IV	MULTICORE ARCHITECTURES	(9)

Homogeneous and Heterogeneous Multicore Architectures – Intel Multicore Architectures – SUN CMP Architecture – IBM Cell Architecture – Introduction to Warehouse – Scale Computers, Cloud Computing – Architectures and Issues – Case Studies.

UNIT – V	VECTOR AND GPU ARCHITECTURES	(9)

Vector Architecture – SIMD Extensions for Multimedia – Graphics Processing Units – Case Studies – GPGPU Computing – Detecting and Enhancing Loop Level Parallelism.

L:45, T:0, P:0, SL:45, TOTAL: 90 PERIODS

Chairman (BoS)

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

COs	Course Outcome	Cognitive Level
CO1	Describe fundamental concepts of computer design, performance metrics, and instruction-level parallelism	Understand
CO2	Apply principles to optimize cache performance and design efficient memory hierarchies	Apply
CO3	Analyze issues related to cache coherence, synchronization, and memory consistency in multiprocessor systems	Analyze
CO4	Compare different multicore architectures and their effectiveness in various computing environments	Understand
CO5	Use knowledge of vector and GPU architectures to improve performance in parallel computing tasks	Understand

REFERENCES:

1. John L. Hennessey and David A. Patterson, "Computer Architecture – A Quantitative Approach", Morgan Kaufmann, Elsevier, Netherlands, 5th Edition, 2012.
2. Darryl Gove, "Multicore Application Programming: For Windows, Linux, and Oracle Solaris", Pearson, New Delhi, 2nd Edition, 2011.
3. David B. Kirk, Wen-mei W. Hwu, "Programming Massively Parallel Processors", Elsevier Inc, 1st Edition, 2010.
4. Wen–mei W. Hwu, "GPU Computing Gems", Morgan Kaufmann / Elsevier, 2nd Edition, 2011.
5. KaiHwang, "Advanced Computer Architecture", Tata McGraw-Hill Education, 3rd Edition, 2003.

Mapping of COs with POs and PSOs

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

1-low, 2-medium, 3-high

Chairman (BoS)

CS24E07	HUMAN COMPUTER INTERACTION (PROFESSIONAL ELECTIVES – I and II)	Category	L	T	P	SL	C
		PEC	45	0	0	45	3

PREREQUISITE

Students should have a foundational understanding of basic design principles and user experience concepts. Familiarity with web development technologies and mobile app design.

OBJECTIVES:

To equip students with foundational knowledge in Human-Computer Interaction (HCI), focusing on user-centered design, interaction styles, usability evaluation, task analysis, and the development of effective web and mobile interfaces.

UNIT – I	FOUNDATIONS OF HCI	(9)

Context of Interaction – Ergonomics – Designing Interactive systems – Understanding Users cognition and cognitive frameworks, User Centered Approaches Usability, Universal Usability, Understanding and conceptualizing interaction, Guidelines, Principles and Theories. Importance of User Interface: Definition – Importance of good design – Benefits of good design.

UNIT – II	INTERACTION STYLES	(9)

GUI: Popularity of graphics – Concept of direct manipulation – Graphical system – Characteristics – Web user – Interface Popularity – Characteristics and Principles of User Interface. Understanding interaction styles – Direct Navigation and Immersive environments – Fluid navigation – Expressive Human and Command Languages.

UNIT – III	EVALUATION OF INTERACTION	(9)

Evaluation Techniques – Assessing user experience – Usability testing – Heuristic evaluation and walkthroughs – Analytics predictive models. Cognitive models – Socio-organizational issues and stakeholder requirements – Communication and collaboration models.

UNIT – IV	MODELS AND THEORIES	(9)

Task analysis – Dialog notations and design – Models of the system – Modeling rich interaction – Ubiquitous computing.

UNIT – V	WEB AND MOBILE INTERACTION	(9)

Hypertext – Multimedia and WWW – Designing for the web Direct Selection – Contextual Tools – Feedback patterns Mobile apps – Mobile navigation – Content and control idioms – Multi-touch gestures – Interapp integration – Mobile web.

L:45, T:0, P:0, SL:45, TOTAL: 90 PERIODS

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

COs	Course Outcome	Cognitive Level

Chairman (BoS)

CO1	Describe Explain core HCI concepts, ergonomics, and user-centered design principles.	Understand
CO2	Identify and explain interaction styles like GUIs, direct manipulation, and immersive environments with focus on their characteristics and usability.	Understand
CO3	Apply evaluation techniques like usability testing, heuristic evaluation, and cognitive models to assess user experience and interface effectiveness.	Apply
CO4	Describe task structures and interaction models used in designing user-friendly dialogs and system behavior	Understand
CO5	Design user-friendly web and mobile interfaces using usability principles and interaction patterns.	Apply

REFERENCES:

1. Ben Shneiderman, Catherine Plaisant, Maxine Cohen, Niklas Elmqvist, "Designing the User Interface: Strategies for Effective Human-Computer Interaction", Pearson Education, India, 6th Edition, 2016.
2. Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale, "Human Computer Interaction", Pearson Education, New Delhi, 3rd Edition, 2004.
3. Helen Sharp Jennifer Preece Yvonne Rogers, "Interaction Design: Beyond Human Computer Interaction", Wiley, India, 5th Edition, 2019.
4. Alan Cooper, Robert Reimann, David Cronin, Christopher Noessel, "About Face: The Essentials of Interaction Design", Wiley, India, 4th Edition, 2014.
5. Wilbert O Galitz, "The Essential Guide to User Interface Design", Wiley India Pvt., Ltd, 3rd Edition, 2007.

Mapping of COs with POs and PSOs

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

1-low, 2-medium, 3-high

Chairman (BoS)

BD24E05	WEB SERVICES AND API DESIGN (PROFESSIONAL ELECTIVES – I and II)	Category	L	T	P	SL	C
		PEC	45	0	0	45	3

(Common to M.E CSE and M.E BDA)

PREREQUISITE

Students should know web development basics, HTTP protocols, and XML/JSON formats. Familiarity with programming and object-oriented design is recommended and general software engineering principles.

OBJECTIVES:

To provide a comprehensive understanding of web services and Service-Oriented Architecture (SOA), covering SOAP and RESTful principles, core technologies like WSDL and UDDI, and hands-on experience in designing and implementing resource-oriented services using frameworks such as Spring and cloud platforms.

UNIT – I	BASICS OF WEB SERVICE	(9)

Overview – Web Service Architecture – Service-Oriented Architecture (SOA) – Architecting Web Services: Web Services Technology Stack – Logical Architectural View – Deployment Architectural View and Process Architectural View.

UNIT – II	WEB SERVICE BUILDING BLOCKS	(9)

Introduction to SOAP: SOAP Syntax – Sending SOAP Messages – SOAP Implementations – Introduction to WSDL: WSDL Syntax – SOAP Binding – WSDL Implementations – Introduction to UDDI: The UDDI API – Implementations –The Future of UDDI.

UNIT – III	RESTFUL WEB SERVICES	(9)

Programmable Web – HTTP: Documents in Envelopes – Method Information – Scoping Information – The Competing Architectures – Technologies on the Programmable Web – Leftover Terminology – Writing Web Service Clients: The Sample Application – Making the Request: HTTP Libraries – Processing the Response: XML Parsers.

UNIT – IV	IMPLEMENTATION OF RESTFUL WEB SERVICES	(9)

Introducing the Simple Storage Service – Object-Oriented Design of S3 – Resources – HTTP Response Codes Resource – URIs – Addressability – Statelessness – Representations – Links and Connectedness – The Uniform Interface – Spring Web Services – Spring MVC Components – Spring Web Flow – A Service Implementation using Spring Data REST.

UNIT – V	RESOURCE ORIENTED ARCHITECTURE	(9)

Resource – URIs – Addressability – Statelessness – Representations – Links and Connectedness – The Uniform Interface – Designing Read-Only Resource-Oriented Services: Resource Design – Turning Requirements into Read-Only Resources – Figure Out the Data Set – Split the Data Set into Resources – Name the Resources – Design Representation – Link the Resources to Each Other – The HTTP Response.

L:45, T:0, P:0, SL:45, TOTAL: 90 PERIODS

Chairman (BoS)

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

COs	Course Outcome	Cognitive Level
CO1	Describe web service architecture and SOA principles, including key architectural views and technologies.	Understand
CO2	Identify the components and functionality of SOAP, WSDL, and UDDI in web service development.	Understand
CO3	Apply RESTful principles to design and manage web services using HTTP methods and URIs.	Apply
CO4	Implement RESTful web services using frameworks like Spring and S3, focusing on statelessness and resource representation.	Apply
CO5	Design resource-oriented services by structuring resources, representations, and links based on client requirements.	Apply

REFERENCES:

1. Leonard Richardson and Sam Ruby, "RESTful Web Services", O'Reilly Media, 1st Edition, 2007
2. McGovern, et al., "Java Web Services Architecture", Morgan Kaufmann Publishers, 2nd Edition, 2005.
3. Lindsay Bassett, "Introduction to JavaScript Object Notation", O'Reilly Media, 2nd Edition, 2015
4. Craig Walls, "Spring in Action", Manning Publications, Shelter Island, 5th Edition, 2018
5. Raja CSP Raman, Ludovic Dewailly, "Building A RESTful Web Service with Spring 5", Packt Publishing, 2nd Edition,2018.
6. Bogunuva Mohanram Balachandar, "Restful Java Web Services: A pragmatic guide to designing and building RESTful APIs using Java", Ingram short title, 3rd Edition, 2017.
7. Mario-Leander Reimer, "Building RESTful Web Services with Java EE 8: Create modern RESTful web services with the Java EE 8 API", Packt publishing, 2nd Edition, 2018.

