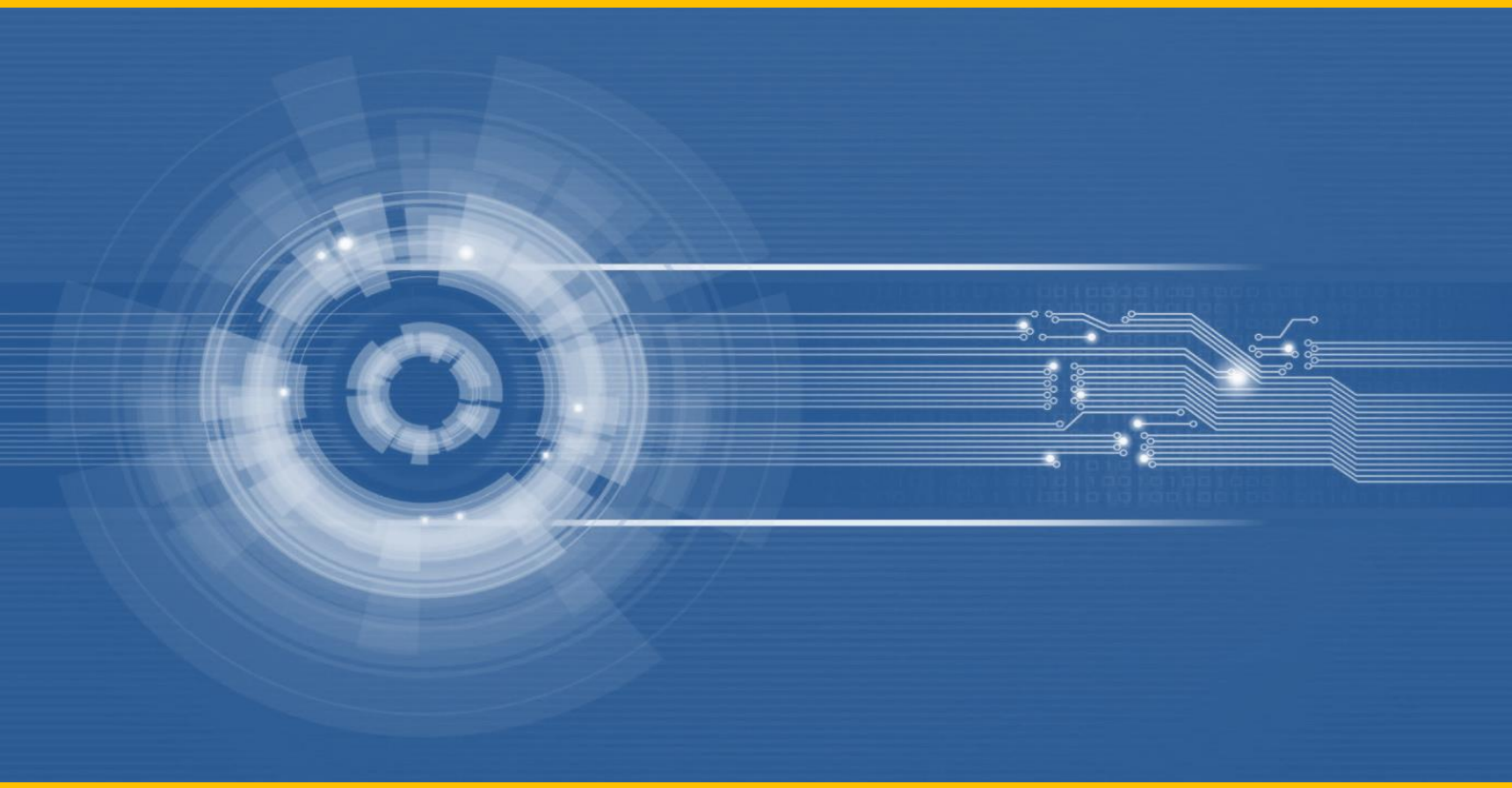
M.I.E.T. ENGINEERING COLLEGE

(Autonomous)

Tiruchirappalli-620007

Curriculum & Syllabus

(Regulations 2024)



M.E. Computer Science and Engineering

M.I.E.T. ENGINEERING COLLEGE

(AUTONOMOUS)

(Approved by AICTE, New Delhi and Affiliated to Anna University, Chennai)
Accredited by NBA (CIVIL, CSE, ECE, EEE & MECH)
Accredited with 'A+' grade by NAAC
(An ISO 9001:2015 Certified Institution)
(Recognized by UGC under section 2(f) & 12(B) of UGC Act, 1956)
TRICHY - PUDUKKOTTAI MAIN ROAD, TRICHY - 620 007

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING



CURRICULUM AND SYLLABUS

M.E. COMPUTER SCIENCE AND ENGINEERING
(Regulation 2024)

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Vision

To attain excellence in Computer Science and Engineering field so as to address societal problems through active research, maintaining ethical standards.

Mission

- ❖ To empower with technical skills to solve the real time problems through interdisciplinary approach.
- ❖ Expose to international ethical practices.
- ❖ Provide personality development for an effective leader and individual member of a team.

Program Outcomes (POs)

At the time of their graduation students of Computer Science and Engineering Program should be in possession of the following Program Outcomes

1. An ability to independently carry out research / investigation and development work to solve practical problems.
2. An ability to write and present a substantial technical report/document.
3. Students should be able to demonstrate a degree of mastery over the area of Computer Science and Engineering.
4. Efficiently design, build and develop system application software for distributed and centralized computing environments in varying domains and platforms.
5. Understand the working of current Industry trends, the new hardware architectures, the software components and design solutions for real world problems by Communicating and effectively working with professionals in various engineering fields and pursue research orientation for a lifelong professional development in computer and automation arenas.
6. Model a computer-based automation system and design algorithms that explore the understanding of the tradeoffs involved in digital transformation.

Program Educational Objectives (PEOs)

1. To accomplish applications of current technologies and exhibit technical skills to develop and implement strategies for solutions in Computer Science and Engineering problems.
2. To inculcate high level of professionalism, ethical attitude, effective communication skills, team spirit, multidisciplinary approach to take on to the challenging environment in the IT industries.
3. To nurture leadership qualities, intellectual curiosity for social needs.

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PO - PEO MAPPING

Program Educational Objectives	Program Outcomes					
	PO1	PO2	PO3	PO4	PO5	PO6
PEO1	2	2	3	3	3	3
PEO2	3	2	3	3	2	3
PEO3	3	3	3	3	3	3

1 - Low, 2 - Medium, 3 – High

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CHOICE BASED CREDIT SYSTEM
CURRICULUM AND SYLLABUS FOR SEMESTERS I TO IV
SEMESTER I

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS PER WEEK	CREDITS
				L	T	P		
1.	24CT1101	Advanced Algorithms & Data Structures	PCC	3	0	0	3	3
2.	24CT1102	Network Technologies	PCC	3	0	0	3	3
3.	24CT1103	Database Design & Practices	PCC	3	0	0	3	3
4.	24CT1104	Advanced Operating Systems	PCC	3	0	0	3	3
5.	24CT1105	Multicore Architecture	PCC	3	0	0	3	3
6.	24RE1101	Research Methodology and IPR	RMC	2	0	0	2	2
7.	24CT1201	Advanced Data Structures and Algorithms Laboratory	PCC	0	0	4	4	2
8.	24CT1202	Database Practices Laboratory	PCC	0	0	4	4	2
							Total	21

SEMESTER II

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS PER WEEK	CREDITS
				L	T	P		
1.	24CT2101	Virtualization & Cloud Computing	PCC	3	0	0	3	3
2.	24CT2102	Advanced Software Engineering	PCC	3	0	0	3	3
3.	-	Professional Elective- I	PEC	3	0	0	3	3
4.	-	Professional Elective - II	PEC	3	0	0	3	3
5.	-	Professional Elective - III	PEC	3	0	0	3	3
6.	-	Professional Elective - IV	PEC	3	0	0	3	3
7.	24RE2101	Scientific Report Writing	RMC	2	0	0	2	2
8.	24CT2201	Cloud Computing Laboratory	PCC	0	0	4	4	2
9.	24CT2202	Software Engineering Laboratory	PCC	0	0	4	4	2
10.	24CT2203	Seminar	FC	0	0	2	2	1
							Total	**25**

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SEMESTER III

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS PER WEEK	CREDITS
				L	T	P		
1.	24CT3101	Cyber Security and Protocols	PCC	3	0	0	3	3
2.	-	Professional Elective-V	PEC	3	0	0	3	3
3.	-	Open Elective	OEC	3	0	0	3	3
4.	24CT3501	Project Work Phase - I	EEC	0	0	12	12	6
5.	24RE3201	Research Article Review	RMC	0	0	4	4	2
							Total	**17**

SEMESTER IV

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS PER WEEK	CREDITS
				L	T	P		
1.	24CT4501	Project Work Phase -II	EEC	0	0	24	24	12
							Total	**12**

PROFESSIONAL CORE COURSES (PCC)

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS PER WEEK	CREDITS
				L	T	P		
1.	24CT1101	Advanced Algorithms & Data Structures	PCC	3	0	0	3	3
2.	24CT1102	Network Technologies	PCC	3	0	0	3	3
3.	24CT1103	Database Design & Practices	PCC	3	0	0	3	3
4.	24CT1104	Advanced Operating Systems	PCC	3	0	0	3	3
5.	24CT1105	Multicore Architecture	PCC	3	0	0	3	3
6.	24CT2101	Virtualization & Cloud Computing	PCC	3	0	0	3	3
7.	24CT2102	Advanced Software Engineering	PCC	3	0	0	3	3
8.	24CT3101	Cyber Security and Protocols	PCC	3	0	0	3	3
9.	24CT1201	Advanced Data Structures and Algorithms	PCC	0	0	4	4	2

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		Laboratory						
10.	24CT1202	Database Practices Laboratory	PCC	0	0	4	4	2
11.	24CT2202	Software Engineering Laboratory	PCC	0	0	4	4	2
12.	24CT2201	Cloud Computing Laboratory	PCC	0	0	4	4	2
							Total	32

PROFESSIONAL ELECTIVES COURSES (PEC)
SEMESTER II, PROFESSIONAL ELECTIVE I, II & III

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS PER WEEK	CREDITS
				L	T	P		
1.	24CT2301	Digital Image and Video Processing	PEC	3	0	0	3	3
2.	24CT2302	Human Computer Interaction	PEC	3	0	0	3	3
3.	24CT2303	Big Data Mining and Analytics	PEC	3	0	0	3	3
4.	24CT2304	Natural Language Processing	PEC	3	0	0	3	3
5.	24CT2305	Compiler Optimization Techniques	PEC	3	0	0	3	3

SEMESTER II & III, PROFESSIONAL ELECTIVE IV & V

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS PER WEEK	CREDITS
				L	T	P		
1.	24CT2306	Multimedia Systems & Applications	PEC	3	0	0	3	3
2.	24CT2307	Block Chain Technologies	PEC	3	0	0	3	3
3.	24CT2308	Full Stack Web Application Development	PEC	3	0	0	3	3
4.	24CT2309	Web Services and API Design	PEC	3	0	0	3	3
5.	24CT2310	Quantum Computing	PEC	3	0	0	3	3

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RESEARCH METHODOLOGY AND IPR COURSES (RMC)

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS PER WEEK	CREDITS
				L	T	P		
1.	24RE1101	Research Methodology and IPR	RMC	2	0	0	2	2
2.	24RE2101	Scientific Report Writing	RMC	2	0	0	2	2
3.	24RE3101	Research Article Review	RMC	0	0	4	4	2

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS PER WEEK	CREDITS
				L	T	P		
1.	24PE1201	Seminar	EEC	0	0	2	2	1
2.	24PE3501	Project Work I	EEC	0	0	12	12	6
3.	24PE4501	Project Work II	EEC	0	0	24	24	12

OPEN ELECTIVE COURSES (OEC)

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS PER WEEK	CREDITS
				L	T	P		
1.	24OEMF01	Green Supply Chain Management	OEC	3	0	0	3	3
2.	24OEMF02	Renewable Energy Technologies	OEC	3	0	0	3	3
3.	24OEMF03	Medical Robotics	OEC	3	0	0	3	3
4.	24OEMF04	Textile Reinforced Composites	OEC	3	0	0	3	3
5.	24OEMF05	Nano Composite Materials	OEC	3	0	0	3	3
6.	24OEMF06	New Product Design and Development	OEC	3	0	0	3	3
7.	24OEVL01	VLSI Architecture for Image Processing	OEC	3	0	0	3	3
8.	24OEVL02	Data Acquisition	OEC	3	0	0	3	3
9.	24OEVL03	Basics of VLSI Design	OEC	3	0	0	3	3
10.	24OEVL04	Embedded System Design	OEC	3	0	0	3	3
11.	24OEVL05	System on Chip	OEC	3	0	0	3	3
12.	24OEVL06	Wireless Sensor Networks	OEC	3	0	0	3	3

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13.	24OEPE01	Electric Vehicle Technology	OEC	3	0	0	3	3
14.	24OEPE02	Renewable Energy Systems	OEC	3	0	0	3	3
15.	24OEPE03	Power Semiconductor Devices	OEC	3	0	0	3	3
16.	24OEPE04	Energy Storage Technologies	OEC	3	0	0	3	3
17.	24OEPE05	Control System Design	OEC	3	0	0	3	3
18.	24OEPE06	Energy Management and Auditing	OEC	3	0	0	3	3
19.	24OEST01	Integrated Water Resources Management	OEC	3	0	0	3	3
20.	24OEST02	Water, Sanitation and Health	OEC	3	0	0	3	3
21.	24OEST03	Principles of Sustainable Development	OEC	3	0	0	3	3
22.	24OEST04	Environmental Impact Assessment	OEC	3	0	0	3	3
23.	24OEST05	Environmental Sustainability	OEC	3	0	0	3	3
24.	24OEST06	Green Building Design	OEC	3	0	0	3	3

Summary

S. No.	Subject Area	Credits Per Semester				Credits Total
		I	II	III	IV	
1.	Professional Core Courses (PCC)	19	10	3	-	**32**
2.	Professional Elective Courses (PEC)	-	12	3	-	**15**
3.	Open Elective Courses (OEC)	-	-	3	-	**3**
4.	Employability Enhancement Courses (EEC)	-	1	6	12	**19**
5.	Research Methodology and IPR courses (RMC)	2	2	2	-	**6**
	Total Credit	**21**	**25**	**17**	**12**	**75**

TOTAL CREDITS TO BE EARNED FOR THE AWARD OF THE DEGREE = 75

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24CT1101 ADVANCED ALGORITHMS AND DATA STRUCTURES **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To understand the usage of algorithms in computing.
- To learn and use hierarchical data structures and its operations.
- To learn the usage of graphs and its applications and study about NP Completeness of problems.

UNIT I ROLE OF ALGORITHMS IN COMPUTING & COMPLEXITY ANALYSIS **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- Data structures and algorithms.

UNIT II HIERARCHICAL DATA STRUCTURES **9**

Binary Search Trees: Basics – Querying a Binary search tree – Insertion and Deletion- Red Black trees: Properties of Red-Black Trees – Rotations – Insertion – Deletion -B-Trees: Definition of B -trees – Basic operations on B-Trees – Deleting a key from a B-Tree- Heap – Heap Implementation–Disjoint Sets-Fibonacci Heaps: structure–Mergeable-heap operations-Decreasing a key and deleting a node-Bounding the maximum degree.

UNIT III GRAPHS **9**

Elementary Graph Algorithms: Representations of Graphs – Breadth-First Search – Depth-First Search – Topological Sort – Strongly Connected Components- Minimum Spanning Trees: Growing a Minimum Spanning Tree – Kruskal and Prim- Single-Source Shortest Paths: The Bellman-Ford algorithm – Single-Source Shortest paths in Directed Acyclic Graphs – Dijkstra‘s Algorithm; Dynamic Programming - All-Pairs Shortest Paths: Shortest Paths and Matrix Multiplication – The Floyd-Warshall Algorithm

UNIT IV ALGORITHM DESIGN TECHNIQUES **9**

Dynamic Programming: Matrix-Chain Multiplication – Elements of Dynamic Programming – Longest Common Subsequence- Greedy Algorithms: – Elements of the Greedy Strategy- An Activity-Selection Problem - Huffman Coding.