Mapping of COs with POs and PSOs

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

1-low, 2-medium, 3-high

Chairman (BoS)

BD24T27	MACHINE LEARNING TECHNIQUES (PROFESSIONAL ELECTIVES – III and IV)	Category	L	T	P	SL	C
		PEC	45	0	0	45	3

(Common to M.E CSE and M.E BDA)

PREREQUISITE

A fundamental understanding of mathematics, including probability and statistics, is essential. Basic programming skills, particularly in Python, are required. Familiarity with fundamental computer science concepts and data analysis techniques.

OBJECTIVES:

To provide a strong foundation in machine learning by covering core mathematical principles, supervised and unsupervised learning techniques, graphical models, reinforcement learning, and sampling methods.

UNIT– I	BASICS OF MACHINE LEARNING	(9)

Machine Learning – Machine Learning Foundations – Overview – Design of a Learning System – Types of Machine learning – Applications Mathematical foundations of Machine Learning – Random Variables and Probabilities – Probability Theory – Probability Distributions – Decision Theory – Bayes Decision Theory – Information Theory.

UNIT – II	SUPERVISED LEARNING	(9)

Linear Models for Regression – Linear Models for Classification – Naive Bayes – Discriminant Functions – Probabilistic Generative Models – Probabilistic Discriminative Models – Bayesian Logistic Regression – Decision Trees – Classification Trees – Regression Trees – Pruning – Neural Networks – Feed Forward Network Functions – Back-Propagation – Support vector machines – Ensemble methods – Bagging – Boosting.

UNIT – III	UNSUPERVISED LEARNING	(9)

Clustering – K means – EM Algorithm – Mixtures of Gaussians – Curse of Dimensionality – Dimensionality Reduction – Factor Analysis – Principal Component Analysis – Probabilistic PCA.

UNIT – IV	PROBABILISTIC GRAPHICAL MODELS	(9)

Graphical Models – Undirected Graphical Models – Markov Random Fields – Directed Graphical Models – Bayesian Networks – Conditional Independence Properties – Inference – Generalization – Hidden Markov Models.

UNIT – V	ADVANCED LEARNING	(9)

Sampling – Basic Sampling methods – Monte Carlo. Reinforcement Learning – K-Armed Bandit – Elements – Model-Based Learning – Value Iteration – Policy Iteration –Temporal Difference Learning – Exploration Strategies.

L:45, T:0, P:0, SL:45, TOTAL: 90 PERIODS

COURSE OUTCOMES:

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

COs	Course Outcome	Cognitive Level

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CO1	Describe the fundamental concepts and mathematical foundations of machine learning.	Understand
CO2	Implement and apply various supervised learning models in real-world scenarios.	Apply
CO3	Recognize and apply unsupervised learning techniques like clustering and PCA.	Understand
CO4	Model complex data using probabilistic graphical models like Bayesian networks and Markov Random Fields.	Understand
CO5	Construct and implement advanced techniques like reinforcement learning.	Apply

REFERENCES:

1. Ethem Alpaydin, "Introduction to Machine Learning", MIT Press, London, 3rd Edition, 2014.
2. Kevin P. Murphy, "Machine Learning: A Probabilistic Perspective", MIT Press, London, 3rd Edition, 2012
3. Trevor Hastie, Robert Tibshirani and Jerome Friedman, "The Elements of Statistical Learning", Springer, United States, 2nd Edition, 2011.
4. Christopher Bishop, "Pattern Recognition and Machine Learning", Springer, United States, 1st Edition, 2007.
5. Tom M Mitchell, "Machine Learning", McGraw Hill Education, India, 1st Edition, 2013.

Mapping of COs with POs and PSOs

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

1-low, 2-medium, 3-high

Chairman (BoS)

CS24E08	SOFTWARE QUALITY ASSURANCE (PROFESSIONAL ELECTIVES – III and IV)	Category	L	T	P	SL	C
		PCC	45	0	0	45	3

PREREQUISITE

Students should have basic knowledge of software engineering, quality management, project management, and software testing to understand quality integration and assurance practices

OBJECTIVES:

To understand and apply the principles of software quality assurance by integrating quality activities into the software lifecycle, managing quality infrastructure, analyzing metrics and cost models, and exploring standards, certifications and assessment methodologies.

UNIT – I	INTRODUCTION TO SOFTWARE QUALITY AND ARCHITECTURE	(9)

Need for Software quality – Software quality assurance (SQA) – Software quality factors- McCall's quality model – SQA system components – Pre project quality components – Development and quality plans

UNIT – II	SQA COMPONENTS AND PROJECT LIFE CYCLE	(9)

Integrating quality activities in the project life cycle – Reviews – Software Testing – Quality of software maintenance components – Quality assurance for external participant's contribution – CASE tools for software quality Management.

UNIT – III	SOFTWARE QUALITY INFRASTRUCTURE	(9)

Procedures and work instructions – Supporting quality devices – Staff training and certification – Corrective and preventive actions – Configuration management – Software change control – Configuration management audit – Documentation control.

UNIT – IV	SOFTWARE QUALITY MANAGEMENT AND METRICS	(9)

Project process control – Software quality metrics – Cost of software quality – Classical quality cost model – Extended model – Application and Problems in application of Cost model

UNIT – V	STANDARDS, CERTIFICATIONS AND ASSESSMENTS	(9)

Quality management standards – ISO 9001 and ISO 9000-3 – Capability Maturity Models – CMM and CMMI assessment methodologies – Bootstrap methodology – SPICE Project – SQA project process standards – Organization of Quality Assurance – Role of management in SQA – SQA units and other actors in SQA systems.

L:45, T:0, P:0, 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	Infer the need for software quality, key quality factors, and the role of Software Quality Assurance (SQA) in ensuring software reliability.	Understand

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CO2	Describe components of an SQA system and pre-project quality planning, including development and quality plans.	Understand
CO3	Develop and manage quality infrastructure, including training and documentation.	Understand
CO4	Apply software quality metrics and cost models to evaluate and control project quality.	Apply
CO5	Assess and apply relevant quality standards and certification models, such as ISO 9001 and CMMI.	Apply

REFERENCES:

1. Daniel Galin, "Software Quality Assurance", Pearson Publication, India, 1st Edition, 2009.
2. Alan C. Gillies, "Software Quality: Theory and Management", International Thomson Computer Press, India, 2nd Edition, 2011.
3. Kshirasagar Naim and Priyadarshi Tripathy, "Software Testing and Quality Assurance Theory and Practice", John Wiley & Sons Inc., USA, 1st Edition, 2008
4. Mordechai Ben-Menachem, "Software Quality: Producing Practical Consistent Software", International Thompson Computer Press, India, 1st Edition, 2014.
5. Solis Tech, "Quality Assurance: Software Quality Assurance Made Easy", Create Space Independent Publishing, South Carolina, 1st Edition, 2016.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5
CO1	3	2	2	3	3
CO2	3	2	2	3	3
CO3	3	2	2	3	3
CO4	3	2	2	3	3
CO5	3	2	2	3	3

1-low, 2-medium, 3-high

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CS24E09	FULL STACK WEB APPLICATION DEVELOPMENT (PROFESSIONAL ELECTIVES – III and IV)	Category	L	T	P	SL	C
		PEC	45	0	0	45	3

(Common to M.E CSE and M.E BDA)

PREREQUISITE

Students should have a fundamental understanding of web development concepts and programming basics. Familiarity with core programming languages such as JavaScript is essential, as well as a basic grasp of HTML and CSS.

OBJECTIVES:

To equip students with the skills to design and develop modern web applications using front-end and back-end technologies such as JavaScript, TypeScript, Angular, Node.js, Express.js and MongoDB.

UNIT – I	JAVASCRIPT AND TYPESCRIPT LANGUAGE	(9)

Server-Side Web Applications – Client-Side Web Applications – Understanding JavaScript: Types – Working with Arrays – Working with Objects – Understanding JavaScript Object Inheritance – Adding Type Declarations for the JavaScript Package – Adding Commands – Persistently Storing. Typescript: Data Types – Classes – Interfaces – Modules – Enumerations and Generics – Constructors – Functions – Getters and Setters.

UNIT – II	ANGULAR	(9)

Angular CLI – Anatomy of a Component – Data Binding: One Way Data Binding –Two Way Data Binding – Event Handling – Angular Module System – Directives – Types of Directives – Accessing the DOM Events in Directives Accessing the DOM Properties in Directives – Component Class Lifecycle.

UNIT – III	NODE.js	(9)

Basics of Node JS – Installation – Working with Node packages – Using Node package manager – Creating a simple Node.js application – Using Events – Listeners –Timers – Callbacks – Handling Data I/O – Implementing HTTP services in Node.js – Implementing Socket Services in Node.js.

UNIT – IV	EXPRESS.Js	(9)

Express.js: How Express.js Works. Configuration, Settings and Environment Middleware – Body Parser – Cookie –Parser – Express-session – Response time – Template Engine – Parameters and Routing – Router Class – Request Object – Response Object – Error Handling.

UNIT – V	MONGODB	(9)

Understanding NoSQL and MongoDB – Building MongoDB Environment – Administering User Accounts – Configuring Access control – Administering databases – Managing collections – Connecting to MongoDB from Node.js – Understanding the Objects Used in the MongoDB Node.js Driver – Accessing and Manipulating Databases – Manipulating MongoDB Documents from Node.js.

L:45, T:0, P:0, SL:45, TOTAL: 90 PERIODS

COURSE OUTCOMES:

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

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COs	Course Outcome	Cognitive Level
CO1	interpret core concepts of JavaScript and TypeScript including data types, objects, classes, and interfaces.	Understand
CO2	Apply Angular features such as data binding, directives, and component lifecycle in front-end development.	Apply
CO3	Build and manage server-side applications using Node.js with events, callbacks, and HTTP/socket services	Apply
CO4	Use Express.js for routing, middleware configuration, and request/response handling in web apps.	Apply
CO5	Integrate and manipulate MongoDB with Node.js for NoSQL data storage and operations	Apply

REFERENCES:

1. Brad Dayley, Brendan Dayley, Caleb Dayley, "Node.js, MongoDB and Angular Web Development", Addison-Wesley, United States, 2nd Edition, 2018.
2. Adam Freeman, "Essential Typescript, Apress, United States, 1st Edition, 2019.
3. Mark Clow, "Angular Projects", Apress, United States, 1st Edition,2018.
4. Azat Mardan, "Pro Express.js", Apress, United States, 1st Edition,2015.
5. Chris Northwood, "The Full Stack Developer: Your Essential Guide to the Everyday Skills Expected of a Modern Full Stack Web Developer", Apress, 1st Edition, 2018.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5
CO1	2	3	3	3	2
CO2	2	3	3	3	2
CO3	2	3	3	3	2
CO4	2	3	3	3	2
CO5	2	3	3	3	2

1-low, 2-medium, 3-high

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CS24E10	DEEP LEARNING (PROFESSIONAL ELECTIVES – III and IV)	Category	L	T	P	SL	C
		PEC	45	0	0	45	3

(Common to M.E CSE and M.E BDA)

PREREQUISITE

Students should have a strong foundation in programming, preferably in Python, which is widely used in the field. A solid understanding of mathematics, including linear algebra, calculus and probability is essential for grasping deep learning algorithms and techniques.

OBJECTIVES:

To equip students with foundational knowledge and practical skills in deep learning, including neural network design, CNNs for image processing, NLP with RNNs, and advanced techniques such as Q-Learning, GANs, and autoencoders

UNIT– I	BASICS OF DEEP LEARNING	(9)

Fundamentals about Deep Learning – Perception Learning Algorithms – Probabilistic modelling – Early Neural Networks – Different from Deep Learning and Machine Learning – Scalars – Vectors – Matrixes – Higher Dimensional Tensors – Manipulating Tensors – Vector Data – Time Series Data – Image Data –Video Data.

UNIT – II	NEURAL NETWORKS	(9)

Fundamentals of Neural Network – Building Blocks of Neural Network – Optimizers. Activation Functions – Loss Functions – Data Pre-processing for neural networks – Feature Engineering – Overfitting and Underfitting – Hyper parameters.

UNIT – III	CONVOLUTIONAL NEURAL NETWORK	(9)

Introduction of CNN – Linear Time Invariant – Image Processing Filtering – Building a convolutional neural network – Input Layers – Convolution Layers – Pooling Layers – Dense Layers – Backpropagation Through the Convolutional Layer – Filters and Feature Maps – Backpropagation Through the Pooling Layers –Transfer Learning with Image Data – Transfer Learning using Inception Oxford VGG Model – Google Inception Model.

UNIT – IV	NATURAL LANGUAGE PROCESSING USING RNN	(9)

NLP and its Toolkits – Language Modeling – Vector Space Model (VSM) – Continuous Bag of Words (CBOW) –Skip-Gram Model for Word Embedding – Global Vectors for Word Representation GloVe – Backpropagation Through Time – Bidirectional RNNs (BRNN) – Long Short-Term Memory (LSTM) – Bi-directional LSTM – Sequence-to-Sequence Models – Gated recurrent unit GRU.

UNIT – V	DEEP REINFORCEMENT AND UNSUPERVISED LEARNING	(9)

Deep Reinforcement Learning – Q-Learning – Deep Q-Network (DQN) – Policy Gradient Methods – Actor-Critic Algorithm – Autoencoding – Convolutional Auto Encoding – Variational Auto Encoding – Generative Adversarial Networks – Autoencoders for Feature Extraction – Auto Encoders for Classification – Denoising Autoencoders – Sparse Autoencoders.

L:45, T:0, P:0, SL:45, TOTAL: 90 PERIODS

COURSE OUTCOMES:

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

Chairman (BoS)

COs	Course Outcome	Cognitive Level
CO1	Infer proficiency in deep learning principles and the ability to manage various data types.	Understand
CO2	Describe the process of building and tuning neural networks using activation and loss functions	Understand
CO3	Develop and use convolutional neural networks for image-related tasks and transfer learning.	Apply
CO4	Apply RNNs, LSTM, and GRU models for processing and modeling language data.	Apply
CO5	Implement reinforcement learning methods and unsupervised techniques for data analysis and generation.	Apply

REFERENCES:

1. Brad Dayley, Josh Patterson and Adam Gibson, "Deep Learning A Practitioner's Approach", O'Reilly Media, USA, 1st Edition, 2017.
2. Jojo Moolayil, "Learn Keras for Deep Neural Networks", Apress, Canada, 1st Edition, 2018.
3. Vinita Silaparasetty, "Deep Learning Projects Using TensorFlow 2", Apress, Canada, 1st Edition, 2020.
4. Francois Chollet, "Deep Learning with Python", Manning Shelter Island, 2nd Edition,2017.
5. Santanu Pattanayak, "Pro Deep Learning with TensorFlow", Apress, Canada, 1st Edition, 2017.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5
CO1	3	2	2	3	3
CO2	3	2	2	3	3
CO3	3	2	2	3	3
CO4	3	2	2	3	3
CO5	3	2	2	3	3

1-low, 2-medium, 3-high

Chairman (BoS)

CS24E11	NATURAL LANGUAGE PROCESSING (PROFESSIONAL ELECTIVES – III and IV)	Category	L	T	P	SL	C
		PEC	45	0	0	45	3

(Common to M.E CSE and M.E BDA)

PREREQUISITE

Knowledge of fundamental linguistic concepts such as syntax, semantics, and morphology. Proficiency in Python or another programming language used in NLP and Basic understanding of machine learning principles and algorithms.

OBJECTIVES:

To provide foundational knowledge and practical skills in natural language processing, covering text classification, parsing, semantic analysis, information extraction, and the development of dialogue and question-answering systems.

UNIT – I	**BASICS OF NLP**	**(9)**

Natural Language Processing – Components – Basics of Linguistics and Probability and Statistics – Words –Tokenization – Morphology – Finite State Automata

UNIT – II	**STATISTICAL NLP AND SEQUENCE LABELING**	**(9)**

N-grams and Language models – Smoothing –Text classification – Naïve Bayes classifier – Evaluation – Vector Semantics – TF – IDF – Word2Vec- Evaluating Vector Models – Sequence Labeling – Part of Speech – Part of Speech Tagging – Named Entities – Named Entity Tagging.

UNIT – III	**CONTEXTUAL EMBEDDING**	**(9)**

Constituency – Context Free Grammar – Lexicalized Grammars – CKY Parsing – Earley's Algorithm – Evaluating Parsers – Partial Parsing – Dependency Relations – Dependency Parsing –Transition Based – Graph Based.

UNIT – IV	**COMPUTATIONAL SEMANTICS**	**(9)**

Word Senses and WordNet – Word Sense Disambiguation – Semantic Role Labeling – Proposition Bank – FrameNet – Selectional Restrictions – Information Extraction – Template Filling.

UNIT – V	**DISCOURSE ANALYSIS AND SPEECH PROCESSING**	**(9)**

Discourse Coherence – Discourse Structure Parsing – Centering and Entity Based Coherence – Question Answering – Factoid Question Answering – Classical QA Models – Chatbots and Dialogue systems – Frame-based Dialogue Systems – Dialogue – State Architecture.

L:45, T:0, P:0, SL:45, TOTAL: 90 PERIODS

COURSE OUTCOMES:

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

Chairman (BoS)

COs	Course Outcome	Cognitive Level
CO1	Outline comprehension of NLP basics, linguistics and tokenization techniques.	Understand
CO2	Implement statistical models for text classification, sequence labeling and vector semantics evaluation.	Apply
CO3	Analyze parsing techniques using contextual embeddings and grammars, including dependency and constituency parsing.	Analyze
CO4	Describe computational semantic techniques such as word sense disambiguation, semantic role labeling, and information extraction.	Understand
CO5	Illustrate methods in discourse analysis, question answering, and the design of dialogue systems.	Understand

REFERENCES:

1. Daniel Jurafsky and James H.Martin, "Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition", Prentice Hall, India, 2nd Edition, 2020
2. Jacob Eisenstein, "Natural Language Processing", MIT Press, USA, 1st Edition, 2019
3. Samuel Burns, "Natural Language Processing: A Quick Introduction to NLP with Python and NLTK", 1st Edition, 2019
4. Nitin Indurkhya,Fred J. Damerau, "Handbook of Natural Language Processing", Chapman & Hall/CRC: Machine Learning & Pattern Recognition, Hardcover, 2r.d Edition, 2010
5. Deepti Chopra, Nisheeth Joshi, "Mastering Natural Language Processing with Python", Packt Publishing Limited, Mumbai, 1st Edition, 2016

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5
CO1	3	3	2	3	2
CO2	3	3	2	3	2
CO3	3	3	2	3	2
CO4	3	3	2	3	2
CO5	3	3	2	3	2

1-low, 2-medium, 3-high

Chairman (BoS)

BD24E09	BLOCKCHAIN TECHNOLOGIES (PROFESSIONAL ELECTIVES – III and IV)	Category	L	T	P	SL	C
		PEC	45	0	0	45	3

(Common to M.E CSE and M.E BDA)

PREREQUISITE

A foundational knowledge of cryptography and hashing algorithms is essential. Familiarity with basic concepts in distributed systems and databases will also be beneficial. Understanding the principles of digital currencies and financial transactions will further aid in grasping blockchain applications.