UNIT V NP COMPLETE AND NP HARD **9**

NP-Completeness: Polynomial Time–Polynomial -Time Verification–NP-Completeness and Reducibility–NP-Completeness Proofs–NP-Complete Problems.

TOTAL: 45 PERIODS

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COURSE OUTCOMES

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

CO1: Design data structures and algorithms to solve computing problems.
CO2: Choose and implement efficient data structures and apply them to solve problems.
CO3: Design algorithms using graph structure and various string-matching algorithms to solve real-life problems.
CO4: Design one's own algorithm for an unknown problem.
CO5: Apply suitable design strategy for problem solving.

TEXT BOOKS

1. Algorithms and Data Structures for Massive "Datasets Dzejla Medjedovic "Manning Pubns Co (5 July 2022).
2. Adam Drozdex,"Data Structures and algorithms in C++",CengageLearning,4th Edition,2013.
3. T.H. Cormen, C.E.Leiserson,R.L.Rivest and C.Stein," Introduction to Algorithms", Prentice Hall of India, 3rd Edition,2012.

REFERENCE BOOKS

1. Mark Allen Weiss, "Data Structures and Algorithms in C++", Pearson Education, 3rdEdition, 2009.
2. E. Horowitz, S.Sahniand S.Rajasekaran,"Fundamentals of Computer Algorithms", University Press, 2nd Edition, 2008.
3. AlfredV.Aho, JohnE.Hopcroft,Jeffrey D.Ullman,"Data Structures and Algorithms", Pearson Education, Reprint 2006.
4. "Advanced Algorithms and Data Structures" Manning; 1st edition (29 June 2021)
5. Introduction To Algorithms, Fourth EditionThomas H. Cormen is Emeritus Professor of Computer Science at Dartmouth College. MIT Press; 4th edition (5 April 2022).

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Mapping of COs and POs

COs	POs					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	2	2	3	1	3
CO2	3	1	-	-	2	3
CO3	3	-	1	1	-	2
CO4	3	2	1	-	2	1
CO5	3	3	1	1	-	1
AVG	**3**	**2**	**1.3**	**1**	**1**	**2**

1 - Low, 2 - Medium, 3 – High, '-' - No correlation

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24CT1102 NETWORK TECHNOLOGIES **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To understand the basic concepts of networks.
- To explore various technologies in the wireless domain.
- To study about 4G and 5G cellular networks and learn about Network Function Virtualization.

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, And 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, mm Wave, 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. The Use of Multiple Tables. Group Table. OpenFlow Protocol. SDN Control Plane Architecture. Control Plane Functions. Southbound Interface. Northbound Interface. Routing. ITU-T Model. Open Day light. Open Day light Architecture. Open Day light Helium. SDN Application Plane Architecture. Northbound Interface. Network Services Abstraction Layer. Network Applications. User Interface.

UNIT V NETWORK FUNCTIONS VIRTUALIZATION **9**

Motivation-Virtual Machines –NFV benefits-requirements – architecture- NFV Infrastructure - Virtualized Network Functions - NFV Management and Orchestration-NFV Use Cases- NFV and SDN –Network virtualization – VLAN and VPN

TOTAL:45 PERIODS

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COURSE OUTCOMES

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

CO1: Explain basic networking concepts.
CO2: Compare different wireless networking protocols.
CO3: Describe the developments in each generation of mobile data networks.
CO4: Explain and develop SDN based applications.
CO5: Explain the concepts of network function virtualization.

TEXT BOOKS

1. James Bernstein, "NetworkingmadeEasy",2018.
2. Houda Labiod, Costantino de Santis, Hossam Afifi "Wi-Fi, Bluetooth, Zigbee and WiMax", Springer 2007
3. 3.Erik Dahlman, StefanParkvall, JohanSkold,4G: LTE/LTE-Advanced for Mobile Broadband, Academic Press, 2013

REFERENCE BOOKS

1. SaadZ.Asif"5GMobileCommunicationsConceptsand Technologies" CRC press–2019.
2. William Stallings "Foundations of Modern Networking: SDN, NFV, QoE, IoT, and Cloud" 1st Edition, Pearson Education, 2016.
3. Thomas D.Nadeau and Ken Gray,SDN–Software Defined Networks, O"Reilly Publishers, 2013.
4. Guy Pujolle, "Software Networks", Second Edition, Wiley-ISTE,2020.
5. Research Advances in Network Technologies, Dr. Anshul Verma, Dr. Pradeepika Verma and Dr. Kiran Kumar Pattanaik.

Mapping of COs and POs

COs	POs					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	1	3	2	-	1	-
CO2	1	3	3	3	-	1
CO3	1	3	3	2	2	2
CO4	1	2	2	1	2	1
CO5	1	3	1	1	1	2
AVG	**1**	**2.8**	**2.2**	**1.8**	**1.5**	**1.5**

1 - Low, 2 - Medium, 3 – High, '-' - No correlation

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24CT1103 DATABASE DESIGN AND PRACTICES **L T P C**
3 0 0 3

COURSE OBJECTIVES

- Describe the fundamental elements of relational database management systems.
- Explain the basic concepts of relational data model, entity-relationship model, relational database design, relational algebra and SQL.
- Understand query processing in a distributed database system.

UNIT I RELATIONAL DATA MODEL **9**

Entity Relationship Model–Relational Data Model–Mapping Entity Relationship Model to Relational Model – Relational Algebra – Structured Query Language – Database Normalization.

UNIT II DISTRIBUTED DATABASES, ACTIVE DATABASES AND OPEN DATABASE CONNECTIVITY **9**

Distributed Database Architecture – Distributed Data Storage – Distributed Transactions – Distributed Query Processing – Distributed Transaction Management – Event Condition Action Model – Design and Implementation Issues for Active Databases – Open Database Connectivity.

UNIT III XML DATABASES **9**

Structured, semi structured, and Unstructured Data – XML Hierarchical Data Model – XML Documents – Document Type Definition – XML Schema – XML Documents and Databases – XML Querying – XPath – XQuery.

UNIT IV NOSQL DATABASES AND BIG DATA STORAGE SYSTEMS **9**

NoSQL – Categories of NoSQL Systems – CAP Theorem – Document-Based NoSQL Systems and MongoDB – MongoDB Data Model – MongoDB Distributed Systems Characteristics – NoSQL Key – Value Stores – DynamoDB Overview – Voldemort Key – Value Distributed Data Store – Wide Column NoSQL Systems – Hbase Data Model – Hbase Crud Operations – Hbase Storage and Distributed system Concepts – NoSQL Graph Databases and Neo4j- Big Data – MapReduce - Hadoop – YARN.

UNIT V DATABASE SECURITY **9**

Database Security Issues – Discretionary Access Control Based on Granting and Revoking Privileges – Mandatory Access Control and Role-Based Access Control for Multilevel Security – SQL Injection – Statistical Database Security – Flow Control – Encryption and Public Key Infrastructures – Preserving Data Privacy – Challenges to Maintaining Database Security – Database Survivability – Oracle Label-Based Security.

TOTAL: 45 PERIODS

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COURSE OUTCOMES

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

CO1: Convert the ER-model to relational tables, populate relational databases and formulate SQL queries on data.

CO2: Understand and write well-formed XML documents.

CO3: Be able to apply methods and techniques for distributed query processing.

CO4: Design and implement secure database systems.

CO5: Use the data control, definition, and manipulation languages of the NoSQL databases.

TEXT BOOKS

1. R. Elmasri, S.B. Navathe, "Fundamentals of Database Systems", Seventh Edition, Pearson Education 2016.
2. Henry F. Korth, Abraham Silberschatz, S. Sudharshan, "Database System Concepts", Seventh Edition, McGraw Hill, 2019.
3. C.J.Date, A.Kannan, S.Swamynathan, "An Introduction to Database Systems, Eighth Edition, Pearson Education, 2006.

REFERENCE BOOKS

1. Raghu Ramakrishnan, Johannes Gehrke "Database Management Systems", Fourth Edition, McGraw Hill Education, 2015.
2. Harrison, Guy, "Next Generation Databases, NoSQL and Big Data", First Edition, Apress publishers, 2015.
3. Thomas Cannolly and Carolyn Begg, "Database Systems, A Practical Approach to Design, Implementation and Management", Sixth Edition,Pearson Education, 2015.
4. Database Design, second edition of Database Design, Adrienne Watt holds a computer systems diploma (BCIT), a bachelor's degree in technology (BCIT) and a master's degree in business administration (City University).
5. Database Design and Implementation: Second Edition (Data-Centric Systems and Applications), Springer Nature Switzerland AG; 1st ed. 2020 edition (28 February 2020).

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Mapping of COs and POs

COs	POs					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	2	2	1	3	1	2
CO2	2	2	-	2	1	1
CO3	3	1	2	1	-	1
CO4	3	2	2	1	1	1
CO5	2	3	1	1	-	1
AVG	**2.4**	**2**	**1.5**	**1.6**	**1**	**1.2**

1 - Low, 2 - Medium, 3 – High, '-' - No correlation

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24CT1202 DATABASE PRACTICES LABORATORY **L T P C**
0 0 4 2

COURSE OBJECTIVES

- Populate and query a database using SQL DDL/DML Commands.
- Declare and enforce integrity constraints on a database.
- Writing Queries using advanced concepts of SQL.

LIST OF EXPERIMENTS

1. Creation, altering and dropping of tables and inserting rows into a table (use constraints while creating tables) examples using SELECT command.
2. Queries (along with sub-Queries) using ANY, ALL, IN, EXISTS, NOTEXISTS, UNION, INTERSET, Constraints. Example: - Select the roll number and name of the student who secured fourth rank in the class.
3. i. Create a simple PL/SQL program which includes declaration section, executable section and exception –Handling section (Ex. Student marks can be selected from the table and printed for those who secured first class and an exception can be raised if no records were found).
   ii. Insert data into student table and use COMMIT, ROLLBACK and SAVEPOINT in PL/SQL block.
4. Develop a program that includes the features NESTED IF, CASE and CASE expression. The program can be extended using the NULLIF and COALESCE functions.
5. Program development using WHILE LOOPS, numeric FOR LOOPS, nested loops using ERROR Handling, BUILT –IN Exceptions, USE defined Exceptions, RAISEAPPLICATION ERROR.
6. Programs development using creation of procedures, passing parameters IN and OUT of PROCEDURES.
7. Program development using creation of stored functions, invoke functions in SQL Statements and write complex functions.
8. Develop programs using features parameters in a CURSOR, FOR UPDATE CURSOR, WHERE CURRENT of clause and CURSOR variables.
9. Develop Programs using BEFORE and AFTER Triggers, Row and Statement Triggers and INSTEAD OF Triggers
10. Create a table and perform the search operation on table using indexing and non-indexing techniques.

TOTAL: 60 PERIODS

COURSE OUTCOMES

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

CO1: Convert the ER-model to relational tables, populate relational databases and formulate SQL queries on data.
CO2: Understand and write well-formed XML documents.
CO3: Be able to apply methods and techniques for distributed query processing.
CO4: Design and implement secure database systems.
CO5: Use the data control, definition, and manipulation languages of the NoSQL databases.

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Mapping of COs and POs

COs	POs					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	2	2	1	3	1	2
CO2	2	2	-	2	1	1
CO3	3	1	2	1	-	1
CO4	3	2	2	1	1	1
CO5	2	3	1	1	-	1
AVG	**2.4**	**2**	**1.2**	**1.6**	**0.6**	**1.2**

1 - Low, 2 - Medium, 3 – High, '-' - No correlation

24CT1201 ADVANCED DATA STRUCTURES AND ALGORITHMS LABORATORY **L T P C 0 0 4 2**

COURSE OBJECTIVES

- To acquire the knowledge of using advanced tree structures.
- To learn the usage of heap structures.
- To understand the usage of graph structures and spanning trees.

LIST OF EXPERIMENTS

1. Implementation of recursive function for tree traversal and Fibonacci.
2. Implementation of iteration function for tree traversal and Fibonacci.
3. Implementation of Merge Sort and Quick Sort.
4. Implementation of a Binary SearchTree.
5. Red-Black Tree Implementation.
6. Heap Implementation.
7. Fibonacci Heap Implementation.
8. Graph Traversals.
9. Spanning Tree Implementation.
10. Shortest Path Algorithms (Dijkstra's algorithm, Bellman Ford Algorithm)
11. Implementation of Matrix Chain Multiplication.
12. Activity Selection and Huffman Coding Implementation.

HARDWARE/SOFTWARE REQUIREMENTS

1. 64-bit Open-source Linux or its derivative
2. Open-Source C++ Programming tool like G++/GCC

TOTAL: 60 PERIODS

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COURSE OUTCOMES

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

CO1: Design and implement basic and advanced data structures extensively.

CO2: Design algorithms using graph structures.

CO3: Design and develop efficient algorithms with minimum complexity using design techniques.

CO4: Develop programs using various algorithms.

CO5: Choose appropriate data structures and algorithms, understand the ADT/libraries and use it to design algorithms for a specific problem.

Mapping of COs and POs

COs	POs					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	1	1	-	1	1	-
CO2	1	-	1	2	2	1
CO3	1	1	1	1	2	1
CO4	1	2	2	2	2	1
CO5	1	2	3	1	3	1
AVG	**1**	**1.5**	**1.8**	**1.4**	**2**	**1**

1 - Low, 2 - Medium, 3 – High, '-' - No correlation

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24CT1104 ADVANCED OPERATING SYSTEMS **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To get a comprehensive knowledge of the architecture of distributed systems.
- To understand the deadlock and shared memory issues and their solutions in distributed environments.
- To know the security issues and protection mechanisms for distributed environments.

UNIT I INTRODUCTION **9**

Distributed Operating Systems – Issues – Communication Primitives – Limitations of a Distributed System – Lamport's Logical Clocks – Vector Clocks – Causal Ordering of Messages.

UNIT II DISTRIBUTED OPERATING SYSTEMS **9**

Distributed Mutual Exclusion Algorithms – Classification – Preliminaries – Simple Solution – Lamport's Algorithm – Ricart- Agrawala Algorithm – Suzuki- Kasami's Broadcast Algorithm –Raymond's Tree-Based Algorithm – Distributed Deadlock

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Detection – Preliminaries – Centralized Deadlock Detection Algorithms – Distributed Deadlock Detection Algorithms – Path Pushing Algorithm – Edge Chasing Algorithm – Hierarchical Deadlock Detection Algorithms -Agreement Protocols – Classification – Solutions to the Byzantine Agreement Problem – Lamport-Shostak- Pease Algorithm.

UNIT III DISTRIBUTED RESOURCE MANAGEMENT 9

Distributed File Systems – Design Issues – Google File System – Hadoop Distributed File System– Distributed Shared Memory – Algorithms for Implementing Distributed Shared Memory -Load Distributing Algorithms – Synchronous and Asynchronous Check Pointing and Recovery -Fault Tolerance – Two-Phase Commit Protocol – Nonblocking Commit Protocol.

UNIT IV REAL TIME OPERATING SYSTEMS 9

Basic Model of Real - Time Systems – Characteristics – Application of Real - Time Systems– Real - Time Task Scheduling – Handling Resource Sharing.

UNIT V MOBILE AND CLOUD OPERATING SYSTEMS 9

Android – Overall Architecture – Linux Kernel – Hardware Support – Native User-Space – Dalvik and Android's Java – System Services – Introduction to Cloud Operating Systems

TOTAL:45 PERIODS

COURSE OUTCOMES

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

CO1: Identify the features of distributed operating systems.
CO2: Demonstrate the various protocols of distributed operating systems.
CO3: Identify the different features of real time operating systems.
CO4: Discuss the features of mobile operating systems.
CO5: Discuss the features of cloud operating systems.

TEXT BOOKS

1. Mukesh Singhal and Niranjan G. Shivaratri, "Advanced Concepts in Operating Systems – Distributed, Database and Multiprocessor Operating Systems", Tata MC Graw-Hill, 2001.
2. Rajib Mall, "Real-Time Systems: Theory and Practice", Pearson Education India, 2006.
3. Karim Yaghmour, "Embedded Android", O'Reilly, First Edition, 2013.