OBJECTIVES:

To introduce the core concepts of blockchain technology, explore various cryptocurrencies, and understand key mechanisms like double spending prevention, Bitcoin, Ethereum, and smart contract applications

UNIT – I	BASICS OF BLOCKCHAIN	(9)

Introduction to Blockchain – How Blockchain works – Blockchain vs Bitcoin – Practical applications – Public and Private key basics – Pros and Cons of Blockchain – Myths about Bitcoin.

UNIT – II	BLOCKCHAIN AND CRYPTOCURRENCIES	(9)

Architecture – Versions – Variants – Use cases – Life use cases of blockchain – Blockchain Vs Shared Database – Introduction to cryptocurrencies –Types – Applications.

UNIT – III	CONCEPT OF DOUBLE SPENDING	(9)

Concept of Double Spending – Hashing – Mining – Proof of work. Introduction to Merkel tree – Privacy – Payment verification –Resolving Conflicts – Creation of Blocks.

UNIT– IV	BITCOIN	(9)

Introduction to Bitcoin – key concepts of Bitcoin – Merits and De Merits Fork and Segwits – Sending and Receiving bitcoins – Choosing bitcoin wallet – Converting Bitcoins to Fiat Currency.

UNIT – V	ETHEREUM AND BLOCKCHAIN APPLICATION	(9)

Introduction to Ethereum – Advantages and Disadvantages – Ethereum vs Bitcoin – Introduction to Smart contracts – usage – Application – Working principle – Law and Regulations. Application: Medical Record Management System, Domain Name Service and Future of Blockchain.

L:45, T:0, P:0, SL:45, TOTAL: 90 PERIODS

COURSE OUTCOMES:

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

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COs	Course Outcome	Cognitive Level
CO1	Summarize the fundamentals of blockchain technology, its working, key features and differences from Bitcoin.	Understand
CO2	Outline the architecture, types and real-world applications of blockchain and cryptocurrencies.	Understand
CO3	Describe the concept of double spending and the role of cryptographic techniques like hashing, mining and Merkle trees	Understand
CO4	Demonstrate knowledge of Bitcoin operations, wallets, transactions and currency conversion.	Apply
CO5	Illustrate Ethereum's features, smart contracts, applications and the future of blockchain in domains like healthcare and DNS.	Understand

REFERENCES:

1. Bikramaditya Signal, Gautam Dhameja, Priyansu Sekhar Panda, "Beginning Blockchain: A Beginner's Guide to Building Blockchain Solutions", APress, USA, 1st Edition, 2018,
2. Bahga, Vijay Madisetti, "Blockchain Applications: A Hands-On Approach", Arshdeep Bahga, USA, 1st Edition, 2018,
3. Alan Wright, "Blockchain - Hardcover Version: Uncovering Blockchain Technology, Cryptocurrencies, Bitcoin and the Future of Money", House of Books, Manchester, 1st Edition, 2021.
4. Arvind Narayanan & Joseph Bonneau & Edward Felten & Andrew Miller & Steven Goldfeder, "Bitcoin and Cryptocurrency Technologies", Princeton University Press, USA,1st Edition, 2016.
5. Andreas M. Antonopoulos, "Mastering Bitcoin Unlocking Digital Cryptocurrencies", Oreilly, USA, 1st Edition, 2014.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5
CO1	3	1	3	3	1
CO2	3	1	3	3	1
CO3	3	1	3	3	1
CO4	3	1	3	3	1
CO5	3	1	3	3	1

1-low, 2-medium, 3-high

Chairman (BoS)

BD24E10	CYBER PHYSICAL SYSTEMS (PROFESSIONAL ELECTIVES – III and IV)	Category	L	T	P	SL	C
		PEC	45	3	0	45	3

(Common to M.E CSE and M.E BDA)

PREREQUISITE

Basic understanding of embedded systems and control theory, as well as knowledge of computer networking and communication protocols. Awareness with real-time operating systems and scheduling algorithms and system design is essential, along with a foundation in verification techniques and security concepts.

OBJECTIVES:

To introduce the concepts and design principles of Cyber-Physical Systems, focusing on safety, security, synchronization, system modeling and real-world applications using simulation tools like CyberSim, Matlab and Simulink

UNIT – I	BASICS OF CYBER-PHYSICAL SYSTEMS	(9)

Cyber-Physical Systems (CPS) – Emergence of CPS – Key Features of Cyber-Physical Systems – CPS Drivers –Synchronous Model: Reactive Components – Properties of Components – Composing Components – Designs – Asynchronous Model of CPS: Processes – Design Primitives – Coordination Protocols.

UNIT – II	CPS REQUIREMENTS	(9)

Safety Specifications: Specifications – Verifying Invariants – Enumerative Search – Symbolic Search – Liveness Requirements: Temporal Logic – Model Checking – Proving Liveness.

UNIT – III	CPS MODELS	(9)

Dynamical Systems: Continuous – Linear Systems –Time Models – Linear Systems – Designing Controllers – Analysis Techniques – Timed Model: Processes – Protocols – Automata – Hybrid Dynamical Models.

UNIT – IV	CPS FOUNDATIONS	(9)

Symbolic Synthesis for CPS – Security in CPS – Synchronization of CPS – Real-Time Scheduling for CPS.

UNIT – V	APPLICATIONS AND PLATFORMS	(9)

Medical CPS – CPS Built on Wireless Sensor Networks – CyberSim User Interface – iClebo Kobuki – iRobot Create –myRIO – Cybersim – Matlab toolboxes – Simulink.

L:45, T:0, P:0, SL:45, TOTAL: 90 PERIODS

COURSE OUTCOMES:

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

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COs	Course Outcome	Cognitive Level
CO1	Summarize the key features, components, and drivers of Cyber-Physical Systems to understand their structure and importance in modern applications	Understand
CO2	Examine synchronous and asynchronous CPS models, focusing on reactive components and coordination protocols.	Analyze
CO3	Apply safety and liveness specifications, using formal methods like model checking and temporal logic, to verify and validate CPS behavior.	Apply
CO4	Implement CPS models using continuous, linear, timed, and hybrid dynamical systems, with appropriate control and analysis techniques.	Apply
CO5	Explore CPS foundations like scheduling, security, and synchronization, and analyze their impact on system reliability.	Understand

REFERENCES:

1. Raj Rajkumar, Dionisio De Niz, and Mark Klein, "Cyber-Physical Systems", Addison Wesley Professional, USA, 2016
2. Rajeev Alur, "Principles of Cyber-Physical Systems", MIT Press, USA, 1st Edition, 2015.
3. Lee, Edward Ashford, and Sanjit Arunkumar Seshia, "Introduction to embedded systems: A cyber physical systems approach", 2nd Edition, 2017
4. André Platzer, "Logical Analysis of Hybrid Systems: Proving Theorems for Complex Dynamics", Springer, USA, 1st Edition, 2010.
5. Jean J. Labrosse, "Embedded Systems Building Blocks: Complete and Ready-To-Use Modules in C", The publisher, Paul Temme, 1st Edition, 2011.

Mapping of COs with POs and PSOs

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

1-low, 2-medium, 3-high

Chairman (BoS)
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CS24E12	GPU COMPUTING (PROFESSIONAL ELECTIVES – III and IV)	Category	L	T	P	SL	C
		PEC	45	3	0	45	3

PREREQUISITE

A strong foundation in parallel computing and an understanding of computer architecture. Familiarity with C/C++ programming is essential for writing CUDA and OpenCL code. Knowledge of memory management and resource handling is important for optimizing applications. Additionally, a basic understanding of concurrency and synchronization concepts is needed for efficient parallel programming.

OBJECTIVES:

To provide a comprehensive understanding of GPU-based supercomputing by exploring CUDA and OpenCL architectures, programming models, memory management, and concurrency techniques for developing optimized solutions on heterogeneous platforms.

UNIT – I	GPU ARCHITECTURE	(9)

History of Supercomputing – Understanding Parallelism with GPU – CUDA Hardware Overview – Threads, Blocks, Grids, Warps, Scheduling – Memory Handling with CUDA: Shared, Global, Constant, and Texture Memory.

UNIT – II	CUDA PROGRAMMING	(9)

Using CUDA – Multi GPU – Multi GPU Solutions – Optimizing CUDA Applications: Problem Decomposition – Memory Considerations – Transfers, Thread Usage – Resource Contentions.

UNIT – III	CUDA PROGRAMMING ISSUES	(9)

Common Problems: CUDA Error Handling – Parallel Programming Issues, Synchronization – Algorithmic Issues – Finding and Avoiding Errors.

UNIT – IV	OPENCL BASICS	(9)

OpenCL Standard – Platform Model – Execution Model – Programming Model – Memory Model – Basic OpenCL Examples.

UNIT – V	CONCURRENCY MODEL	(9)

Commands and Queuing Model – Native and Built-in Kernels – Device side Queuing – Host-side Memory Model – Device side Memory Model – Dissecting OpenCL on Heterogeneous System.

L:45, T:0, P:0, SL:45, TOTAL: 90 PERIODS

COURSE OUTCOMES:

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

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COs	Course Outcome	Cognitive Level
CO1	Infer the architecture and parallel processing capabilities of GPUs to understand their role in high-performance computing.	Understand
CO2	Develop efficient CUDA programs and apply optimization techniques to enhance application performance.	Apply
CO3	Identify and resolve common programming issues in CUDA to ensure correctness and efficiency.	Understand
CO4	Explore the core concepts and programming models of the OpenCL standard for cross-platform parallel computing.	Understand
CO5	Examine concurrency models in heterogeneous systems through the use of OpenCL.	Apply

REFERENCES:

1. Shane Cook, "CUDA Programming: A Developer's Guide to Parallel Computing with GPUs (Applications of GPU Computing)", Morgan Kaufmann, USA, 1st Edition, 2012
2. David R. Kaeli, Perhaad Mistry, Dana Schaa, Dong Ping Zhang, "Heterogeneous computing with OpenCL", Morgan Kauffman, USA, 3rd Edition, 2015.
3. Nicholas Wilt, "CUDA Handbook: A Comprehensive Guide to GPU Programming", Addison Wesley, Delhi, 1st Edition, 2013.
4. Jason Sanders, Edward Kandrot, "CUDA by Example: An Introduction to General Purpose GPU Programming", Addison Wesley, Delhi, 1st Edition, 2010.
5. https://opencl.org/

Mapping of COs with POs and PSOs

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

1-low, 2-medium, 3-high

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CS24E13	QUANTUM COMPUTING (PROFESSIONAL ELECTIVES – III and IV)	Category	L	T	P	SL	C
		PEC	45	0	0	45	3

(Common to M.E CSE and M.E BDA)

PREREQUISITE

A strong foundation in linear algebra, probability theory, and complex numbers. Familiarity with basic quantum mechanics and classical computing concepts is essential.

OBJECTIVES:

To introduce the principles of quantum computing by studying qubit systems, quantum operations, algorithm design, error correction strategies, and secure communication protocols such as quantum cryptography and teleportation.

UNIT – I	QUANTUM BUILDING BLOCKS	(9)

The Quantum Mechanics of Photon Polarization – Single-Qubit Quantum Systems – Quantum State Spaces – Entangled States – Multiple-Qubit Systems – Measurement of Multiple-Qubit States – EPR Paradox and Bell's Theorem – Bloch sphere.

UNIT – II	QUANTUM STATE TRANSFORMATIONS	(9)

Unitary Transformations – Quantum Gates – Unitary Transformations as Quantum Circuits – Reversible Classical Computations to Quantum Computations – Language for Quantum Implementations.

UNIT – III	QUANTUM ALGORITHMS	(9)

Computing with Superpositions – Quantum Subroutines – Quantum Fourier Transformations – Shor's Algorithm and Generalizations – Grover's Algorithm and Generalizations.

UNIT – IV	ENTANGLED SUBSYSTEMS AND ROBUST QUANTUM COMPUTATION	(9)

Quantum Subsystems – Properties of Entangled States – Quantum Error Correction – Graph states and codes – CSS Codes – Stabilizer Codes – Fault Tolerance and Robust Quantum Computing.

UNIT – V	QUANTUM INFORMATION PROCESSING	(9)

Limitations of Quantum Computing – Alternatives to the Circuit Model of Quantum Computation – Quantum Protocols – Building Quantum – Computers, Simulating Quantum Systems, Bell states. Quantum teleportation – Quantum Cryptography – No cloning theorem.

L:45, T:0, P:0, SL:45, TOTAL: 90 PERIODS

COURSE OUTCOMES:

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

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COs	Course Outcome	Cognitive Level
CO1	Infer the fundamental concepts of quantum mechanics and qubit systems.	Understand
CO2	Apply quantum gates and unitary transformations to quantum circuits.	Apply
CO3	Implement quantum algorithms such as Shor's and Grover's algorithms.	Apply
CO4	Make use of quantum error correction methods and fault-tolerant quantum computing.	Apply
CO5	Discover quantum protocols, cryptography, and the no-cloning theorem in quantum information processing.	Understand

REFERENCES:

1. John Gribbin, "Computing with Quantum Cats: From Colossus to Qubits", Bantam Press, New York, 3rd Edition, 2021.
2. William (Chuck) Easttom, "Quantum Computing Fundamentals", Addison-Wesley Professional, USA, 1st Edition, 2021.
3. Parag Lala, "Quantum Computing", McGraw-Hill Education, India, 1st Edition, 2019
4. Eleanor Rieffel and Wolfgang Polak, "Quantum Computing A Gentle Introduction", MIT Press, USA, 1st Edition, 2011.
5. Nielsen M. A., "Quantum Computation and Quantum Information", Cambridge University Press, England, 1st Edition, 2002.

Mapping of COs with POs and PSOs

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

1-low, 2-medium, 3-high

Chairman (BoS)

BD24E12	INFORMATION RETRIEVAL TECHNIQUES (PROFESSIONAL ELECTIVES – III and IV)	Category	L	T	P	SL	C
		PEC	45	0	0	45	3

(Common to M.E CSE and M.E BDA)

PREREQUISITE

A foundational knowledge of data structures and algorithms, especially related to search and sorting techniques. Familiarity with basic probability, statistics, and machine learning concepts is essential for understanding classification, clustering, and retrieval models. Knowledge of web technologies and experience in programming languages like Python or Java will be beneficial for implementing IR systems.

OBJECTIVES:

To provide a comprehensive understanding of Information Retrieval by exploring foundational concepts, retrieval models, indexing techniques, text classification and clustering algorithms, and advanced methods including web search, link analysis, and multimedia retrieval.

UNIT – I	MOTIVATION	(9)

Basic Concepts – Practical Issues – Retrieval Process – Architecture – Boolean Retrieval – Retrieval Evaluation – Open-Source IR Systems – History of Web Search – Web Characteristics – Impact of the web on IR – IR Versus Web Search – Components of a Search Engine.

UNIT – II	MODELING	(9)

Taxonomy and Characterization of IR Models – Boolean Model – Vector Model – Term Weighting – Scoring and Ranking – Language Models – Set Theoretic Models – Probabilistic Models – Algebraic Models – Structured Text Retrieval Models – Models for Browsing.

UNIT – III	INDEXING	(9)

Static and Dynamic Inverted Indices – Index Construction and Index Compression. Searching – Sequential Searching and Pattern Matching – Query Operations – Query Languages – Query Processing – Relevance Feedback and Query Expansion – Automatic Local and Global Analysis – Measuring Effectiveness and Efficiency.

UNIT – IV	CLASSIFICATION AND CLUSTERING	(9)

Text Classification and Naive Bayes – Vector Space Classification – Support Vector Machines and Machine Learning on Documents. Flat Clustering – Hierarchical Clustering – Matrix Decompositions and Latent Semantic Indexing – Fusion and Meta Learning.

UNIT – V	SEARCHING THE WEB	(9)

Searching the Web – Structure of the Web – IR and web search – Static and Dynamic Ranking – Web Crawling and Indexing – Link Analysis – XML Retrieval Multimedia IR: Models and Languages – Indexing and Searching Parallel and Distributed IR – Digital Libraries.

L:45, T:0, P:0, SL:45, TOTAL: 90 PERIODS

COURSE OUTCOMES:

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

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COs	Course Outcome	Cognitive Level
CO1	Describe the architecture and process of Information Retrieval systems.	Understand
CO2	Apply different IR models like Boolean, Vector and Probabilistic models.	Apply
CO3	Implement indexing techniques, including static and dynamic inverted indices.	Apply
CO4	Perform text classification and clustering using machine learning methods.	Understand
CO5	Discover web search processes, web crawling and multimedia IR techniques.	Understand

REFERENCES:

1. Ricardo Baeza, Yates, Berthier Ribeiro and Neto, "Modern Information Retrieval: The concepts and Technology behind Search", ACM Press Books, New York, 2nd Edition, 2011.
2. Stefan Buttcher, Charles L. A. Clarke and Gordon V. Cormack, "Information Retrieval Implementing and Evaluating Search Engines", The MIT Press, Cambridge, Massachusetts London, England, 3rd Edition, 2010.
3. Christopher D. Manning, Prabhakar Raghavan and Hinrich Schutze, "Introduction to Information Retrieval", Cambridge University Press, US, 1st Edition, 2008.
4. Gerald J. Kowalski, Mark T. Maybury, "Information Storage and Retrieval Systems: Theory and Implementation", Springer, US, 6th Edition, 2013.

Mapping of COs with POs and PSOs

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

1-low, 2-medium, 3-high

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K.S.R College of Engineering

BD24E14	DEVOPS AND MICROSERVICES (PROFESSIONAL ELECTIVES –V)	Category	L	T	P	SL	C
		PEC	45	0	0	45	3

(Common to M.E CSE and M.E BDA)

PREREQUISITE

Basic knowledge in any programming languages, automation tools and cloud services are needed. In addition, knowledge in Machine learning helps to deploy it in real world problems.

OBJECTIVES:

This course aims to introduce the fundamental concepts and terminology of DevOps, including its platforms and automation tools. It helps learners understand the processes involved in code building, integration, and deployment. The course also provides basic insights into MLOps and its role in modern development practices.

UNIT – I	INTRODUCTION	(9)

Software Engineering – Traditional and Agile process models – DevOps – Definition – Practices – DevOps life cycle process – Need for DevOps – Barriers

– UNIT – II	DEVOPS PLATFORM AND SERVICES	(9)

Cloud as a platform – IaaS, PaaS, SaaS – Virtualization – Containers – Supporting Multiple Data Centers –Operation Services – Hardware provisioning – software Provisioning – IT services – SLA – capacity planning – security – Service Transition – Service Operation Concepts.