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REFERENCE BOOKS

1. Nikolay Elenkov, "Android Security Internals: An In-Depth Guide to Android's Security Architecture", No Starch Press, 2014.
2. Advanced Concepts In Operating Systems, by Mukesh Singhal, Niranjan G. Shivaratri, Niranjan Shivaratri, January 1, 1994 by McGraw-Hill Science/Engineering/Math.
3. ADVANCED CONCEPTS IN OPERATING SYSTEMS, by Mukesh Singhal (Author), Niranjan Shivaratri (Author), McGraw Hill Education (1 July 2017).
4. Advanced Concepts in Operating Systems, Mukesh Singhal, Niranjan G. Shivaratri, Tata McGraw-Hill Edition 2001.
5. Distributed Systems: Andrew S. Tanenbaum, Maarten Van Steen, Pearson Prentice Hall, Edition.

Mapping of COs and POs

COs	POs					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	-	3	3	-	-
CO2	3	-	3	2	-	-
CO3	3	-	2	2	2	-
CO4	3	-	2	2	-	-
CO5	3	-	2	3	-	-
AVG	**5**	-	**2.4**	**2.4**	**2**	-

1 - Low, 2 - Medium, 3 – High, '-' - No correlation

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24CT1105 MULTICORE ARCHITECTURES **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To understand the need for multi-core processors, and their architecture.
- To understand the challenges in parallel and multi-threaded programming.
- To learn about the various parallel programming paradigms.

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.

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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 EXPLOITING DIFFERENT TYPES OF PARALLELISM **9**

Homogeneous and Heterogeneous Multi - core Architectures – Intel Multicore Architectures – SUN CMP architecture – IBM Cell Architecture. Introduction to Warehouse – Scale computers, Cloud Computing – Architectures and Issues. Vector, SIMD and GPU Architectures – Vector Architecture – SIMD Extensions for Multimedia – Graphics Processing Units – Case Studies – GPGPU Computing.

UNIT V DOMAIN SPECIFIC ARCHITECTURES **9**

Introduction to Domain Specific Architectures - Guidelines for DSAs. Case Studies – Domain: Deep Neural Networks - Google's Tensor Processing Unit - Microsoft Catapult - Intel Crest - Pixel Visual Core. CPUs Versus GPUs Versus DSAs.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Discuss and evaluate the performance of computer systems.

CO2: Discuss and point out the various ways of exploiting ILP.

CO3: Point out the various optimizations that can be performed to improve the memory hierarchy design.

CO4: Discuss the issues related to multiprocessing and suggest solutions.

CO5: Point out the salient features of different multicore architectures and how they exploit different types of parallelism.

TEXT BOOKS

1. John L. Hennessey and David A. Patterson, "Computer Architecture Quantitative Approach", Morgan Kaufmann / Elsevier, 6th edition, 2019.
2. Wen–mei W.Hwu,"GPU Computing Gems", Morgan Kaufmann / Elsevier, 2011.
3. Yan Solihin, "Fundamentals of Parallel Multicore Architecture", Chapman & Hall/CRC Press, 2016.

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REFERENCE BOOKS

1. David B. Kirk, Wen-mei W. Hwu, "Programming Massively Parallel Processors",Morgan Kauffman, 2010.
2. Multi Core Architectures & Programming, Vijay Nicole Imprints Private Limited, Dr. M. Shyamala Devi.
3. Advanced Computer Organization & Architecture,1st Edition, By Smruti Ranjan Sarangi, Published: June 25, 2021.
4. Fundamentals of Parallel Multicore Architecture by Yan Solihin, Released November 2015, Chapman and Hall/CRC.
5. Fundamentals of Parallel Multicore Architecture Hardcover – Illustrated, 24 November 2015by Yan Solihin (Author), Chapman & Hall; Illustrated edition (24 November 2015).

Mapping of COs and POs

COs	POs					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	3	3	2	1	2
CO2	3	3	3	2	1	2
CO3	3	3	3	2	1	2
CO4	3	3	3	2	1	2
CO5	3	3	3	2	1	2
AVG	**3**	**3**	**3**	**2**	**1**	**2**

1 - Low, 2 - Medium, 3 – High, '-' - No correlation

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24RE1101 RESEARCH METHODOLOGY AND IPR **L T P C**
2 0 0 2

COURSE OBJECTIVES

- To acknowledge the importance of intellectual property and teach students the fundamental concepts of Intellectual Property Rights (IPR).
- To highlight the significance of understanding the practices and procedures for obtaining patents, copyrights, trademarks, and industrial designs.
- To simplify the statutory provisions of various forms of IPR and empower students to effectively maintain and manage their intellectual property rights.

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, Research problem formulation, Research gap identification, Formulation of materials and methods.

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UNIT II DATA COLLECTION AND SOURCES **9**

Measurements, Measurement Scales, Questionnaires and Instruments, Sampling and methods. Data - Preparing, Exploring, examining and displaying, Advanced tools and techniques.

UNIT III DATA ANALYIS AND REPORTING **9**

Overview of Multivariate analysis, Hypotheses testing and Measures of Association- Presenting Insights and findings using written reports and oral presentation, Computer aided Research – Simulation – Case study.

UNIT IV INTELLECTUAL PROPERTY RIGHTS **9**

Intellectual Property - The concept of IPR, Evolution and development of 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.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Differentiate and describe various types of intellectual property rights (IPRs).
CO2: Determine how to classify one's own intellectual work under specific form of IPRs.
CO3: Apply legal provisions to safeguard particular forms of IPRs.
CO4: Examine the rights and responsibilities associated with patents, copyrights, trademarks, industrial designs, and other IPRs.
CO5: Identify the procedures for protecting different forms of IPRs at both national and international levels.

TEXT BOOKS

1. "Research Methodology: Concepts and Cases" by Deepak Chawla and Neena Sondhi Year: 2011
2. "Research Methodology: A Step-by-Step Guide for Beginners" by Ranjit Kumar Year: 2019
3. "Intellectual Property Rights: Unleashing the Knowledge Economy" by Prabha Shukla Year: 2018.

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REFERENCES BOOKS

1. Cooper Donald R, Schindler Pamela S and Sharma JK, “Business Research Methods”, Tata McGraw Hill Education, 11e (2012).
2. Catherine J. Holland, “Intellectual property: Patents, Trademarks, Copyrights, Trade Secrets”, Entrepreneur Press, 2007.
3. Daniel Riordan - Technical Report Writing Today (1998)
4. Darla-Jean Weatherford - Technical Writing for Engineering Professionals (2016) Penwell Publishers.
5. "Intellectual Property Rights: A Global Vision" by R. P. Singh Year: 2016 Secrets” Entrepreneur Press, 2007.

Mapping of COs and POs

COs	POs					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	3	3	2	1	2
CO2	3	3	3	2	1	2
CO3	2	3	2	2	1	2
CO4	3	3	3	2	1	2
CO5	2	3	2	2	1	2
AVG	**2.6**	**5**	**2.6**	**2**	**1**	**2**

1 - Low, 2 - Medium, 3 – High, ‘-’ - No correlation

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24CT2101VIRTUALIZATION & CLOUD COMPUTING **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To gain expertise in Virtualization, Virtual Machines and deploy practical virtualization solution.
- To understand the architecture, infrastructure and delivery models of cloud computing and AWS cloud platform.
- To gain knowledge in the working of Windows Azure and programming model of Hadoop and Aneka.

UNIT I VIRTUALIZATION AND VIRTUALIZATION INFRASTRUCTURE **6**

Basics of Virtual Machines - Process Virtual Machines – System Virtual Machines – Emulation – Interpretation – Binary Translation - Taxonomy of Virtual Machines. Virtualization –Management Virtualization — Hardware Maximization – Architectures – Virtualization Management – Storage Virtualization–Network Virtualization– Implementation levels of virtualization – virtualization structure – virtualization of CPU, Memory and I/O devices – virtual clusters and Resource Management – Virtualization for data center automation.

UNIT II CLOUD PLATFORM ARCHITECTURE **12**

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 III AWS CLOUD PLATFORM – IAAS **9**

Amazon Web Services: AWS Infrastructure - AWS API - AWS Management Console - Setting up AWS Storage - Stretching out with Elastic Compute Cloud - Elastic Container Service for Kubernetes- AWS Developer Tools: AWS Code Commit, AWS Code Build, AWS Code Deploy, AWS Code Pipeline, AWS code Star - AWS Management Tools: Cloud Watch, AWS Auto Scaling, AWS control Tower, Cloud Formation, Cloud Trail, AWS License Manager

UNIT IV PAAS CLOUD PLATFORM **9**

Windows Azure: Origin of Windows Azure, Features, The Fabric Controller – First Cloud APP in Windows Azure- Service Model and Managing Services: Definition and Configuration, Service runtime API- Windows Azure Developer Portal- Service Management API- Windows Azure Storage Characteristics-Storage Services- REST API - Blops.

UNIT V PROGRAMMING MODEL **9**

Introduction to Hadoop Framework - MapReduce, Input splitting, map and reduce functions, specifying input and output parameters, configuring and running a job –Developing Map Reduce Applications - Design of Hadoop file system –Setting up Hadoop Cluster- Aneka: Cloud Application Platform, Thread Programming, Task Programming and Map-Reduce Programming in Aneka.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Employ the concepts of virtualization in the cloud computing.
CO2: Identify the architecture, infrastructure and delivery models of cloud computing.
CO3: Develop the Cloud Application in AWS platform.
CO4: Apply the concepts of Windows Azure to design Cloud Application.
CO5: Develop services using various Cloud computing programming models.

TEXT BOOKS

1. Bernard Golden, Amazon Web Service for Dummies, John Wiley & Sons, 2013.
2. Raoul Alongi, AWS: The Most Complete Guide to Amazon Web Service from Beginner to Advanced Level, Amazon Asia- Pacific Holdings Private Limited, 2019.
3. Sriram Krishnan, Programming: Windows Azure, O'Reilly,2010.

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REFERENCE BOOKS

1. Danielle Ruest, Nelson Ruest, ―Virtualization: A Beginner's Guide‖, McGraw-Hill Osborne Media, 2009.
2. Jim Smith, Ravi Nair, "Virtual Machines: Versatile Platforms for Systems and Processes", Elsevier/Morgan Kaufmann, 2005.
3. John Rittenhouse and James Ransome, "Cloud Computing: Implementation,
4. Management, and Security", CRC Press, 2010.
5. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing, A Practical Approach", McGraw-Hill Osborne Media, 2009.

Mapping of COs and POs

COs	POs					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	-	-	-	2	2	1
CO2	2	3	1	-	-	1
CO3	3	-	3	-	1	3
CO4	-	-	-	2	-	3
CO5	3	2	-	-	-	-
AVG	**2.6**	**1**	**2**	**2**	**1.5**	**2**

1 - Low, 2 - Medium, 3 – High, '-' – No correlation

24CT2102 ADVANCED SOFTWARE ENGINEERING **L T P C 3 0 0 3**

COURSE OBJECTIVES

- To understand the rationale for software development process models.
- To understand why the architectural design of software is important.
- To understand the five important dimensions of dependability, namely, availability, reliability, safety, security, and resilience.

UNIT I SOFTWARE PROCESS &MODELING **9**

Prescriptive Process Models – Agility and Process – Scrum – XP – Kanban – DevOps – Prototype Construction – Prototype Evaluation – Prototype Evolution – Modelling – Principles – Requirements Engineering – Scenario-based Modelling – Class-based Modelling – Functional Modelling – Behavioral Modelling.

UNIT II SOFTWARE DESIGN **9**

Design Concepts – dayt Model – Software Architecture – Architectural Styles – Architectural Design – Component-Level Design – User Experience Design – Design for Mobility – Pattern- Based Design.

UNIT III SYSTEM DEPENDABILITY AND SECURITY **9**

Dependable Systems – Dependability Properties – Sociotechnical Systems – Redundancy and Diversity – Dependable Processes – Formal Methods and Dependability – Reliability Engineering – Availability and Reliability – Reliability Requirements – Fault-tolerant Architectures – Programming for Reliability – Reliability Measurement – Safety Engineering – Safety-critical Systems – Safety Requirements – Safety Engineering Processes – Safety Cases – Security Engineering – Security and Dependability – Safety and Organizations – Security Requirements – Secure System Design – Security Testing and Assurance – Resilience Engineering – Cybersecurity – Sociotechnical Resilience – Resilient Systems Design.

UNIT IV SERVICE-ORIENTED SOFTWARE ENGINEERING, SYSTEMS ENGINEERING AND REAL-TIME SOFTWARE ENGINEERING **9**

Service-oriented Architecture – RESTful Services – Service Engineering – Service Composition – Systems Engineering – Sociotechnical Systems – Conceptual Design – System Procurement – System Development – System Operation and Evolution – Real-time Software Engineering – Embedded System Design – Architectural Patterns for Real-time Software – Timing Analysis – Real-time Operating Systems.

UNIT V SOFTWARE TESTING AND SOFTWARE CONFIGURATION MANAGEMENT **9**

Software Testing Strategy – Unit Testing – Integration Testing – Validation Testing – System Testing – Debugging – White-Box Testing – Basis Path Testing – Control Structure Testing – Black-Box Testing – Software Configuration Management (SCM) – SCM Repository – SCM Process – Configuration Management for Web and Mobile Apps.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Identify appropriate process models based on the Project requirements.

CO2: Understand the importance of having a good Software Architecture.

CO3: Understand the five important dimensions of dependability, namely, availability, reliability, safety, security, and resilience.

CO4: Understand the basic notions of a web service, web service standards and service-oriented architecture.

CO5: Be familiar with various levels of Software testing.

TEXT BOOKS

1. Software Engineering: A Practitioner's Approach, 9th Edition. Roger Pressman and Bruce Maxim, McGraw-Hill 2019.
2. Software Engineering, 10th Edition, Ian Somerville, Pearson Education Asia 2016.
3. Software Architecture in Practice, 3rd Edition, Len Bass, Paul Clements and Rick Kazman, Pearson India 2018

REFERENCE BOOKS

1. An integrated approach to Software Engineering, 3rd Edition, Pankaj Jalote, Narosa Publishing House, 2018.
2. Fundamentals of Software Engineering, 5th Edition, Rajib Mall, PHI Learning Private Ltd, 2018.
3. C.Easteal and G.Davis, Software Engineering Analysis and Design, Tata McGraw Hill.
4. Richard Fairley, Software Engineering Concepts, Tata Mcgraw Hill.
5. Pankaj Jalote, An Integrated Approach to Software engineering, Narosa Publication.

Mapping of COs and POs

COs	POs					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	1	3	2	-	2
CO2	2	1	3	2	-	2
CO3	1	1	3	2	-	2
CO4	3	1	3	3	-	2
CO5	1	1	3	1	-	1
AVG	**2**	**1**	**5**	**2**	**-**	**1.8**

1 - Low, 2 - Medium, 3 – High, '-' – No correlation

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24RE2101 SCIENTIFIC REPORT WRITING **L T P C**
2 0 0 2

COURSE OBJECTIVES

- Understand the essentials of project writing.
- Perceive the difference between general writing and technical writing.
- Assimilate the fundamental features of report writing.

UNIT-I WRITING SKILL **9**

Writing Skills – Essential Grammar and Vocabulary – Passive Voice, Reported Speech, Concord, Signpost words, Cohesive Devices – Paragraph writing – Technical Writing vs. General Writing.

UNIT II PROJECT REPORT **9**

Project Report – Definition, Structure, Types of Reports, and Purpose – Intended Audience – Plagiarism – Report Writing in STEM fields – Experiment Statistical Analysis.

UNIT III STRUCTURE OF PROJECT REPORT **9**

Structure of the Project Report: Framing a Title – Content – Acknowledgement – Funding Details -Abstract – Introduction – Aim of the Study – Background - Writing the research question – Need of the Study/Project Significance, Relevance – Determining the feasibility – Theoretical Framework

UNIT IV REPORT WRITING **9**

Literature Review, Research Design, Methods of Data Collection - Tools and Procedures – Data Analysis - Interpretation - Findings – Limitations - Recommendations – Conclusion – Bibliography.

UNIT V PROOF READNG **9**

Proof reading a report –Avoiding Typographical Errors –Bibliography in required Format – Font Spacing – Checking Tables and Illustrations – Presenting a Report Orally – Techniques.

TOTAL: 30 PERIODS

COURSE OUTCOMES

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

CO1: Write effective project reports.

CO2: Use statistical tools with confidence.

CO3: Explain the purpose and intension of the proposed project coherently and with clarity.

CO4: Create writing texts to suit achieve the intended purpose.

CO5: Master the art of writing winning proposals and projects.

TEXT BOOKS

1. "Scientific Writing and Communication in Agriculture and Natural Resources" C. Choudhury Publisher: New India Publishing Agency Year: 2018.
2. "Technical Writing: A Practical Guide for Engineers and Scientists" by Phillip A. LaPlante (with contributions from Indian authors) Publisher: Wiley Year: 2016.
3. "Effective Technical Communication" by M. Ashraf Rizvi Publisher: Tata McGraw Hill Year: 2008.

REFERENCE BOOKS

1. Gerson and Gerson - Technical Communication: Process and Product, 7th Edition, Prentice Hall (2012).
2. Virendra K. Pamecha - Guide to Project Reports, Project Appraisals and Project Finance (2012).
3. Daniel Riordan - Technical Report Writing Today (1998).
4. Darla-Jean Weatherford - Technical Writing for Engineering Professionals (2016) Penwell Publishers.
5. "Writing Scientific Research Articles: Strategy and Steps" by S.R.K.Rao Publisher: Springer Year: 2019

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Mapping of COs and POs

COs	POs					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	3	-	-	1	-
CO2	3	3	-	-	1	-
CO3	3	3	-	-	1	-
CO4	3	3	-	-	1	-
CO5	3	3	-	-	1	-
AVG	**3**	**3**	**-**	**-**	**1**	**-**

1 - Low, 2 - Medium, 3 – High, '-' – No correlation

24CT2202 SOFTWARE ENGINEERING LABORATORY **L T P C**
0 0 4 2

COURSE OBJECTIVES

- To impart state-of-the-art knowledge on Software Engineering and UML in an interactive manner through the Web.
- Present case studies to demonstrate practical applications of different concepts.
- Provide a scope to students where they can solve small, real-life problems.

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LIST OF EXPERIMENTS

1. Write a Problem Statement to define a title of the project with bounded scope of project.
2. Select relevant process model to define activities and related task set for assigned project.
3. Prepare broad SRS (Software Requirement Specification) for the above selected projects.
4. Prepare USE Cases and Draw Use Case Diagram using modelling Tool.
5. Develop the activity diagram to represent flow from one activity to another for software development.
6. Develop data Designs using DFD Decision Table & ER Diagram.
7. Draw class diagram, sequence diagram, Collaboration Diagram, State Transition Diagram for the assigned project.
8. Write Test Cases to Validate requirements of assigned project from SRS Document.
9. Evaluate Size of the project using function point metric for the assigned project.
10. Estimate cost of the project using COCOMO and COCOCMOII for the assigned project.

11. Use CPM/PERT for scheduling the assigned project.
12. Use timeline Charts or Gantt Charts to track progress of the assigned project.

TOTAL: 60 PERIODS

COURSE OUTCOMES

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

CO1: Can produce the requirements and use cases the client wants for the software being produced.

CO2: Participate in drawing up the project plan. The plan will include at least extent and work assessments of the project, the schedule, available resources, and risk management can model and specify the requirements of mid-range software and their architecture.

CO3: Create and specify such software design based on the requirement specification that the software can be implemented based on the design.

CO4: Can assess the extent and costs of a project with the help of several different assessment methods.

CO5: Be familiar with various levels of Software testing.

Mapping of COs and POs

COs	POs					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	3	3	3	3	3
CO2	2	3	3	3	2	2
CO3	3	1	2	2	1	2
CO4	2	3	1	2	-	-
CO5	1	1	3	1	-	1
AVG	**2**	**1**	**5**	**2**	**-**	**1.8**

1 - Low, 2 - Medium, 3 – High, '-' – No correlation

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24CT2201 CLOUD COMPUTING LABORATORY **L T P C**
0 0 4 3

COURSE OBJECTIVES

- To understand the principles of cloud architecture, models and infrastructure.
- To familiarize the concepts of cloud computing and services.
- To explain cloud platform and types of cloud IV. To explain resource management in cloud.

LIST OF EXPERIMENTS

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

TOTAL:30 PERIODS

COURSE OUTCOMES

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

CO1: Understand the fundamental principles of distributed computing.
CO2: Create virtual machines and virtual templates.
CO3: Create Cloud platform using Virtual machines.
CO4: Identify suitable business models of cloud computing.
CO5: Develop services using various Cloud computing programming models.

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TEXT BOOKS

1. Bernard Golden, Amazon Web Service for Dummies, John Wiley & Sons, 2013.
2. Raoul Alongi, AWS: The Most Complete Guide to Amazon Web Service from Beginner to Advanced Level, Amazon Asia- Pacific Holdings Private Limited, 2019.
3. Sriram Krishnan, Programming: Windows Azure, O'Reilly,2010.

REFERENCE BOOKS

1. Rajkumar Buyya, Christian Vacchiola, S.Thamarai Selvi, Mastering Cloud Computing , MCGraw Hill Education (India) Pvt. Ltd., 2013.
2. Danielle Ruest, Nelson Ruest, ―Virtualization: A Beginner‟s Guide‖, McGraw-Hill Osborne Media, 2009.
3. Jim Smith, Ravi Nair, "Virtual Machines: Versatile Platforms for Systems and Processes", Elsevier/Morgan Kaufmann, 2005.
4. John W.Rittinghouse and James F.Ransome, "Cloud Computing: Implementation, Management, and Security", CRC Press, 2010.
5. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing, A Practical Approach",McGraw-Hill Osborne Media, 2009.

Mapping of COs and POs

COs	POs					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	3	3	3	3	3
CO2	2	3	3	3	2	2
CO3	3	1	2	2	1	2
CO4	2	3	1	2	-	-
CO5	2	1	1	-	-	-
AVG	**2.4**	**2**	**2**	**2**	**2**	**2.3**

1 - Low, 2 - Medium, 3 – High, '-' – No correlation

24CT2203 SEMINAR **L T P C**
0 0 2 1

COURSE OBJECTIVES

- To encourage the students to study advanced engineering developments.
- To prepare and present technical reports.
- To encourage the students to use various teaching aids such as overhead projectors, Power point presentation and demonstrative models.

METHOD OF EVALUATION

During the seminar session each student is expected to prepare and present a topic on engineering/ technology, for a duration of about 45 minutes Each student is expected to present minimum 10 topics during the semester and the student is evaluated based on that. At the end of the semester, he / she can submit a report on his / her topic of seminar and marks are given based on the report. A Faculty guide is to be allotted and he / she will guide and monitor the progress of the student and maintain attendance also. Evaluation is 100% internal.

TOTAL: 30 PERIODS

COURSE OUTCOMES

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

CO1: Review, prepare and present technological developments.
CO2: Face the placement interviews.
CO3: Develop presentation skills.
CO4: Develop report writing.
CO5: Present ideas in conferences.

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Mapping of COs and POs

COs	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1	1	1	2	2
CO2	2	1	1	1	2	2
CO3	-	-	-	-	-	-
CO4	-	-	-	-	-	-
CO5	-	-	-	-	-	-
AVG	2	1	1	1	2	2

1 - Low, 2 - Medium, 3 – High, '-' – No correlation

24CT3101 CYBER SECURITY AND PROTOCOLS **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To become familiar with forensics tools.
- To learn to analyze and validate forensics data.
- Understand key terms and concepts in Cryptography, Governance and Compliance.

UNIT I INTRODUCTION **9**

Need for Cyber security - History of Cyber security - Defining Cyberspace and Cyber security- Standards - CIA Triad – Cyber security Framework.

UNIT II ATTACKS AND COUNTERMEASURES **9**

Malicious Attacks, Threats, and Vulnerabilities – Scope of cyber-attacks – Tools used to attack Computer systems –security breach – Risks, vulnerabilities and threats. Malware – malicious Software attack – social engineering attack – wireless network attack – web application attack Access control - Audit – Authentication - Biometrics - Denial of Service Filters - Ethical Hacking -Firewalls - Scanning, Security policy, Threat Management - Applying software update and patches- Intrusion Detection Systems -Virtual Private Networks –Cryptographic Techniques.

UNIT III SECURING THE INFRASTRUCTURE **9**

Infrastructure Security in the Real World - Understanding Access -Control and Monitoring Systems Understanding Video Surveillance Systems - Understanding Intrusion - Detection and Reporting Systems.

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UNIT IV SECURING LOCAL HOSTS AND NETWORKS **9**

Local Host Security in the Real World - Securing Devices - Protecting the Inner Perimeter Protecting Remote Access Local Network Security in the Real World - Networking Basics –Understanding Networking Protocols - Understanding Network Servers - Understanding Network Connectivity Devices - Understanding Network Transmission Media Security.

UNIT V TOOLS **9**

Zenmap – Hydra –Kismet – John the Ripper – Airgeddon – Deauther Board – Aircrack-ng – EvilOSX.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Analyze and evaluate the cyber security needs of an organization.

CO2: Analyze the security issues in networks and computer systems to secure an infrastructure.

CO3: Design operational cyber security strategies and policies.

CO4: Understand the functionality of cyber security tools.

CO5: Critical thinking and problem-solving skills to detect current and future attacks on an organization's computer systems and networks.

TEXT BOOKS

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1. Network Protocols for Security Professionals Paperback – Import, 26 October 2022 by Yoram Orzach (Author, Contributor), Packet Publishing (26 October 2022)
2. INTRODUCTION TO CYBER SECURITY Paperback – 25 April 2024 by Ajay Singh (Author), Universities Press (25 April 2024).
3. Cyber Security for Beginners Lucas Glisson: Comprehensive and Essential Guide for Newbies to Understand and Master Cybersecurity (2022 Crash Course).

REFERENCES

1. William Stallings, "Effective Cybersecurity: A Guide to Using Best Practices and Standards, 1st edition, 2019.
2. Charles J. Brooks, Christopher Grow, Philip A. Craig, Donald Short, Cybersecurity Essentials, Wiley Publisher, 2018.
3. Yuri Diogenes, ErdalOzkaya, Cyber security - Attack and Defense Strategies, Packt Publishers, 2018.
4. Carol C. Woody, Nancy R. Mead, Cyber Security Engineering: A Practical Approach for Systems and Software Assurance, Addison-Wesley, 2016.
5. Thomas A. Johnson Cyber Security- Protecting Critical Infrastructures from Cyber Attack and Cyber Warfare, CRC Press, 2015.

Mapping of COs and POs

COs	POs					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	1	2	1	1	2	1
CO2	2	1	3	1	1	2
CO3	-	-	2	3	3	3
CO4	2	2	1	2	1	3
CO5	1	-	1	1	2	3
AVG	**1.5**	**1**	**1.6**	**1.6**	**1.8**	**2.4**

1 - Low, 2 - Medium, 3 – High, '-' – No correlation

24RE3201 RESEARCH ARTICLE REVIEW **L T P C**
0 0 4 2

COURSE OBJECTIVES

- To gain knowledge on collecting the research articles.
- To read and understand the various literatures related to the research.
- To write the review article for publication.

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STAGES OF REVIEW

Stage-1: Collection of latest Research articles.
Stage-2: Read the entire article and take a note in his/her own words.
Stage-3: Summarize the literature in his/her own words.
Stage-4: Classify and arrange the literatures with template.
Stage-5: Preparation of review article.
Stage-6: Plagiarism checked by the department and it must be less than 10%.
Stage-7: Article must be communicated to the journal.

The students must do the above work individually by the guidance of faculty members and one coordinator is required to monitor the work progress. The evaluation will be done based on the following

a) Review of work after stage 3 10%
b) Review of work after stage 5 20%
c) Review of work after stage 7 20%
d) Final examination 50%

TOTAL: 60 PERIODS

COURSE OUTCOMES

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

CO1: Understand the technique to collect the literatures from various resources.

CO2: Apply the knowledge for collecting the required research data from the articles.

CO3: Formulate the research problem.

CO4: Analyze the research gap from various researchers work.

CO5: Create the new article to publish in the research journals.

Mapping of COs and POs

COs	POs					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	2	2	-	-	2	-
CO2	2	2	-	-	-	-
CO3	2	2	-	-	-	-
CO4	2	2	-	-	2	-
CO5	2	2	-	-	2	-
AVG	**2**	**2**	-	-	**2**	-

1-Low, 2-Medium, 3-High, '-'- No correlation

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24CT2301 DIGITAL IMAGE AND VIDEO PROCESSING **L T P C**
3 0 0 3

COURSE OBJECTIVES

- Provide the student with the fundamentals of digital image processing.
- Introduce the students to some advanced topics in digital image processing.
- Give the students a useful skill base that would allow them to carry out further study should they be interested and to work in the field.

UNIT I FUNDAMENTALS OF IMAGE PROCESSING **9**

Introduction – Elements of visual perception, Steps in Image Processing Systems – Digital Imaging System – Image Acquisition – Sampling and Quantization – Pixel Relationships – File Formats color images and models – Image Operations.

UNIT II IMAGE ENHANCEMENT AND RESTORATION **9**

Image Transforms – Enhancement in the Spatial Domain –Enhancement in the Frequency Domain Image restoration.

UNIT III IMAGE SEGMENTATION AND MORPHOLOGY **9**

Detection of Discontinuities–Edge operators- Edge Linking and Boundary Detection – Thresholding –Region Based Segmentation – Motion Segmentation - Binary and Gray level morphology Operations – Erosion, Dilation, Opening and Closing Operations Distance Transforms - Basic Morphological Algorithms. Features – Textures – Boundary representations and Descriptions - Component Labeling – Regional Descriptors and Feature Selection Techniques.

UNIT IV BASICS OF VIDEO PROCESSING **9**

Introduction – Video Sampling and Interpolation- Motion Detection and Estimation – Video Enhancement and Restoration.

UNIT V VIDEO SEGMENTATION, TRACKING &APPLICATIONS **9**

Video Segmentation- Motion Segmentation- Motion Tracking in Video-Video Quality Assessment- Case Studies –Image processing in Biometrics, Image Security, Steganography and Watermarking, Stereo vision, Object Segmentation and Tracking in the Presence of Complex Background in video, Forensic video analysis.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Have a clear impression of the breadth and practical scope of digital image processing and have arrived at a level of understanding that it is the foundation for most of the work currently underway in this field.

CO2: Critically analyze the role of video in modern technologies.

CO3: Implement basic image and video processing algorithms.

CO4: Design and develop various applications that incorporate different techniques of Image and Video processing.

CO5: Apply and explore new techniques in the areas of Image and Video Processing.

TEXT BOOKS

1. Rafael C.Gonzalez and Richard E.Woods, “Digital Image Processing”, Third Edition, Pearson Education, New Delhi, 2008.
2. Al Bovik (Alan C Bovik, “The Essential Guide to Video Processing”, Academic Press, Second Edition, 2009.
3. S. Sridhar, “Digital Image Processing”, Oxford University Press, New Delhi, 2011.

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REFERENCE BOOKS

1. Murat Tekalp, "Digital Video Processing", Prentice Hall, 2015.
2. Oges Marques, "Practical Image and Video Processing Using MATLAB", Wiley-IEEE Press, 2011.
3. Handbook of Image and Video Processing A volume in Communications, Networking and Multimedia Book • Second Edition • 2005.
4. Digital Video Processing, Second Edition by A. Murat Tekalp Released June Publisher(s): Pearson ISBN: 9780133991116.
5. Digital Image and Video Processing for GTU B.E. E &TC Engineering Sem Paperback – 2 October 2023 by Dhananjay K. Theckedath (Author).

Mapping of COs and POs

COs	POs					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	1	2	1	1	2	1
CO2	2	1	3	1	1	2
CO3	-	-	2	3	3	3
CO4	2	2	1	2	1	3
CO5	1	-	1	1	2	3
AVG	**1.5**	**1.6**	**1.6**	**1.6**	**1.6**	**2.4**

1 - Low, 2 - Medium, 3 – High, '-' - No correlation

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24CT2303 HUMAN COMPUTER INTERACTION- **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To learn the foundations of Human Computer Interaction
- Understanding Interaction Styles and to become familiar with the design technologies for individuals and persons with disabilities.
- To understand the process of Evaluation of Interaction Design.

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-Human-centered development and Evaluation-Human Performance models-A Brief history of screen design.