UNIT – III	BUILDING, TESTING AND DEPLOYMENT	(9)

Microservices architecture – Coordination model – Building and testing – Deployment pipeline – Development and Pre-Commit Testing – Build and Integration Testing – Continuous integration – Monitoring – Security – Resources to Be Protected – Identity Management

UNIT – IV	DEVOPS AUTOMATION TOOLS	(9)

Infrastructure Automation – Configuration Management – Deployment Automation – Performance Management – Log Management – Monitoring

UNIT – V	MLOPS	(9)

MLOps – Definition – Challenges – Developing Models – Deploying to production – Model Governance – Real world examples.

L:45, T:0, P:0, 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	Describe the key concepts of DevOps, its lifecycle, practices, and the need for adopting DevOps over traditional models	Understand
CO2	Implement cloud-based DevOps solutions using service models such as IaaS, PaaS, and SaaS to support IT operations and service delivery	Apply

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CO3	Illustrate the process of building, testing, and deploying applications using continuous integration and microservices architecture	Understand
CO4	Apply DevOps automation tools for infrastructure management, performance monitoring and automated deployment.	Apply
CO5	Summarize the principles of MLOps, including model development, deployment and governance in real-world scenarios	Understand

REFERENCES:

1. Len Bass, Ingo Weber and Liming Zhu, DevOps: A Software Architect's Perspective, Pearson Education, First Edition, 2016
2. Joakim Verona, Practical DevOps, Packet Publishing, Second Edition, 2018
3. Viktor Farcic, The DevOps 2.1 Toolkit: Docker Swarm, Packet Publishing, First Edition, 2017
4. Mark Treveil, and the Dataiku Team, Introducing MLOps, O'Reilly Media, First Edition, 2020.
5. Kalpesh Parikh and Amit Johri, Combining DataOps, MLOps and DevOps, BPB Publication, India, First Edition, 2022.

Mapping of COs with POs and PSOs

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

1-low, 2-medium, 3-high

Chairman (BoS)

CS24E14	AUGMENTED REALITY AND VIRTUAL REALITY (PROFESSIONAL ELECTIVES –V)	Category	L	T	P	SL	C
		PEC	45	0	0	45	3

PREREQUISITE

Students should have a basic understanding of programming concepts, Basic Mathematical foundation. Familiarity with 3D Modeling, Animation and AR VR Platforms concepts is also needed. Basic knowledge of hardware devices used in AR and VR.

OBJECTIVES:

This course introduces the core concepts of Augmented and Virtual Reality, covering input-output devices, application models, visualization techniques and audio-video interaction methods used in AR/VR environments.

UNIT – I	INTRODUCTION TO VIRTUAL REALITY (VR)	(9)

Defining Virtual Reality – Key elements of virtual reality experience – Virtual Reality – Telepresence – Augmented Reality and Cyberspace – Role of human sensory organs – Hardware – Software – Interaction.

UNIT – II	INPUT AND OUTPUT DEVICES	(9)

Input Devices: Three-dimensional position trackers – Navigation and Manipulation – Interfaces and Gesture interfaces. Output Devices: Graphics displays – Sound displays – Haptic feedback.

UNIT – III	MODELING	(9)

Geometric modeling – Transforming rigid bodies – yaw – pitch – roll – axis angle representation – Kinematics modeling – Physical modeling – Behaviour modeling – Model management.

UNIT – IV	AUGMENTED REALITY	(9)

Taxonomy – Technology and Features of Augmented Reality – AR Vs VR – Challenges with AR– AR systems and functionality – Augmented Reality Methods – Visualization Techniques for Augmented Reality – Enhancing interactivity in AR Environments – Evaluating AR systems.

UNIT – V	INTERACTION AND AUDIO	(9)

Interaction – Motor Programs and Remapping – Locomotion – Manipulation – Social Interaction – Audio – The Physics of Sound – The Physiology of Human Hearing – Auditory Perception – Auditory Rendering.

L:45, T:0, P:0, 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	Summarize the key concepts of Virtual Reality, including telepresence, AR, cyberspace and the role of sensory organs in immersive experiences.	Understand

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CO2	Classify various input and output devices used in VR/AR environments and demonstrate their roles in user interaction	Apply
CO3	Apply different modeling techniques such as geometric, kinematic, and behavioral models in the development of virtual environments.	Apply
CO4	Enlighten the taxonomy, features, and challenges of AR systems and differentiate them from VR technologies.	Understand
CO5	Describe interaction techniques and analyze the principles of audio perception and rendering in immersive environments	Analyze

REFERENCES:

1. Gregory C. Burdea & Philippe Coiffet, Virtual Reality Technology, John Wiley & Sons, Inc, Second Edition, 2017.
2. Steven M. LaValle, Virtual Reality, Cambridge University Press, First Edition, 2016.
3. William R. Sherman and Alan B. Craig, Understanding Virtual Reality Interface, Application and Design, Morgan Kaufmann Publishers, Elsevier, Second Edition 2019.
4. Grigore C. Burdea, Philippe Coiffet, Virtual Reality Technology, Second Edition, Wiley, 2017.
5. K.S. Hale and K. M. Stanney, Handbook on Virtual Environments, Second Edition, CRC Press, 2015.

WEB REFERENCES:

1. http://vr.cs.uiuc.edu/vrbook.pdf
2. https://nptel.ac.in/courses/106/106/106106138/

Mapping of COs with POs and PSOs

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

1-low, 2-medium, 3-high

Chairman (BoS)

CS24E15	SOFTWARE INDUSTRIALIZATION (PROFESSIONAL ELECTIVES –V)	Category	L	T	P	SL	C
		PEC	45	0	0	45	3

PREREQUISITE

Basic knowledge about Basic Software Engineering, Object-Oriented Programming is required for better understanding of industrialization deployment.

OBJECTIVES:

This course introduces software industrialization concepts, project management and design methodologies. It covers automation using AI/ML, low-code tools and DevOps practices. Learners will also explore cloud-based development and future trends in software engineering.

UNIT – I	INTRODUCTION TO SOFTWARE INDUSTRIALIZATION	(9)

Definition – Need for software industrialization – Evolution of software industrialization – Overview of software development lifecycle models – Traditional Software Engineering vs. Software Industrialization – Technical evaluation metrics for software quality.

UNIT – II	PROJECT MANAGEMENT AND COST ESTIMATION	(9)

Traditional SDLC – Project planning – Scheduling techniques – Resource allocation – Risk management Cost estimation models – budgeting.

UNIT – III	ANALYSIS AND DESIGN	(9)

Requirements elicitation – Use case modeling – System design methodologies – User interface design principles Agile methodologies and frameworks – Dynamic Systems Development Method (DSDM) – Collaboration and communication in DevOps environments.

UNIT – IV	AUTOMATION IN SOFTWARE INDUSTRIALIZATION	(9)

Role of AI and Machine Learning in Software Development – automated Code Generation – Software Testing Deployment Automation – Infrastructure as Code (IaC) – Low-Code – No-Code Platforms.

UNIT – V	SOFTWARE INDUSTRIALIZATION IN CLOUD AND AI	(9)

Cloud-based software factories – Industrialization in SaaS applications – AI-driven software development and automation – Future trends in software industrialization – Ethical and economic impact.

L:45, T:0, P:0, 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	Compare traditional software engineering practices with software industrialization in terms of lifecycle models and quality metrics	Understand
CO2	Apply project planning, scheduling, and cost estimation techniques to manage software development effectively.	Apply
CO3	Use system design methodologies and agile frameworks to perform requirements elicitation and UI design in collaborative environments	Apply

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CO4	Demonstrate the use of automation tools such as AI/ML, code generators, and infrastructure as code in modern software development.	Apply
CO5	Identify the role of cloud platforms and AI in driving software industrialization and assess their impact on the industry.	Understand

REFERENCES:

1. Andrew Hunt and David Thomas, The Pragmatic Programmer: Your Journey to Mastery, Addison-Wesley Professional, Second Edition, 2019.
2. Jim Highsmith, Agile Project Management: Creating Innovative Products, Addison-Wesley Professional, Second Edition, 2009.
3. Jez.Humble and David Farley, Reliable Software Releases through Build, Test and Deployment Automation, Addison-Wesley Professional, Second Edition, 2010.
4. Ian Sommerville, Software Engineering, Pearson, Tenth Edition, 2017.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5
CO1	3	3	2	2	2
CO2	3	3	2	2	2
CO3	3	3	2	2	2
CO4	3	3	2	2	2
CO5	3	3	2	2	2

1-low, 2-medium, 3-high

Chairman (BoS)

CS24E16	DIGITAL IMAGE PROCESSING (PROFESSIONAL ELECTIVES –V)	Category	L	T	P	SL	C
		PEC	45	0	0	45	3

PREREQUISITE

Students should know basic math like algebra and probability. They should be able to write simple programs in Python or MATLAB. Knowing some signal processing and data structures will also be helpful.

OBJECTIVES:

The course aims to teach the basics of digital image processing, including how images are captured, enhanced, and analyzed. Students will learn to use tools like MATLAB and Python to apply various techniques. It also helps them understand how image processing is used in real-world applications like medical and remote sensing.

UNIT – I	DIGITAL IMAGE FUNDAMENTALS	(9)

Introduction to Digital Image Processing – Image Types and File Formats – Image Acquisition and Sampling – Quantization and Resolution – Basic Relationships Between Pixels – Overview of Tools: MATLAB, OpenCV and Python for image processing.

UNIT – II	IMAGE ENHANCEMENT IN SPATIAL DOMAIN	(9)

Intensity Transformation Functions – Histogram Processing – Basics of Spatial Filtering – Smoothing Filters – Sharpening Filters – Edge Enhancement Techniques.