UNIT II INTERACTION STYLES - 9

GUI: Popularity of graphics - The 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, Communication and Collaboration Advancing the user experience, Timely user Experience, Information search, Data Visualization Design process: Human Interaction with computers - Importance of Human Characteristics - Human Consideration - Human Interaction Speeds and Understanding Business Junctions.

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.

UNITV WEB AND MOBILE INTERACTION- 9

Hypertext, Multimedia and WWW, Designing for the web Direct Selection, Contextual Tools, Overlays, Inlays and Virtual Pages, Process Flow. Use Transitions-Lookup Patterns-Feedback patterns Mobile apps, Mobile navigation, content and control idioms, multi-touch gestures, Inter- app integration, Mobile web.

COURSE OUTCOMES

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

CO1: Understand the basics of human computer interactions via usability engineering and cognitive modeling.
CO2: Understand the basic design paradigms, complex interaction styles.
CO3: Understand the models and theories for user interaction.
CO4: Examine the evaluation of interaction designs and implementations.
CO5: Elaborate the above issues for web and mobile applications.

TOTAL: 45 PERIODS

TEXT BOOKS

1. Ben Shneiderman, Catherine Plaisant, Maxine Cohen, Steven Jacobs, NiklasElmqvist, “Designing the User Interface: Strategies for Effective Human-Computer Interaction”, Sixth Edition, Pearson Education, 2016.
2. Alan Dix, Janet Finlay, G D Abowd and Russel Beale, "Human Computer Interaction", Pearson Education, Third Edition, 2004.
3. Helen Sharp Jennifer Preece Yvonne Rogers, “Interaction Design: Beyond Human- Computer Interaction”, Wiley, 5th Edition, 2019.

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REFERENCE BOOKS

1. Alan Cooper, Robert Reimann, David Cronin, Christopher Noessel, "About Face: The Essentials of Interaction Design", 4th Edition, Wiley, 2014.
2. Donald A. Norman, "Design of Everyday Things", MIT Press, 2013.
3. Wilbert O Galitz, "The Essential Guide to User Interface Design", Third Edition, Wiley India Pvt., Ltd., 2007.
4. B. Shackel, editors, Human-Computer Interaction - Proceedings INTERACT'90, pages 143-146. North-Holland, Amsterdam, 1990.
5. L. Allinson and N. Hammond. A learning support environment: the hitch-hiker's guide. In R. McAleese, editor, Hypertext: Theory into Practice. Intellect, 1993.

Mapping of COs and POs

COs	POs					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	3	3	3	3	3
CO2	1	-	1	2	2	1
CO3	2	3	2	2	-	1
CO4	2	3	1	2	-	2
CO5	2	2	3	3	3	3
AVG	**2**	**2.7**	**2**	**2.4**	**1.6**	**2**

1 - Low, 2 - Medium, 3 – High, '-' - No Correlation

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24CT2303 BIG DATA MINING AND ANALYTICS **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To understand the computational approaches to Modeling, Feature Extraction.
- To understand the need and application of Map Reduce.
- To understand the various search algorithms applicable to Big Data.

UNIT I DATA MINING AND LARGE-SCALE FILES **9**

Introduction to Statistical modeling – Machine Learning – Computational approaches to modeling – Summarization – Feature Extraction – Statistical Limits on Data Mining - Distributed File Systems – Map-reduce – Algorithms using Map Reduce – Efficiency of Cluster Computing Techniques.

UNIT II SIMILAR ITEMS **9**

Nearest Neighbor Search – Shingling of Documents – Similarity preserving summaries – Locality sensitive hashing for documents – Distance Measures – Theory of Locality Sensitive Functions – LSH Families – Methods for High Degree of Similarities.

UNIT III MINING DATA STREAMS **9**

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

UNIT IV LINK ANALYSIS AND FREQUENT ITEMSETS **9**

Page Rank –Efficient Computation - Topic Sensitive Page Rank – Link Spam – Market Basket Model – A-priori algorithm – Handling Larger Datasets in Main Memory – Limited Pass Algorithm – Counting Frequent Item sets.

UNIT V CLUSTERING **9**

Introduction to Clustering Techniques – Hierarchical Clustering –Algorithms – K-Means – CURE – Clustering in Non -– Euclidean Spaces – Streams and Parallelism – Case Study: Advertising on the Web – Recommendation Systems.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Design algorithms by employing Map Reduce technique for solving Big Data problems.

CO2: Design algorithms for Big Data by deciding on the apt Features set.

CO3: Design algorithms for handling petabytes of datasets.

CO4: Design algorithms and propose solutions for Big Data by optimizing main memory Consumption.

CO5: Design solutions for problems in Big Data by suggesting appropriate clustering techniques.

TEXT BOOKS

1. Jure Leskovec, AnandRajaraman, Jeffrey David Ullman, “Mining of Massive Datasets”, Cambridge University Press, 3rd Edition, 2020.
2. Jiawei Han, MichelineKamber, Jian Pei, “Data Mining Concepts and Techniques”, Morgan Kaufman Publications, Third Edition, 2012.
3. Ian H.Witten, Eibe Frank “Data Mining – Practical Machine Learning Tools and Techniques”, Morgan Kaufman Publications, Third Edition, 2011.

REFERENCE BOOKS

1. Michael Minelli, Michelle Chambers, and AmbigaDhiraj, “Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today’s Businesses”, Wiley, 2013.
2. Eric Sammer, “Hadoop Operations”, O’Reilley, 2012.
3. Sadalage, Pramod J. “NoSQL distilled”, 2013.
4. David Hand, HeikkiMannila and Padhraic Smyth, “Principles of Data Mining”, MIT PRESS, 2001.
5. https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/106104189/lec1.pdf.

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Mapping of COs and POs

COs	POs					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	-	-	-	2	3	3
CO2	-	-	-	-	2	2
CO3	-	-	-	2	3	3
CO4	1	-	2	2	3	3
CO5	2	3	2	2	3	3
AVG	**1**	**3**	**2**	**2**	**2.8**	**2.8**

1 - Low, 2 - Medium, 3 – High, '-' - No Correlation

24CT2304 NATURAL LANGUAGE PROCESSING **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To understand basics of linguistics, probability and statistics.
- To study statistical approaches to NLP and understand sequence labeling.
- To outline different parsing techniques associated with NLP.

UNIT I INTRODUCTION **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- Frame Net- Selection Restrictions - Information Extraction - Template Filling.

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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

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Understand basics of linguistics, probability and statistics associated with NLP.
CO2: Implement a Part-of-Speech Tagger.
CO3: Design and implement a sequence labeling problem for a given domain.
CO4: Implement semantic processing tasks and simple document indexing and searching system using the concepts of NLP.
CO5: Implement a simple chatbot using dialogue system concepts.

TEXT BOOKS

1. Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition 2/e Paperback – 1 January 2013 by Jurafsky / Martin (Author).
2. Handbook Of Natural Language Processing Second Edition, Ralf herbrich and thore graepel, Microsoft research ltd, Cambridge.
3. 5 Free Books on Natural Language Processing to Read in 2023 By Nisha Arya, Contributing Editors & Marketing and Client Success Manager on June 29, 2023 in Natural Language Processing.

REFERENCE BOOKS

1. Building Natural Language Generation Systems (Studies in Natural Language Processing) Paperback – 9 March 2006 by Ehud Reiter (Author), Robert Dale (Author).
2. Natural Language Processing in Artificial Intelligence Hardcover – Import, 2 November 2020 by Brojo Kishore Mishra (Editor), Raghvendra Kumar (Editor) , Apple Academic Press; 1st edition.
3. Natural Language Processing with Transformers: Building Language Applications with Hugging Face, Revised Colour Edition Paperback – 27 June 2022 by Lewis Tunstall (Author), Leondro von Werra (Author), Thomas Wolf (Author) Shroff/O'Reilly; First Edition (27 June 2022); Shroff Publishers & Distributors Pvt. Ltd.,

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Mapping of COs and POs

COs	POs					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	-	2	3	1	1	-
CO2	2	2	2	3	-	3
CO3	3	-	3	3	-	3
CO4	1	-	2	3	-	3
CO5	1	-	2	3	-	3
AVG	**1.7**	**2**	**2.4**	**2.6**	**1**	**3**

1 - Low, 2 - Medium, 3 – High, '-' - No Correlation

24CT2305 COMPILER OPTIMIZATION TECHNIQUES **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To understand the optimization techniques used in compiler design.
- To be aware of the various computer architectures that support parallelism.
- To become familiar with the theoretical background needed for code optimization.

UNIT I INTRODUCTION **9**

Language Processors - The Structure of a Compiler – The Evolution of Programming Languages- The Science of Building a Compiler – Applications of Compiler Technology Programming Language Basics - The Lexical Analyzer Generator -Parser Generator - Overview of Basic Blocks and Flow Graphs - Optimization of Basic Blocks - Principle Sources of Optimization.

UNIT II INSTRUCTION-LEVEL PARALLELISM **9**

Processor Architectures – Code-Scheduling Constraints – Basic-Block Scheduling –Global Code Scheduling – Advanced code motion techniques – Interaction with Dynamic Schedulers- Software Pipelining.

UNIT III OPTIMISING FOR PARALLELISM AND LOCALITY-THEORY **9**

Basic Concepts – Matrix-Multiply: An Example - Iteration Spaces - Affine Array Indexes – Data Reuse- Array data dependence Analysis.

UNIT IV OPTIMISING FOR PARALLELISM AND LOCALITY APPLICATION **9**

Finding Synchronization - Free Parallelism – Synchronization Between Parallel Loops – Pipelining – Locality Optimizations – Other Uses of Affine Transforms.

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UNIT V INTERPROCEDURAL ANALYSIS **9**

Basic Concepts – Need for Intraprocedural Analysis – A Logical Representation of Data Flow – A Simple Pointer-Analysis Algorithm – Context Insensitive Intraprocedural Analysis - Context- Sensitive Pointer-Analysis - Data log Implementation by Binary Decision Diagrams.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Design and implement techniques used for optimization by a compiler.
CO2: Modify the existing architecture that supports parallelism.
CO3: Modify the existing data structures of an open-source optimizing compiler.
CO4: Design and implement new data structures and algorithms for code optimization.
CO5: Critically analysis different data structures and algorithms used in the building of an optimizing compiler.

TEXT BOOKS

1. Alfred V. Aho, Monica S.Lam, Ravi Sethi, Jeffrey D.Ullman, "Compilers: Principles, Techniques and Tools", Second Edition, Pearson Education,2008.
2. Randy Allen, Ken Kennedy, "Optimizing Compilers for Modern Architectures: A Dependence-based Approach", Morgan Kaufmann Publishers, 2002.
3. Steven S. Muchnick, "Advanced Compiler Design and Implementation", Morgan Kaufmann Publishers - Elsevier Science, India, 2007.

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REFERENCE BOOKS

1. John Hopcroft, Rajeev Motwani, Jeffrey Ullman, "Introduction to Automata Theory Languages, and Computation", Third Edition, Pearson Education, 2007.
2. Torbengidius Mogensen, "Basics of Compiler Design", Springer, 2011.
3. Aho, A., Lam, M., Sethi, R., Ullman, J., Compilers: Principles, Techniques, & Tools, Addison Wesley, 2007.
4. Y. N. Srikant, Priti Shankar, The Compiler Design Handbook: Optimizations and Machine Code Generation, CRC Press, 2008
5. Randy Allen, Ken Kennedy, Optimizing Compilers for Modern Architectures: A Dependence-based Approach, Morgan Kaufmann, 2001.

Mapping of COs and POs

COs	POs					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	2	2	2	3	2	2
CO2	-	-	3	3	-	3
CO3	3	-	3	3	-	3
CO4	3	3	3	3	-	-
CO5	-	3	3	3	3	-
AVG	**2.6**	**2.6**	**2.8**	**3**	**2.5**	**1.6**

1 - Low, 2 - Medium, 3 – High, '-' - No Correlation

24CT2306 MULTIMEDIA SYSTEMS AND APPLICATIONS **L T P C**
3 0 0 3

COURSE OBJECTIVES

- Understanding the role of World Wide Web.
- Study the Structuring Information in a Multimedia Form.
- Know about Multimedia Systems and Application.

UNIT I MULTIMEDIA ELEMENTS **9**

Principles – Cognition, Learning, Interaction, Medium of Consumption: Elements - Text – characteristics, standards, formats; Graphics – representation, file formats, Image / Graphics – file formats, standards; Digital Audio – Characteristics, formats, standards, Speech, Video – characteristics, formats; Animation – characteristics, formats; Multidimensional Data Structures, k- d trees, Quad Trees, R-trees.

UNIT II MULTIMEDIA TOOLS and AUTHORING **9**

Hardware – Display Devices, wearables, Graphics cards, I/O devices, software – Editing tools For Text, Image, Audio, Video and animation. Authoring tools, Authoring Multimedia presentations, Authoring Metaphors.

UNIT III MULTIMEDIA COMPRESSION **9**

Symmetric and Asymmetric methods, Lossy and Lossless Compression, Text compression – RLE, Huffman, Arithmetic, Dictionary based; Document Image compression standards – CCITT and Color Image Compression – JPEG, Audio Compression – PCM, ADPCM, MPEG, AAC, AC3, speech compression; Video Compression-MPEG-4, H.265, DVI.

UNIT IV MULTIMEDIA COMMUNICATION SYSTEMS **9**

Multimedia Communication Standards, Transport Protocols, streaming protocols, Internet Protocols Wireless multimedia communications, synchronization and QOS, security,

Entertainment networks, Collaborative multimedia support, Real-time distributed multimedia networks, Hypertext, Hypermedia.

UNIT V MULTIMEDIA APPLICATIONS 9

Applications for WWW - Multimedia databases–Indexing and Retrieval, Visualization, Virtual, Augmented and Mixed Reality, Interactive E-learning, HCI and UX design, Games and Animation, Real-Time video conferencing.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Handle the multimedia elements effectively

CO2: Use Multimedia Hardware and Software for Editing and Authoring multimedia applications.

CO3: Implement Compression algorithms for various multimedia applications.

CO4: Develop effective strategies to deliver Quality-of-Experience in networked Multimedia applications.

CO5: Design and develop multimedia applications in various domains.

TEXT BOOKS

1. Ze-Nian Li, Mark S. Drew, Jiangchuan Liu, “Fundamentals of Multimedia”, Second Edition, Springer Nature (Texts in Computer Science), 2014.
2. Prabhat K. Andleigh, Kiran Thakrar, “Multimedia Systems Design”, Pearson Education India, Ist Edition, 2015.
3. Ralf Steinmetz and KlaraNahrstedt, “Multimedia computing, communications, and applications”, Pearson India, Pearson, 2002.

REFERENCE BOOKS

1. FredHalsall, “Multimedia Communications: Applications, Networks, Protocols and Standards”, Pearson Education, 2002.
2. Khalid Sayood, “Introduction to Data Compression”, 4th Edition, Morgan Kauffman, 2012.
3. K.R. Rao, Zoran S. Bojkovic, Bojan M. Bakmaz, “Wireless Multimedia Communication systems: Design, Analysis and Implementation”, CRC press, 2017.
4. V.S. Subrahmanian, “Principles of Multimedia Database Systems”, Elsevier / Morgan Kauffmann, 2008.
5. Kiran Thakrar, Prabhat k.andleigh, “Multimedia System Design”, Prentice Hall India.

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Mapping of COs and POs

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

1 - Low, 2 - Medium, 3 – High, '-' - No Correlation

24CT2307 BLOCKCHAIN TECHNOLOGIES **L T P C**
3 0 0 3

COURSE OBJECTIVES

- Explain the objectives of Cryptography.
- To Introduce block chain technology and Crypto currency.
- Explain the importance and application of Bitcoin 2.0 protocols, smart tracts.

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UNIT I INTRODUCTION **9**

Blockchain Overview-History and Origin of Blockchain - Technical Concepts of Blockchain Systems: Physical Ledger Technology and Security - Digital Ledger Technology, Digital Security Technology: Cryptographic Hash Functions - Digital Signatures.

UNII FOUNDATIONS **9**

Centralization vs. Decentralization of Blockchain - Distributed Ledger Technology (DLT) Technical Concepts: Mining - Distributed Consensus- Incentives - Proof of Work - Cryptosystems in practice- Distributed Networks – Attacks - Consensus Protocols.

UNIT III WEB3 AND HYPERLEDGER **9**

Web 3 Contract deployment – POST requests – Frontend – Development framework – Hyperledger Projects – Protocol – Reference architecture – Hyperledger Fabric – Corda.

UNIT IV SMART CONTRACTS & ETHEREUM **9**

Smart Contracts – Definition – Ricardian contracts - Ethereum blockchain –Ethereum network – Components of Ethereum ecosystem –Programming languages - Ethereum development environment - Non-Fungible Token (NFT).

UNIT V ALTERNATIVE BLOCKCHAINS AND APPLICATIONS 9

Alternative blockchains – Applications, Internet of Things, Government, Health, Finance – Scalability -Privacy.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Explain cryptocurrencies and their relationship with the blockchain technology.
CO2: Explain the different steps in the use of Bitcoins.
CO3: Relate Web 3 and Hyperledger to concepts in blockchain technologies.
CO4: Apply blockchains to different real-life problems.
CO5: Implement a simple application using Ethereum.

TEXT BOOKS

1. Imran Bashir, "Mastering Blockchain: Distributed Ledger Technology, Decentralization, and Smart Contracts Explained", Second Edition, Packt Publishing, 2018.
2. Narayanan, J. Bonneau, E. Felten, A. Miller, S. Goldfeder, "Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction" Princeton University Press, 2016.
3. Alex Leverington, "Ethereum Programming" Packt Publishing Limited, 2017.

REFERENCE BOOKS

1. Andreas Antonopoulos, Satoshi Nakamoto, "Mastering Bitcoin", O'Reilly Publishing, 2014.
2. Roger Wattenhofer, "The Science of the Blockchain" Create Space Independent Publishing Platform, 2016.
3. Arshdeep Bahga and Vijay Madisetti, "Blockchain Applications: A Hands- On Approach", 2017.

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Mapping of COs and POs

COs	POs					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	2	1	3	2	2	3
CO2	2	1	2	3	2	2
CO3	2	1	3	1	2	1
CO4	2	1	2	3	2	2
CO5	-	-	-	-	-	-
AVG	**2**	**1**	**2.5**	**2.25**	**2**	**2**

1 - Low, 2 - Medium, 3 – High, '-' - No Correlation

24CT2308 FULL STACK WEB APPLICATION DEVELOPMENT **L T P C**
3 0 0 3

COURSE OBJECTIVES

- Develop Type Script Application.
- Develop Single Page Application (SPA).
- Able to communicate with a server over the HTTP protocol.

UNIT I FUNDAMENTALS & TYPESCRIPT LANGUAGE **9**

Server-Side Web Applications. Client-Side Web Applications. Single Page Application. About TypeScript. Creating TypeScript Projects. TypeScript Data Types. Variables. Expression and Operators. Functions. OOP in Typescript. Interfaces. Generics. Modules. Enums. Decorators. Enums. Iterators. Generators.

UNIT II ANGULAR **9**

About Angular. Angular CLI. Creating an Angular Project. Components. Components Interaction. Dynamic Components. Angular Elements. Angular Forms. Template Driven Forms. Property, Style, Class and Event Binding. Two-way Bindings. Reactive Forms. Form Group. Form Controls. About Angular Router. Router Configuration. Router State. Navigation Pages. Router Link. Query Parameters. URL matching. Matching Strategies. Services. Dependency Injection. HttpClient. Read Data from the Server. CRUD Operations. Http Header Operations. Intercepting requests and responses.

UNIT III NODE.js **9**

About Node.js. Configuring Node.js environment. Node Package Manager NPM. Modules. Asynchronous Programming. Call Stack and Event Loop. Callback functions. Callback errors. Abstracting callbacks. Chaining callbacks. File System. Synchronous vs. asynchronous I/O. Path and directory operations. File Handle. File Synchronous API. File Asynchronous API. File Callback API. Timers. Scheduling Timers. Timers Promises API. Node.js Events. Event Emitter. Event Target and Event API. Buffers. Buffers and TypedArrays. Buffers and iteration. Using buffers for binary data. Flowing vs. non-flowing streams. JSON.

UNIT IV EXPRESS.Js **9**

Express.js. How Express.js Works. Configuring Express.js App Settings. Defining Routes. Starting the App. Express.js Application Structure. Configuration, Settings. Middleware. body-parser. cookie-parser. express-session. response-time. Template Engine. Jade. EJS. Parameters. Routing. router. Route(path). Router Class. Request Object. Response Object. Error Handling. RESTful.

UNIT V MONGODB **9**

Introduction to MongoDB. Documents. Collections. Subcollections. Database. Data Types. Dates. Arrays. Embedded Documents. CRUD Operations. Batch Insert. Insert Validation. Querying The Documents. Cursors. Indexing. Unique Indexes. Sparse Indexes. Special Index and Collection Types. Full-Text Indexes. Geospatial Indexing. Aggregation framework.

TOTAL:45 PERIODS

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COURSE OUTCOMES

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

CO1: Develop basic programming skills using JavaScript.
CO2: Implement a front-end web application using Angular.
CO3: Will be able to create modules to organize the server.
CO4: Build RESTful APIs with Node, Express and MongoDB with confidence.
CO5: Will learn to Store complex, relational data in MongoDB using Mongoose.

TEXT BOOKS

1. Adam Freeman, Essential TypeScript, Apress, 2019.
2. Mark Clow, Angular Projects, Apress, 2018.
3. Alex R. Young, Marc Harter, Node.js in Practice, Manning Publication, 2014.

REFERENCE BOOKS

1. Full Stack Development with Angular and Spring Boot: Build scalable, responsive. dynamic enterprise-level web applications (English Edition) Paperback – 16 August 2024 by Sangeeta Joshi (Author).
2. Full-Stack Web Development with Jakarta EE and Vue.js: Your One-Stop Guide to Building Modern Full-Stack Applications with Jakarta EE and Vue.js Paperback – Import, 11 December 2020 by Daniel Andres Pelaez Lopez (Author).
3. Full Stack Web Development Paperback – 29 April 2024 by Yerragudipadu Subbarayudu (Author), Suresh Kumar Kanaparthi (Author) .
4. Pro Express.js, Azat Mardan, Apress, 2015.
5. MongoDB in Action, Kyle Banker, Peter Bakkum, Shaun Verch, Douglas Garrett, Tim Hawkins, Manning Publication, Second edition, 2016.

Mapping of COs and POs

COs	POs					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	1	1	-	1	-
CO2	3	1	1	1	-	1
CO3	2	2	3	1	-	2
CO4	3	1	1	-	-	1
CO5	3	1	1	1	1	1
AVG	**2.8**	**1.2**	**1.4**	**1**	**1**	**1.3**

1 - Low, 2 - Medium, 3 – High, '-' - No Correlation

24CT2309 WEB SERVICES AND API DESIGN **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To learn the basics of Web service.
- To become familiar with the Web Services building blocks.
- To learn to work with RESTful web services.

UNIT I INTRODUCTION TO 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 - JSON Parsers: Handling Serialized Data - Clients Made Easy with WADL.

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.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Explain how to write XML documents.
CO2: Apply the web service building blocks such as SOAP, WSDL and UDDI.
CO3: Describe the REST ful web services.
CO4: Implement the RESTful web service with Spring Boot MVC.
CO5: Discuss Resource-oriented Architecture.

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TEXT BOOKS

1. Leonard Richardson and Sam Ruby, RESTful Web Services, O'Reilly Media, 2007
2. McGovern, et al., "Java Web Services Architecture", Morgan Kaufmann Publishers,2005.
3. Lindsay Bassett, Introduction to JavaScript Object Notation, O'Reilly Media, 2015.

REFERENCE BOOKS

1. Craig Walls, "Spring in Action, Fifth Edition", Manning Publications, 2018
2. Raja CSP Raman, Ludovic Dewailly, "Building A RESTful Web Service with Spring 5", Packt Publishing, 2018.
3. Bogunuva Mohanram Balachandar, "Restful Java Web Services, Third Edition: A pragmatic guide to designing and building RESTful APIs using Java", Ingram short title, 3rd Edition, 2017.
4. Mario-Leander Reimer, "Building RESTful Web Services with Java EE 8: Create modern RESTful web services with the Java EE 8 API", Packt publishing, 2018.
5. XML, Web Services, and the Data Revolution, F.P.Coyle, Pearson Education.

Mapping of COs and POs

COs	POs					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	2	1	3	2	2	3
CO2	2	1	2	3	2	2
CO3	2	1	3	1	2	1
CO4	2	1	2	3	2	2
CO5	-	-	-	-	-	-
AVG	**2**	**1**	**2.5**	**2.3**	**2**	**2**

1 - Low, 2 - Medium, 3 – High, '-' - No Correlation

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24CT2310 QUANTUM COMPUTING **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To introduce the building blocks of Quantum computers and highlight.
- The paradigm changes between conventional computing and quantum computing.
- To understand the Quantum state transformations and the algorithms.

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.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Understand the basic principles of quantum computing.

CO2: Gain knowledge of the fundamental differences between conventional computing and quantum computing.

CO3: Understand several basic quantum computing algorithms.

CO4: Understand the classes of problems that can be expected to be solved well by quantum computers.

CO5: Simulate and analyze the characteristics of Quantum Computing Systems.

TEXT BOOKS

1. John Gribbin, Computing with Quantum Cats: From Colossus to Qubits, 2021.
2. William (Chuck) Easttom, Quantum Computing Fundamentals, 2021.
3. Parag Lala, Quantum Computing, 2019.

REFERENCE BOOKS

1. Eleanor Rieffel and Wolfgang Polak, QUANTUM COMPUTING A Gentle Introduction, 2011.
2. Nielsen M. A., Quantum Computation and Quantum Information, Cambridge University Press.2002.
3. Benenti G., Casati G. and Strini G., Principles of Quantum Computation and Information, Vol. I: Basic Concepts, Vol II: Basic Tools and Special Topics, World Scientific. 2004.
4. Pittenger A. O., An Introduction to Quantum Computing Algorithms 2000
5. Eric R. Johnston, Nic Harrigan, Mercedes Gimeno-Segovia : Programming Quantum Computers. 2019.

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Mapping of COs and POs

COs	POs					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	1	2	3	-	1	-
CO2	1	2	3	-	2	-
CO3	-	1	3	2	3	2
CO4	2	-	2	2	1	3
CO5	3	-	1	2	3	3
AVG	**1.7**	**1.6**	**2.4**	**2**	**2**	**2.6**

1- Low, 2 - Medium, 3 – High, '-' - No Correlation

24OEMF01 GREEN SUPPLY CHAIN MANAGEMENT **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To introduce the concept and significance of Green Supply Chain Management.
- To equip learners with the knowledge of environmental management practices.
- To develop analytical and strategic skills.

UNIT I INTRODUCTION **9**

Concept and importance of Green Supply Chain Management - Evolution of GSCM: Traditional Supply Chains vs. Green Supply Chains. Environmental Impact, Key Drivers and Challenges in GSCM. Green Procurement and Eco-friendly Sourcing - Life Cycle Assessment (LCA) and its role in GSCM.

UNIT II ENVIRONMENTAL MANAGEMENT IN SUPPLY CHAIN **9**

Environmental Policies and Regulations Impacting Supply Chains - Green Manufacturing. Role of Technology and Innovation in Reducing Environmental Footprints - Eco-labeling and Certifications in Supply Chains - Reverse Logistics and Recycling - Waste Management and Circular Economy Principles - Carbon Footprint Calculation and Reduction Strategies in SCM.

UNIT III GREEN LOGISTICS AND TRANSPORTATION MANAGEMENT **9**

Sustainable Transportation Practices and Eco-friendly Logistics - Green Packaging: Materials, Design, and Processes - Optimizing Distribution and Transportation Networks for Sustainability - Carbon Emissions in Logistics - Energy Efficiency in Transportation - Role of ICT in Greening Transportation Networks - Urban Logistics and Green Infrastructure.

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UNIT IV SUSTAINABLE SUPPLY CHAIN DESIGN AND STRATEGY 9

Sustainable Supply Chain Network Design - Supplier Selection and Collaboration for Sustainability. Risk Management - Sustainable Product Design and Eco-innovation. Green Supply Chain Metrics and Performance Indicators - Integration of Environmental and Social Considerations into SCM Strategy - Case Studies.

UNIT V GREEN SUPPLY CHAIN ANALYTICS AND PERFORMANCE MANAGEMENT 9

Data Analytics for Green Supply Chain Management - Tools and Techniques for Evaluating Sustainability in SCM - Environmental and Economic Performance Evaluation in GSCM - Benchmarking and Best Practices in Green SCM - Use of Green Certifications and Standards for Supply Chain Performance - Reporting and Communicating Sustainability in the Supply Chain - Challenges in Monitoring and Managing Green Supply Chains.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Explain the key drivers, challenges, and environmental policies.
CO2: Apply green procurement strategies and life cycle assessment.
CO3: Implement sustainable practices in logistics and transportation.
CO4: Design and manage sustainable supply chain networks.
CO5: Analyze and monitor green supply chain performance.

TEXT BOOKS

1. Wang, Hsiao-Fan & Gupta, Surendra M. Green Supply Chain Management: Product Life Cycle Approach, McGraw-Hill Professional, 2011.
2. Sarkis, Joseph & Dou, Yijie, Green Supply Chain Management: A Concise Introduction, Routledge, 2017.
3. Khan, Mehmood; Hussain, Matloub; Ajmal, Mian M. Green Supply Chain Management for Sustainable Business Practice, IGI Global, 2017.

REFERENCE BOOKS

1. Johnsen, Thomas E.; Howard, Mickey; Miemczyk, Joe, Purchasing and Supply Chain Management: A Sustainability Perspective, Routledge, 2018
2. Bouchery, Yann; Corbett, Charles J.; Fransoo, Jan C.; Tan, Sustainable Supply Chains: A Research-Based Textbook on Operations and Strategy Springer, 2017.
3. Khan, Syed Abdul Rehman (Ed.), Green Practices and Strategies in Supply Chain Management, Intech Open, 2019
4. Esty, Daniel C.; Winston, Andrew S. Yale University Green to Gold: How Smart Companies Use Environmental Strategy to Innovate, Create Value, and Build Competitive Advantage, Press, 2006
5. Sarkis, Joseph (Ed.), Handbook of Green Supply Chain Management, CRC Press, 2012.

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24OEMF02 RENEWABLE ENERGY TECHNOLOGIES **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To understand the fundamentals and classification of renewable energy sources, their environmental impact, and the current scenario in India.
- To analyze the working principles and characteristics of solar photovoltaic and wind energy systems, including system design and performance factors.
- To explore various alternative renewable energy technologies such as biomass, ocean, hydrogen, fuel cells, and geothermal systems.

UNIT I INTRODUCTION **9**

Classification of energy sources – Co2 Emission - Features of Renewable energy – Renewable energy scenario in India -Environmental aspects of electric energy conversion: impacts of renewable energy generation on environment Per Capital Consumption - CO2 Emission - importance of renewable energy sources, Potentials – Achievements– Applications.

UNIT II SOLAR PHOTOVOLTAICS **9**

Solar Energy: Sun and Earth-Basic Characteristics of solar radiation- angle of sunrays on solar collector-Estimating Solar Radiation Empirically - Equivalent circuit of PV Cell-Photovoltaic cell characteristics: P-V and I-V curve of cell-Impact of Temperature and Insolation on I-V characteristics-Shading Impacts on I-V characteristics-Bypass diode - Blocking diode.

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UNIT III PHOTOVOLTAIC SYSTEM DESIGN **9**

Block diagram of solar photo voltaic system : Line commutated converters (inversion mode) - Boost and buck-boost converters - selection of inverter, battery sizing, array sizing - PV systems classification- standalone PV systems - Grid tied and grid interactive inverters- grid connection issues.

UNIT IV WIND ENERGY CONVERSION SYSTEMS **9**

Origin of Winds: Global and Local Winds- Aerodynamics of Wind turbine-Derivation of Betz's limit Power available in wind-Classification of wind turbine: Horizontal Axis wind turbine and Vertical axis wind turbine- Aerodynamic Efficiency-Tip Speed-Tip Speed Ratio-Solidity-Blade Count-Power curve of wind turbine - Configurations of wind energy conversion systems: Type A, Type B, Type C and Type D Configurations- Grid connection Issues - Grid integrated SCIG and PMSG based WECS.