UNIT – III	IMAGE RESTORATION AND MORPHOLOGICAL PROCESSING	(9)

Image Degradation Model and Noise Types – Mean, Median, and Adaptive Filters – Inverse and Wiener Filtering – Geometric Transformations – Dilation and Erosion – Opening, Closing and Boundary Extraction.

UNIT – IV	SEGMENTATION AND FEATURE EXTRACTION	(9)

Edge Detection Techniques – Thresholding Methods – Region-Based Segmentation – Morphological Watershed Segmentation – Feature Extraction – Shape, Size, Texture Descriptors – Feature Representation and Feature Vector Construction.

UNIT – V	FREQUENCY DOMAIN, COMPRESSION, AND APPLICATIONS	(9)

2D Fourier Transform and Its Properties – Frequency Domain Filtering – Image Compression Techniques – Lossless and Lossy – JPEG Compression and DCT –Wavelet Transform and JPEG2000 – Applications in Medical Imaging, Remote Sensing, and Industrial Vision Systems.

L:45, T:0, P:0, SL:45, TOTAL: 90 PERIODS

COURSE OUTCOMES:

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

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COs	Course Outcome	Cognitive Level
CO1	Describe the basic concepts of digital images, types, formats, sampling, and quantization, and identify suitable tools for processing.	Understand
CO2	Apply spatial domain techniques such as intensity transformations and filtering to enhance image quality.	Apply
CO3	Analyze image degradation and implement restoration methods and morphological operations for noise removal and object shaping.	Analyze
CO4	Apply segmentation techniques and extract features like shape, size, and texture for further image analysis.	Apply
CO5	Employ frequency domain techniques and image compression methods to process images for real-world applications.	Apply

REFERENCES:

1. A. Baskar, Muthaiah Rajappa, S.K. Vasudevan & T.S. Murugesh, Digital Image Processing, Chapman & Hall/CRC Press, First Edition, 2023.
2. Rafael C. Gonzalez & Richard E. Woods, Digital Image Processing, Pearson Education, Fourth Edition, 2018.
3. Wilhelm Burger & Mark J. Burge, Principles of Digital Image Processing: Fundamental Techniques, Springer, First Edition, 2009.
4. Mark S. Nixon and Alberto S. Aguado, Feature Extraction and Image Processing for Computer Vision, Academic Press, Third Edition, 2012.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5
CO1	2	2	1	2	2
CO2	2	2	1	2	2
CO3	2	2	1	2	2
CO4	2	2	1	2	2
CO5	2	2	1	2	2

1-low, 2-medium, 3-high

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BD24E17	SOCIAL NETWORK ANALYSIS (PROFESSIONAL ELECTIVES –V)	Category	L	T	P	SL	C
		PEC	45	0	0	45	3

(Common to M.E CSE and M.E BDA)

PREREQUISITE

Students should know basic data structures, especially graphs. They should be familiar with Python and using tools like NetworkX. A basic idea of statistics and probability will also be useful.

OBJECTIVES:

The course aims to introduce the theoretical foundations and practical tools used in Social Network Analysis. It enables students to explore network models, centrality measures, link analysis, and community structures. Students will also learn about information diffusion, privacy concerns, and real-world applications using tools like NetworkX and Gephi.

UNIT – I	FOUNDATIONS OF SOCIAL NETWORKS	(9)

Introduction to Social Networks –Types of Networks: Social, Information, Biological – Graph Theory Basics: Nodes, Edges, Degree – Paths, Cycles, and Network Representation – Network Visualization using NetworkX – Bipartite and Ego Networks.

UNIT – II	NETWORK MODELS AND MEASURES	(9)

Random Graph Model – Small-world Model – Scale-Free Networks – Degree Distribution and Network Growth – Clustering Coefficient and Network Robustness – Distance Measures and Components.

UNIT – III	CENTRALITY AND LINK ANALYSIS	(9)

Degree, Closeness, and Betweenness Centrality – Eigenvector Centrality and PageRank – HITS Algorithm – Introduction to Link Analysis – Link Prediction Techniques – Applications of Centrality in Real Networks.

UNIT – IV	COMMUNITIES AND NETWORK COHESION	(9)

Community Detection Overview – Girvan-Newman Algorithm – Louvain and Label Propagation Methods – Network Cohesion and k-Cliques – Structural Equivalence and Subgroups – Brokerage and Role of Ego Networks.

UNIT – V	INFORMATION DIFFUSION, SECURITY & TOOLS	(9)

Information Diffusion Models (SI, SIR) – Independent Cascade and Linear Threshold Models – Privacy and Security in Social Networks – De-anonymization and Privacy Preservation – Ethical and Legal Issues in SNA – Tools: NetworkX, Gephi, iGraph.

L:45, T:0, P:0, 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	Identify different types of networks and interpret basic graph concepts such as nodes, edges, and paths using visualization tools.	Understand

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CO2	Apply various network models to analyze structural properties like clustering and robustness in real-world networks.	Apply
CO3	Analyze centrality measures and link analysis algorithms to determine node importance in social networks.	Analyze
CO4	Compare different community detection techniques and discuss their role in identifying cohesive subgroups in networks.	Understand
CO5	Demonstrate how diffusion models and privacy techniques are used to manage information spread and security in networks.	Apply

REFERENCES:

1. Niyati Aggrawal & Adarsh Anand, Social Networks: Modelling and Analysis, CRC Press, First Edition,2022.
2. John Scott, John McLevey & Peter J. Carrington, The SAGE Handbook of Social Network Analysis, SAGE Publications, Second Edition,2023.
3. Charu C. Aggarwal, Social Network Data Analytics, Springer, First Edition, 2011.
4. Peter Mika, Social Networks and the Semantic Web, Springer, First Edition, 2007.
5. BorkoFurht, Handbook of Social Network Technologies and Applications, Springer, First Edition, 2010.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5
CO1	2	2	1	2	2
CO2	2	2	1	2	2
CO3	2	2	1	2	2
CO4	2	2	1	2	2
CO5	2	2	1	2	2

1-low, 2-medium, 3-high

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AX24A01	DISASTER MANAGEMENT	Category	L	T	P	SL	C
		AC	30	0	0	0	0

(Common to All Branches)

PREREQUISITE:

A basic understanding of geography, environmental science and public health is a prerequisite for studying disaster management.

OBJECTIVES:

To enable students to understand the nature, causes, and impacts of natural and manmade disasters, identify disaster prone areas with special reference to India and develop knowledge on disaster preparedness, management strategies, risk assessment techniques and sustainable approaches for effective disaster mitigation and community resilience.

UNIT - I	INTRODUCTION	(6)

Disaster: Definition, Factors and Significance; Difference between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

UNIT - II	REPERCUSSIONS OF DISASTERS AND HAZARDS	(6)

Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts.

UNIT - III	DISASTER PRONE AREAS IN INDIA	(6)

Study of Seismic Zones; Areas Prone to Floods and Droughts, Landslides and Avalanches; Areas Prone to Cyclonic and Coastal Hazards with Special Reference to Tsunami; Post-Disaster Diseases and Epidemics.

UNIT - IV	DISASTER PREPAREDNESS AND MANAGEMENT	(6)

Preparedness: Monitoring Of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological and Other Agencies, Media Reports: Governmental and Community Preparedness.

UNIT - V	RISK ASSESSMENT	(6)

Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Green economy, Blue economy, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment, Strategies for Survival.

L:30, T:0, P:0, SL:0, TOTAL: 30 PERIODS

COURSE OUTCOMES:

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

COs	Course Outcome	Cognitive Level
CO1	Understand the definitions, differences, and classifications of disasters and hazards	Understand
CO2	Discuss the destruction of ecosystems and the loss of human and animal life resulting from different disaster events.	Understand
CO3	Compare the vulnerability of different regions in India to various natural disasters.	Understand

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CO4	Summarize the methods and technologies used in assessing and monitoring disaster risks.	Understand
CO5	Describe the concept, elements, and current global and national scenarios of disaster risk.	Understand

TEXT BOOKS:

1. Gupta, Harsh K., "Disaster Management", Universities Press, Hyderabad, 2nd Edition, 2013.
2. Satendra, "Disaster Management in India: Perspectives, Issues and Strategies", National Institute of Disaster Management, New Delhi, 1st Edition, 2018.

REFERENCES:

1. Goel S. L., "Disaster Administration and Management Text and Case Studies", Deep & Deep Publication Pvt. Ltd., New Delhi, 2009.
2. Nishitha Rai, Singh AK, "Disaster Management in India: Perspectives, issues and strategies" New Royal book Company, 2007.
3. Sahni, Pardeep et.al., "Disaster Mitigation Experiences and Reflections", Prentice Hall of India, New Delhi, 2001.
4. Sharma, R.K. and Sharma, G. "Natural Disaster Management: Causes, Effects and Mitigation", Deep & Deep Publications, New Delhi, 2005.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5
CO1	1	1	1	-	-
CO2	1	1	1	-	-
CO3	1	1	1	-	-
CO4	1	1	1	-	-
CO5	1	1	1	-	-

1-low, 2-medium, 3-high

Chairman (BoS)

AX24A02	VALUE EDUCATION	Category	L	T	P	SL	C
		AC	30	0	0	0	0

(Common to All Branches)

PREREQUISITE:

Basic understanding of moral principles, social responsibilities, and a willingness to engage in self-reflection and personal growth.

OBJECTIVES:

To foster self-development, strengthen human values, and promote overall personality growth and social empowerment through value-based education.

UNIT - I	INTRODUCTION TO VALUE EDUCATION	(6)

Values and self-development – Social values and individual attitudes, Work ethics, Indian vision of humanism, Moral and non- moral valuation, Standards and principles, Value judgements.