UNIT V OTHER RENEWABLE ENERGY SOURCES **9**

Qualitative study of different renewable energy resources: ocean, Biomass, Hydrogen energy systems, Fuel cells, Ocean Thermal Energy Conversion (OTEC), Tidal and wave energy, Geothermal Energy Resources.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Demonstrate the need for renewable energy sources.

CO2: Develop a stand-alone photo voltaic system and implement a maximum power point tracking in the PV system.

CO3: Design a stand-alone and Grid connected PV system.

CO4: Analyze the different configurations of the wind energy conversion systems.

CO5: Realize the basic of various available renewable energy sources.

TEXT BOOKS

1. S.N.Bhadra, D. Kastha, & S. Banerjee "Wind Electrical Systems", Oxford University Press, 2009.
2. Rai. G.D, "Non conventional energy sources", Khanna publishes, 1993.
3. Chetan Singh Solanki, "Solar Photovoltaics: Fundamentals, Technologies and Applications", PHI Learning Private Limited, 2012.

REFERENCE BOOKS

1. John Twideu and Tony Weir, "Renewal Energy Resources" BSP Publications, 2006
2. Gray, L. Johnson, "Wind energy system", prentice hall of India, 1995.
3. B.H.Khan, " Non-conventional Energy sources", , McGraw-hill, 2nd Edition, 2009.
4. Fang Lin Luo Hong Ye, " Renewable Energy systems", Taylor & Francis Group,2013
5. Rai. G.D," Solar energy utilization", Khanna publishes, 1993.

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24OEMF03 MEDICAL ROBOTICS **L T P C**

3 0 0 3

COURSE OBJECTIVES

- Identify and describe different types of medical robots and their potential applications.
- Know basic concepts in kinematics, Dynamics, and control relevant to Medical Robotics.
- Develop the Analytical and Experimental skills necessary to Design and Implement robotic assistance for both minimally invasive surgery and Image guided interventions.

UNIT I INTRODUCTION **9**

Types of medical robots - Navigation - Motion Replication - Imaging - Rehabilitation and Prosthetics – Stateof art of robotics in the field of healthcare-DICOM

UNIT II LOCALIZATION AND TRACKING **9**

Position sensors requirements - Tracking - Mechanical linkages - Optical – Sound based - Electromagnetic - Impedance-based - In-bore MRI tracking-Video matching - Fiber optic tracking systems - Hybrid systems.

UNIT III DESIGN OF MEDICAL ROBOTS **9**

Characterization of gestures to the design of robots - Design methodologies - Technological choices - Security.

UNIT IV SURGICAL ROBOTICS **9**

Minimally invasive surgery and robotic integration - surgical robotic sub systems – synergistic control - Control Modes - Radiosurgery - Orthopedic Surgery - Urologic Surgery and Robotic Imaging -Cardiac Surgery – Neurosurgery - case studies.

UNIT V ROBOTS I REHABILITATION AND MEDICAL CARE **9**

Rehabilitation for Limbs - Brain-Machine Interfaces - Steerable Needles - Assistive robots – Robots in Physiotherapy - case studies

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Identify various medical robots and their potential applications.
CO2: Recognize the position tracking and hybrid systems.
CO3: Apply Robotics and its concepts in Medical field
CO4: Simulate a MIS procedure and be aware of the state of art in surgical and oncology robotics.
CO5: Design a medical robotic system given the specific requirements for Rehabilitation and medical care.

TEXT BOOKS

1. Achim Ernst Floris Schweikard, "Medical Robotics", Springer, 2016.
2. Paula Gomes, "Medical robotics Minimally invasive surgery", Woodhead, 2013.
3. Russell H. Taylor, Paolo Dario, Gabor Fichtinger, "Medical Robotics", Springer,2022.

REFERENCE BOOKS

1. Jaydev P Desai, Rajni V Patel, Antoine Ferreira; Sunil Kumar Agrawal, "The
2. Encyclopedia of Medical Robotics", World Scientific Publishing Co. Pvt. Ltd,2019.
3. Jocelyne Troccaz , "Medical Robotics", John Wiley & Sons Incorporated, 2013.
4. Vanja Bonzovic , "Medical Robotics", I-tech Education publishing, Austria, 2008.
5. Farid Gharagozloo "Robotic Surgery", Springer, 2022.

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24OEMF04 TEXTILE REINFORCED COMPOSITES **L T P C**
3 0 0 3

COURSE OBJECTIVES

- Describe the role and properties of reinforcements in composite materials.
- Explain the difference between thermoset and thermoplastic matrices in composites.
- List and briefly explain two mechanical tests used for evaluating composite materials.

UNIT I REINFORCEMENTS **9**

Introduction – composites –classification and application; reinforcements- fibres and its properties; preparation of reinforced materials and quality evaluation; preforms for various composites

UNIT II MATRICES **9**

Preparation, chemistry, properties and applications of thermoplastic and thermoset resins; mechanism of interaction of matrices and reinforcements; optimization of matrices.

UNIT III COMPOSITE MANUFACTURING **9**

Classification; methods of composites manufacturing for both thermoplastics and hermosets Hand layup, Filament Winding, Resin transfer moulding, prepregs and autoclave moulding, pultrusion, vacuum impregnation methods, compression moulding; post Processing of composites and composite design requirements.

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UNIT IV TESTING **9**

Fibre volume and weight fraction, specif ic gravity of composites, tensile, flexural, impact, compression, inter laminar shear stress and fatigue properties of thermoset and thermoplastic composites.

UNIT V MECHANICS **9**

Micro mechanics, macro mechanics of single layer, macro mechanics of laminate, classical Lamination theory, failure theories and prediction of inter laminar stresses using at ware.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Compare the different types of textile reinforcements
CO2: Explain the different types of matrices
CO3: Explore the manufacturing of composites
CO4: Evaluation of the properties of thermoset and thermoplastic composite
CO5: Discuss the mechanics of composites failure

TEXT BOOKS

1. Bor Z.Jang,“Advanced Polymer composites”,ASM International,USA,1994.
2. Carlsson L.A. and Pipes R.B., “Experimental Characterization of advanced composite Materials”,Second Edition,CRCPress,NewJersey,1996.
3. K. K. Chawla, "Composite Materials: Science and Engineering", Springer, 2012.

REFERENCE BOOKS

1. George LubinandStanley T.Peters, “Handbook of Composites”, Springer Publications,1998.
2. Mel. M. Schwartz, “Composite Materials”, Vol. 1 &2, Prentice Hall PTR, New Jersey,1997.
3. RichardM.Christensen,“Mechanics compositematerials”,DoverPublications,2005.
4. Sanjay K. Mazumdar, “Composites Manufacturing: Materials, Product, and Process Engineering”, CRC Press,2001.
5. Autar K. Kaw, "Mechanics of Composite Materials", CRC Press, 2005.

24OEMF05 NANO COMPOSITE MATERIALS **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To explore the difficulties, fabrication technologies and properties of nano composite materials.
- To gain knowledge on Nano materials.
- To get familiarize in synthesis of nano materials.

UNIT I CERAMIC-BASED NANOCOMPOSITES **9**

Composites – nomenclature, properties; classification of ceramic nanocomposites; challenges with bulk nanoceramics/Nano ceramic composites; problems associated with synthesis of nanosize powders – chemical /physical methods of synthesis of nanoscaled ceramic powders, challenges posed by the typical properties of nanoscaled powders, Challenges faced during processing/ sintering; various processing techniques, spark plasma sintering; properties of nanoceramics – hardness, tensile; superplasticity – superplastic forming applications; superhard nanocomposites – properties, bottle neck, industrial applications.

UNIT II METAL-BASED NANOCOMPOSITES **9**

Processing of metal-matrix nanocomposites – liquid metallurgy processing techniques, thermal spray techniques, cold spray, powder metallurgy (PM) techniques, difficulties, applications of metal matrix nanocomposites – Cu–Ni alloy nanocomposites, magnesium metal–matrix nanocomposites- implants, titanium nanocomposites; fractal-based glass-metal nanocomposites, its designing and fractal dimension analysis; core–shell structured nanocomposites; bio-medical imaging, environmental remediation applications, semiconductor core–shell nanomaterials, heterojunction photo catalyst.

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UNIT III POLYMER-BASED NANOCOMPOSITES **9**

Block copolymer nanocomposites – features, advantage over homopolymer composites; fundamentals of block copolymer; nanoparticle co-assembly; particle–polymer enthalpic interactions; particle surface chemistry – grafting suitable polymeric ligands, entropic interactions, mechanism of nanoparticle incorporation; applications of block copolymers nanocomposites – Textile fabric, bulk heterojunction (BHJ) organic photovoltaic (solar cell) devices, drug delivery; polymer and carbon nanotube–based composites, their mechanical properties, and industrial possibilities.

UNIT IV BIOMEDICAL NANOCOMPOSITES **9**

Natural nanocomposite systems – spider silk, bones, shells; ceramic nanocomposites – biomedical applications; toughening mechanisms; alumina and zirconia ceramics, alumina–zirconia nanocomposites; tooth nanocomposites and dental implants; organic–inorganic nanocomposite formation through self-assembly; biomimetic synthesis of nanocomposites material.

UNIT V NANOCOMPOSITE TECHNOLOGY **9**

Nanocomposite membrane structures – preparation and applications; nanotechnology in textiles and cosmetics; nano-fillers embedded polypropylene fibers – soil repellency, lotus effect; nano finishing in textiles (UV resistant, anti-bacterial, hydrophilic, self-cleaning, flame-retardant finishes); sun-screen dispersions for UV protection using titanium oxide – colour cosmetics; nanotechnology in food technology – nanopackaging for enhanced shelf life, smart/intelligent packaging.

TOTAL: 45 PERIODS

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COURSE OUTCOMES

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

CO1: Explain the fabrication technologies, properties and drawbacks of ceramic nanocomposites

CO2: Explain the fabrication technologies, properties and drawbacks of metal matrix nanocomposites

CO3: Explain the fabrication technologies, properties and drawbacks of block copolymer Nano composites

CO4: Comprehend biomimicry and evaluate them in load bearing arena for bone tissue engineering

CO5: Design nanocomposite materials for engineering applications.

TEXT BOOKS

1. Twardowski T.E., “Introduction to nanocomposite materials: properties, processing, characterization”, DES Tech Publications, USA, 2007
2. Ajayan P.M., Schadler L.S. and Braun P.V., “Nanocomposites science and technology”, 2006.
3. Tsuji, Nobuo, "Nano Structured Metals and Alloys: Processing, Microstructure, Mechanical Properties and Applications", Woodhead Publishing, 2011.

REFERENCE BOOKS

1. Sadasivuni K.K., Ponnamma D., Rajan M., Ahmed B. and Al-Maadeed M.A.S.A., "Polymer nanocomposites in biomedical engineering", Springer Nature, Switzerland, 2019.
2. Basu B. and Balani K., "Advanced structural ceramics", John Wiley & Sons, 2011.
3. Brown P. and Stevens K., "Nanofibers and nanotechnology in textiles", Woodhead publication, London, 2006.
4. Rakesh K. Gupta, "Polymer and Composite Nanotechnology: Synthesis and Applications", DEStech Publications, 2012.
5. Sabu Thomas, Shaijumon Manayil Jacob, Deepalekshmi Ponnamma, "Nanocomposite Materials: Synthesis, Properties and Applications", Wiley-VCH, 2020.

24OEMF06 NEW PRODUCT DESIGN AND DEVELOPMENT **L T P C**

3 0 0 3

COURSE OBJECTIVE

- The course aims at providing the basic concepts of product design, product features.
- Architecture so that student can have a basic knowledge in the common features a product has and how to incorporate them suitably in product.
- To gain knowledge for business opportunity.

UNIT I INTRODUCTION **9**

Need for IPPD – Strategic importance of Product development – integration of customer, designer, material supplier and process planner, Competitor and customer – Behaviour analysis. Understanding customer – prompting customer understanding – involve customer in development and managing requirements – Organization – process management and improvement – Plan and establish product specifications.

UNIT II CONCEPT GENERATION AND SELECTION **9**

Task – Structured approaches – clarification – search – externally and internally – explore systematically – reflect on the solutions and processes – concept selection – methodology – benefits.

UNIT III PRODUCT ARCHITECTURE **9**

Implications – Product change – variety – component standardization – product performance – manufacturability – product development management – establishing the architecture – creation – clustering – geometric layout development – fundamental and incidental interactions – related system level design issues – secondary systems – architecture of the chunks – creating detailed interface specifications.

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UNIT IV INDUSTRIAL DESIGN **9**

Integrate process design – Managing costs – Robust design – Integrating CAE, CAD, CAM tools – Simulating product performance and manufacturing processes electronically – Need for industrial design – impact – design process – investigation of for industrial design – impact – design process – investigation of customer needs – conceptualization – refinement – management of the industrial design process – technology driven products – user – driven products – assessing the quality of industrial design.

UNIT V DESIGN FOR MANUFACTURING AND PRODUCT DEVELOPMENT **9**

Definition – Estimation of Manufacturing cost – reducing the component costs and assembly costs – Minimize system complexity – Prototype basics – principles of prototyping – planning for prototypes – Economic Analysis – Understanding and representing tasks – baseline project planning – accelerating the project – project execution.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Explain the significance of product development and the integration of customer, designer, supplier, and process planner in IPPD.

CO2: Apply structured methods to generate, explore, and evaluate innovative product concepts effectively.

CO3: Analyze product architecture and its impact on design, manufacturability, variety, and system-level interactions.

CO4: Evaluate the role of industrial design in product development, integrating tools and customer needs to enhance usability and performance.

CO5: Demonstrate principles of design for manufacturing, cost estimation, prototyping, and economic analysis to ensure efficient product development.

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TEXT BOOK

1. Kari T.Ulrich and Steven D.Eppinger, ”Product Design and Development”, McGraw-Hill International Edns. 1999.
2. Kevin Otto, Kristin Wood, "Product Design: Techniques in Reverse Engineering and New Product Development", Pearson Education, 2001.
3. Anil Mital, Anoop Desai, Anand Subramanian, Aashi Mital, "Product Development: A Structured Approach to Design and Manufacture", Elsevier, 2008

REFERENCE BOOKS

1. Kemnneth Crow, “Concurrent Engg./Integrated Product Development”, DRM Associates, 26/3,Via Olivera, Palos Verdes, CA 90274(310) 377-569, Workshop Book.
2. Stephen Rosenthal, “Effective Product Design and Development”, Business One Orwin, Homewood, 1992, ISBN 1-55623-603-4.
3. Staurt Pugh, “Tool Design –Integrated Methods for Successful Product Engineering”, Addison Wesley Publishing, New york, NY.

4. Michael Luchs, Scott Swan, Abbie Griffin, "Design Thinking: New Product Development Essentials from the PDMA", Wiley, 2015.
5. Don Norman, "The Design of Everyday Things", Basic Books, 2013.

24OEVL01 VLSI ARCHITECTURE FOR IMAGE PROCESSING **L T P C**
3 0 0 3

COURSE OBJECTIVES

- The students will be able to acquire knowledge on image and video processing algorithms.
- The students will be able to acquire knowledge on design of VLSI architectures.
- To enhance the knowledge on the concepts of image processing.

UNIT I IMAGE PROCESSING ALGORITHMS AND ARCHITECTURES **9**

Image Processing Tasks - Low Level Image Processing Operations - Intermediate Level Operations Image Processor Architecture: Requirements and Classification - Uni and Multi Processors - MIMD Systems - SIMD Systems - Pipelines - Design Aspects of Real Time Low Level Image Processors - Design Method for Special Architectures.

UNIT II 3D IMAGE PROCESSING **9**

Overview of 3D Image - Types and Characteristics of 3D Image Processing - Examples of 3D Image Processing, Continuous and Digitized Images, Models of Image Operations, Algorithm of Image Operations - Smoothing Filter - Difference Filter - Differential Features of a Curved Surface - Region Growing.

UNIT III 3D BINARY IMAGE PROCESSING **9**

Fast convolution – Cook-Toom algorithm, modified Cook-Toom algorithm, Pipelined and parallel recursive filters – Look-Ahead pipelining in first-order IIR filters, Look-Ahead pipelining with powerof-2 decomposition, Clustered look-ahead pipelining, Parallel processing of IIR filters, combined pipelining and parallel processing of IIR filters.