UNIT - II	IMPORTANCE OF VALUES	(6)

Importance of cultivation of values, Sense of duty, Devotion, Self-reliance, Confidence, Concentration, Truthfulness, Cleanliness. Honesty, Humanity, Power of faith, National Unity, Patriotism, Love for nature, Discipline

UNIT - III	INFLUENCE OF VALUE EDUCATION	(6)

Personality and Behaviour development - Soul and Scientific attitude. Positive Thinking, Integrity and discipline, Punctuality, Love and Kindness, avoid fault Thinking, Free from anger, Dignity of labour, Universal brotherhood and religious tolerance, True friendship Happiness Vs suffering, love for truth.

UNIT - IV	REINCARNATION THROUGH VALUE EDUCATION	(6)

Aware of self-destructive habits, Association and Cooperation, Doing best for saving nature Character and Competence – Holy books vs Blind faith, Self-management and good health, Science of reincarnation

UNIT - V	VALUE EDUCATION IN SOCIAL EMPOWERMENT	(6)

Equality, Nonviolence, Humility, Role of Women, all religions and same message, mind your Mind, Self-control, Honesty, Studying effectively

L:30, T:0, P:0, SL:0, TOTAL: 30 PERIODS

COURSE OUTCOMES:

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

COs	Course Outcome	Cognitive Level
CO1	Gain knowledge of self-development.	Understand
CO2	Learn the importance of Human values.	Understand
CO3	Develop the overall personality through value education.	Understand
CO4	Overcome the self-destructive habits with value education.	Understand
CO5	Interpret social empowerment with value education.	Understand

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TEXT BOOKS:

1. Chakravarthy.S.K. "Values and Ethics for organizations Theory and practice", Oxford University Press, New Delhi, 1999.
2. M.G. Chitakra, "Education and Human Values", A.P.H. Publishing Corporation, New Delhi, 2003.

REFERENCES:

1. Satchidananda, M.K, "Ethics, Education, Indian Unity and Culture", Ajantha Publications, Delhi, 1991.
2. Das, M.S., Gupta, V.K. "Social Values among Young adults: A changing Scenario", M.D. Publications, New Delhi, 1995.
3. Bandiste, D.D., "Humanist Values: A Source Book", B.R. Publishing Corporation, Delhi, 1999
4. Ruhela, S.P., "Human Values and education", Sterling Publications, New Delhi, 1986

Mapping of COs with POs and PSOs

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

1-low, 2-medium, 3-high

Chairman (BoS)

AX24A03	CONSTITUTION OF INDIA	Category	L	T	P	SL	C
		AC	30	0	0	0	0

(Common to All Branches)

PREREQUISITE:

Basic awareness of Indian history, civics, and political system at the school level, along with interest in understanding the democratic framework and governance of India.

OBJECTIVES:

To provide a comprehensive understanding of the India Constitution, including its basic structure, fundamental rights and duties, directive principles, the functioning of the Union and State governments, and the electoral system.

UNIT - I	INTRODUCTION TO INDIAN CONSTITUTION	(6)

Indian Constitution: Necessity of the Constitution, Societies before and after the Constitution adoption. Introduction to the Indian constitution, Making of the Constitution, Role of the Constituent Assembly.

UNIT - II	FUNDAMENTAL RIGHTS AND DUTIES	(6)

Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

UNIT - III	UNION GOVERNMENT	(6)

Parliamentary System, Union Executive – President, Prime Minister, Union Cabinet, Parliament - LS and RS, Parliamentary Committees, Important Parliamentary Terminologies. Supreme Court of India, Judicial Reviews and Judicial Activism.

UNIT - IV	STATE GOVERNMENT	(6)

State Government – Structure and Functions – Governor – Chief Minister – Cabinet – State Legislature – Judicial System in States – High Courts and other Subordinate Courts.

UNIT - V	ELECTION COMMISSION	(6)

Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners - Institute and Bodies for the welfare of SC/ST/OBC and women.

L:30, T:0, P:0, SL:0, TOTAL: 30 PERIODS

COURSE OUTCOMES:

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

COs	Course Outcome	Cognitive Level
CO1	Understand the basic structure of Indian Constitution.	Understand
CO2	Remember their Fundamental Rights, DPSP's and Fundamental Duties (FD's) of our constitution.	Understand
CO3	Know about our Union Government, political structure & codes, procedures.	Understand
CO4	Understand our State Executive of India.	Understand
CO5	Understand our Elections system of India.	Understand

Chairman (BoS)

TEXT BOOKS:

1. Durga Das Basu, "Introduction to the Constitution of India", Lexis Nexis Publisher, New Delhi, 23rd edition, 2018.
2. P.M. Bakshi, "The Constitution of India", Universal law Publishing, New Delhi, Fifteenth Edition, 2018.

REFERENCES:

1. Brij Kishore sharma, "Introduction to the constitution india", PHI Learning Pvt. Ltd, New Delhi, Seventh Edition, 2015.
2. M. Laxmikanth, "Indian Polity", Tata McGraw Hill, New Delhi, Sixth Edition, 2017.
3. P. K. Agarwal, "Constitution of India", Prabhat Publishers, New Delhi, Second Edition, 2015.
4. M.P. Jain, "Indian Constitution Law", Lexis Nexis Publisher, New Delhi, 7th Edition, 2014.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5
CO1	2	1	2	-	-
CO2	2	1	2	-	-
CO3	2	1	2	-	-
CO4	2	1	2	-	-
CO5	2	1	2	-	-
Avg.	2	1	2	-	-

1-low, 2-medium, 3-high

Chairman (BoS)

AX24A04	INDIAN KNOWLEDGE SYSTEM	Category	L	T	P	SL	C
		AC	30	0	0	0	0

(Common to All Branches)

PREREQUISITE:

Basic knowledge of Indian history and culture, and an interest in exploring traditional systems of knowledge across disciplines such as science, technology, humanities, and philosophy.

OBJECTIVES:

To provide an understanding of the historical evolution, key features, and multidisciplinary applications of the Indian Knowledge System, encompassing its contributions to humanities, science, engineering, socio-religious practices, and the need for its protection and preservation.

UNIT - I	INTRODUCTION TO INDIAN KNOWLEDGE SYSTEM	(6)

Importance of Ancient Knowledge System, Definition, concept, and scope of Indian Knowledge System (IKS), IKS based approaches on knowledge paradigms, IKS in modern India, Some unique Aspects of IKS.

UNIT - II	TRADITIONAL KNOWLEDGE IN HUMANITIES AND SCIENCES	(6)

Linguistics, Number and measurements - Mathematics, Chemistry, Physics, Art, Astronomy, Astrology, Crafts and Trade in India and Engineering and Technology.

UNIT - III	TRADITIONAL KNOWLEDGE IN PROFESSIONAL DOMAIN	(6)

Town planning and architecture Construction, Health, wellness and Psychology – Medicine, Agriculture, Governance and public administration, United Nations Sustainable development goals.

UNIT - IV	APPLIED TRADITIONAL KNOWLEDGE	(6)

Myths, Rituals, Spirituals, Taboos and Belief System, Folk Stories, Songs, Proverbs, Dance, Play, Acts and Traditional Narratives, Agriculture, animal husbandry, Forest, Sacred Groves, Water Mills, Sacred Water Bodies, Land, water and Soil Conservation and management Practices, Indigenous Bio-resource Conservation, Utilization Practices and Food Preservation Methods, Handicrafts, Wood Processing and Carving, -Fiber Extraction and Costumes

UNIT - V	PROTECTION OF INDIAN KNOWLEDGE SYSTEM	(6)

Documentation and Preservation of IKS, approaches for conservation and Management of nature and bio-resources, Approaches and strategies to protection and conservation of IKS.

L:30, T:0, P:0, SL:0, TOTAL: 30 PERIODS

COURSE OUTCOMES:

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

COs	Course Outcome	Cognitive Level
CO1	Explain the historicity of Indian Knowledge System.	Understand
CO2	Explain the features of traditional knowledge in humanities and sciences.	Understand
CO3	Develop familiarity with science, engineering and technology of IKS	Understand
CO4	Understand the importance of functional, aesthetic, and socio-religious concept of IKS.	Understand
CO5	Understand the concepts of protection of IKS.	Understand

TEXT BOOKS:

Chairman (BoS)

1. B Mahadevan, Vinayak Rajat Bhat, Nagendra Pavana R N, "Introduction to India Knowledge System Concepts and Applications", PHI Learning Private Ltd, 2022, ISBN-978-93-91818-21-0.
2. Amit Jha, "Traditional Knowledge System in India", Atlantic Publishers and Distributors (P) Ltd., 2009, ISBN-13: 978-8126912230.

REFERENCES:

1. Kapil Kapoor, Avadesh Kumar Singh, "Knowledge Traditions and Practices of India" Vol. 1, DK Print World (P) Ltd., 2005, ISBN 81-246-0334.
2. D.N. Bose, S.N. Sen, B. V. Subbarayappa, "A Concise History of Science in India", Indian National Science Academy, New Delhi, 2009.
3. S. N. Sen, K. S. Shukla, "History of Astronomy in India", Indian National Science Academy, 2nd edition, New Delhi, 2000.
4. Dr. Ravindra Singh Rana, Indian Knowledge System of Materials in Science and Technology, Walnut Publication, 2023.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5
CO1	2	2	2	-	-
CO2	2	2	2	-	-
CO3	2	2	2	-	-
CO4	2	2	2	-	-
CO5	2	2	2	-	-

1-low, 2-medium, 3-high

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