UNIT IV PIPELINED, 2D AND 3D IMAGE PROCESSING ARCHITECTURES **9**

Architecture of a Cellular Logic Processing Element - Second Decomposition in Data Path and Control - Real Time Pipeline for Low Level Image Processing - Design Aspects of Image Processing Architectures - Implementation of Low Level 2D and 3D and Intermediate Level Algorithms

UNIT V VLSI SYSTEMS FOR IMAGE PROCESSING **9**

Concurrent Systems for Image Analysis- VLSI Wavefront Arrays for Image Processing- Curve Detection in VLSI-Design of VLSI Based Multicomputer Architecture for Dynamic Scene AnalysisVLSI-Based Image Resampling for Electronic Publishing.

TOTAL:45 PERIODS

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COURSE OUTCOMES

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

CO1: Analyze Various Architectures to Realize Image Processing Algorithms and Explain The 3D Image Processing Algorithms.

CO2: Explore Various Processing Techniques of Image and Design Different Architectures for Image Processing.

CO3: Analyze various pipelined hardware architecture for 2D and 3D Image processing

CO4: Realize binary image processing algorithm in VLSI systems

CO5: Implement filter techniques in 2D and 3D image.

TEXT BOOKS

1. Pieter Jonker, "Morphological Image Processing: Architecture and VLSI Design", Springer, First Edition, 1992.
2. Junichiro Toriwaki · Hiroyuki Yoshida, "Fundamentals of Three-Dimensional Digital Image Processing", Springer 2009.
3. King-Sun Fu, "VLSI for Pattern Recognition and Image Processing", Springer-Verlag, 1984.

REFERENCE BOOKS

1. U. Meyer – Baese, “Digital Signal Processing with Field Programmable Gate Arrays”, Springer, 2nd Edition, 2004.
2. J.G. Proakis and D.G. Manolakis, Digital Signal Processing, Third Edition, Prentice Hall,2007.
3. Jose E. France, YannisTsividls, Design of Analog Digital VLSI Circuits for Telecommunications and Signal Processing’ Prentice Hall, 1994.
4. Mohammed Ismail, Terri, Fiez, Analog VLSI Signal and Information Processing, McGraw Hill, 1994.
5. Kung. S.Y., H.J. While house T.Kailath, VLSI and Modern singal processing, Prentice Hall, 1985.

24OEVL02 DATA ACQUISITION **L T P C**

3 0 0 3

COURSE OBJECTIVES

- To teach Learn to develop Hadoop applications for storing processing and analyzing data stored in Hadoop cluster.
- To Understand the complexity and volume of Big Data and their challenges.
- To comprehend the necessity for pre-processing Big Data and their issues.

UNIT I INTRODUCTION TO BIG DATA ACQUISITION **9**

Big data framework – fundamental concepts of Big Data Management and analytics – Current challenges and trends in Big Data Acquisition. Anatomy of File Write and Read, NameNode, Secondary Name Node, and Data Node - Hadoop Configuration – Pig Configuration – Hive Configuration - HBase Configuration.

UNIT II DATA COLLECTION AND TRANSMISSION **9**

Big data collection – Strategies – Types of Data Sources – Structured Vs Unstructured data – ELT vs ETL – storage infrastructure requirements – Collection methods – Log files – sensors – Methods for acquiring network data (Libcap-based and zero-copy packet capture technology) – Specialized network monitoring softwares (Wireshark, Smartsniff and Winnetcap) – Mobile equipments, Transmission methods, Issues.

UNIT III PIG FEATURES **9**

Introduction - Pig features - Pig Architecture - Pig Execution modes, Pig Grunt shell and Shell commands. Pig Latin Basics: Data model, Data Types, Operators - Pig Latin Commands - Load & Store, Filtering, Sorting, Splitting - Built-In Functions, User define functions. Pig Execution Modes: Batch Mode – Embedded Mode – Pig Execution in Batch Mode –Use cases - Map Reduce programs with Pig – Pig Vs SQL

UNIT IV HIVE FEATURES **9**

Introduction - Hive Features - Hive architecture -Hive Meta store - Hive data types - Hive Tables - Table types - Creating database, Altering database, Create table, alter table, Drop table, Built-In Functions - Built-In Operators, User defined functions(UDFs), View, Pig Vs Hive.

UNIT V HBASE FEATURES **9**

HBasics, Features of HBase, Concepts, Clients, Example, Hbase Versus RDBMS, Limitations of HBase Big Data Privacy And Applications: Data Masking – Privately identified Information (PII) – Privacy preservation in Big Data – Popular Big Data Techniques and tools –Applications- Social Media Analytics – Fraud Detection.

TOTAL:45 PERIODS

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COURSE OUTCOMES

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

CO1: Study the various sources of Big Data.

CO2: Collect and store Big Data from various sources.

CO3: Write Pig Scripts- Extract, Transform and Load the data on HDFS.

CO4: Write Hive Scripts- Extract, Transform, Load and Analyse the data present in HDFS.

CO5: Write scripts to extract data from structured and un-structured data for analytics.

TEXT BOOKS

1. Raj. Pethuru " Handbook of Research on Cloud Infrastructures for Big Data Analytics", IGI Global..
2. M. Pelgrom, "Analog-to-Digital Conversion", Springer, 2010.
3. Rudy Van De Plassche, "CMOS Integrated Analog-to-Digital and Digital-to-Analog Converters" Kluwer Acedamic Publishers, Boston, 2003.

REFERENCE BOOKS

1. Bart Baesens, “Analytics in a Big Data World: The Essential Guide to Data Science and its Applications’, John Wiley & Sons, 2014.
2. Tom White “ Hadoop: The Definitive Guide” Third Edit on, O’reily Media, 2012.
3. Seema Acharya, Subhasini Chellappan, "Big Data Analytics" Wiley 2015.
4. Min Chen. Shiwen Mao, Yin Zhang. Victor CM Leung, Big Data: Related Technologies, Challenges and Future Prospects, Springer, 2014.
5. Michael Minelli, Michele Chambers Ambiga Dhiraj, “Big Data, Big Analytics : Emerging Business Intelligence and Analytic Trends”, John Wiley & Sons, 2013.

24OEVL03 BASICS OF VLSI DESIGN **L T P C**

3 0 0 3

COURSE OBJECTIVES

- To understand MOS transistor fabrication processes.
- To have an exposure to the design rules to be followed for drawing the layout of circuits.
- To have a knowledge of the testing processes of CMOS circuits.

UNIT I INTRODUCTION **9**

Brief Introduction to IC technology MOS, PMOS, NMOS, CMOS & BiCMOS Technologies.

UNIT II VLSI CIRCUIT DESIGN PROCESSES **9**

VLSI Design Flow, MOS Layers, Stick Diagrams, Design Rules and Layout, Lambda(λ)-based design rules for wires, contacts and Transistors, Layout Diagrams for NMOS and CMOS Inverters and Gates, Scaling of MOS circuits, Limitations of Scaling.

UNIT III GATE LEVEL DESIGN **9**

Logic gates and other complex gates, Switch logic, Alternate gate circuits. Sheet Resistance Rs and its concepts to MOS, Area Capacitances calculations, Inverter Delays, Driving large Capacitive Loads, Wiring Capacitances, Fan-in and fan-out.

UNIT IV SUBSYSTEM DESIGN **9**

Shifters, Adders, ALUs, Multipliers, Parity generators, Comparators, Counters. Full-custom, Standard Cells, Gate-arrays, FPGAs, CPLDs and Design Approach for Full-custom and Semi-custom devices, parameters influencing low power design.

UNIT V CMOS TESTING **9**

CMOS Testing, Need for Testing, Test Principles, Design Strategies for Test, Chip Level and Board Level Test Techniques.

TOTAL:45 PERIODS

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COURSE OUTCOMES

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

CO1: Use various VLSI design MOS transistor fabrication methodologies.

CO2: Explain the basic circuit concepts.

CO3: Develop algorithms for partitioning and placement.

CO4: Design of building blocks using different approaches.

CO5: Design and testing processes of CMOS circuits.

TEXT BOOKS

1. Sabih H. Gerez, "Algorithms for VLSI Design Automation", Second Edition, Wiley-India, 2017.
2. Naveed a. Sherwani, "Algorithms for VLSI Physical Design Automation", 3rd Edition, Springer, 2017.
3. Essentials of VLSI Circuits and Systems, Kamran Eshraghian, Eshraghian Dougles, A. Pucknell, 2005, PHI..

REFERENCE BOOKS

1 . Charles J. Alpert, Dinesh P. Mehta and Sachin S Sapatnekar, "Handbook of Algorithms for Physical Design Automation, CRC Press, 1st Edition,

2. N.A. Sherwani, "Algorithms for VLSI Physical Design Automation", Kluwer Academic Publishers, 2002.
3. Ramachandran, "Digital VLSI systems design", Springer, 2007.
4. M. Sarrafzadeh and C.K. Wong, An introduction to physical design, McGraw Hill, 1996.
5. J. Bhasker, Verilog VHDL synthesis: a practical primer, B S Publications, 1998.

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24OEVL04 EMBEDDED SYSTEM DESIGN **L T P C**

3 0 0 3

COURSE OBJECTIVES

- To understand the design challenges in embedded systems.
- To understand the bus structures and protocols.
- To design a real time embedded system.

UNIT I EMBEDDED SYSTEM OVERVIEW **9**

Embedded System Overview, Design Challenges – Optimizing Design Metrics, Design Methodology, RT-Level Combinational and Sequential Components, Optimizing Custom Components, Optimizing Custom Single-Purpose Processors.

UNIT II GENERAL AND SINGLE PURPOSE PROCESSOR **9**

Basic Architecture, Pipelining, Superscalar and VLIW Architectures, Programmer's View, Development Environment, Application-Specific Instruction-Set Processors (ASIPS) Microcontrollers, Timers, Counters and Watchdog Timer, UART, LCD Controllers and Analog-to- Digital Converters, Memory Concepts.

UNIT III BUS STRUCTURES **9**

Basic Protocol Concepts, Microprocessor Interfacing – I/O Addressing, Port and Bus - based I/O, Arbitration, Serial Protocols, I2C, CAN and USB, Parallel Protocols – PCI and ARM bus, Wireless Protocols – IRDA, Bluetooth, IEEE 802.11.

UNIT IV STATE MACHINE AND CONCURRENT PROCESS MODELS **9**

Basic State Machine Model, Finite-State Machine with Data path Model, Capturing State Machine in Sequential Programming Language, Program-State Machine Model, Concurrent Process Model, Communication among Processes, Synchronization among processes, RTOS – System design using RTOS.

UNIT V SYSTEM DESIGN **9**

Burglar alarm system-Design goals -Development strategy-Software development-Relevance to more complex designs- Need for emulation -Digital echo unit-Creating echo and reverb-Design requirements-Designing the codecs -The overall system design

TOTAL:45 PERIODS

COURSE OUTCOMES

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

CO1: Use different protocols.
CO2: Apply state machine techniques and design process models.
CO3: Apply knowledge of embedded sotware development tools and RTOS.
CO4: Apply networking principles in embedded devices.
CO5: Design suitable embedded systems for real world applications.

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TEXT BOOKS

1. Mohammed Ali Mazidi, Janice Gillispie Mazidi, Rolin D.McKinlay, The 8051 Microcontroller and Embedded Systems Using Assembly and C, Second Edition, Pearson Education, 2008.
2. Marilyn Wolf, Computers as Components – Principles of Embedded Computing System Design, Third Edition, Morgan Kaufmann, 2012.
3. Arshdeep Bahga, Vijay Madisetti, Internet – of- Things – A Hands on Approach, Universities Press, 2015.

REFERENCES BOOKS

1. Frank Vahid and Tony Gwargie, “Embedded System Design”, John Wiley & Sons, 2009.
2. Steve Heath, “Embedded System Design”, Elsevier, Second Edition, 2004.
3. Bruce Powel Douglas, “Real Time UML, Second Edition: Developing Efficient Objects for Embedded Systems”, 3rd Edition 2004, Pearson Education.
4. Daniel W.Lewis, “Fundamentals of Embedded Software where C and Assembly Meet”, Pearson Education, 2004.
5. Bruce Powel Douglas, “Real Time UML; Second Edition: Developing Efficient Objects for Embedded Systems”, 3rd Edition 1999, Pearson Education.

224OEVL05 SYSTEM ON CHIP **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To introduce architecture and design concepts underlying system on chips.
- Students can gain knowledge of designing SoCs.
- To impart knowledge about the hardware-software design of a modest complexity chip all the way from specifications, modeling, synthesis and physical design.

UNIT I SYSTEM ARCHITECTURE OVERVIEW **9**

Components of the system – Processor architectures – Memory and addressing – system level interconnection – SoC design requirements and specifications – design integration – design complexity – cycle time, die area and cost, ideal and practical scaling, area-time-power tradeoff in processor design, Configurability.

UNIT II PROCESSOR SELECTION FOR SOC **9**

Overview – soft processors, processor core selection. Basic concepts – instruction set, branches, interrupts and exceptions. Basic elements in instruction handling – Minimizing pipeline delays – reducing the cost of branches – Robust processors – Vector processors, VLIW processors, Superscalar processors.

UNIT III MEMORY DESIGN **9**

SoC external memory, SoC internal memory, Scratch pads and cache memory – cache organization and write policies – strategies for line replacement at miss time – split I- and Dcaches – multilevel caches – SoC memory systems – board-based memory systems – simple processor/memory interaction.

UNIT IV INTERCONNECT ARCHITECTURES AND SOC CUSTOMIZATION **9**

Bus architectures – SoC standard buses – AMBA, Core Connect – Processor customization approaches – Reconfigurable technologies – mapping designs onto reconfigurable devices - FPGA based design – Architecture of FPGA, FPGA interconnect technology, FPGA memory, Floor plan and routing.

UNIT V FPGA BASED EMBEDDED PROCESSOR **9**

Hardware software task partitioning – FPGA fabric Immersed Processors – Soft Processors and Hard Processors – Tool flow for Hardware/Software Co-design –Interfacing Processor with memory and peripherals – Types of On-chip interfaces – Wishbone interface, Avalon Switch Matrix, OPB Bus Interface, Creating a Customized Microcontroller - FPGA-based Signal Interfacing and Conditioning.

TOTAL:45 PERIODS

COURSE OUTCOMES

On successive completion of this course, the students should be able to:

CO1: Explain all important components of a System-on-Chip and an embedded system.

CO2: Digital hardware and embedded software.

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CO3: Outline the major design flows for digital hardware and embedded software.
CO4: Discuss the major architectures and trade-offs concerning performance.
CO5: Consumption of single chip and embedded systems.

TEXT BOOKS

1. ChrysostoMOSnicopoulos, Vijaykrishnan Narayanan, Chita R.Das" System-On - Chip" Architectures Holistic Design Exploration", Springer.
2. Wayne Wolf, ―Modern VLSI Design – System – on – Chip Design‖, Prentice Hall, 3rd Edition, 2008.
3. Sudeep Pasricha and NikilDutt, On-Chip Communication Architectures System on Chip Interconnect, Elsevier, 2008.

REFERENCES BOOKS

1. F Wayne Wolf, "Modern VLSI Design – System – on – Chip Design", Prentice Hall, 3rd Edition, 2008.
2. Wayne Wolf , "Modern VLSI Design – IP based Design", Prentice Hall, 4th Edition, 2008
3. Konstantinos Tatas and Kostas Siozios "Designing 2D and 3D Network-On-Chip, Architectures" 2013
4. Palesi, Maurizio, Daneshtalab, Masoud "Routing Algorithms in System-On-Chip" 2014
5. Fayezgebali, Haythamelmiligi, Hqhahedwatheq E1-Kharashi "On-Chips Theory and Practice CRC Press.

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24OEVL06 WIRELESS SENSOR NETWORKS **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To enable the student to understand the role of sensors and the networking of sensed data for different applications.
- To expose the students to the sensor node essentials and the architectural details.
- To enable the student to understand the challenges in synchronization and localization of sensor nodes.

UNIT I OVERVIEW OF WIRELESS SENSOR NETWORKS **9**

Challenges for wireless sensor networks-characteristics requirements-required mechanisms, difference between mobile ad-hoc and sensor networks, applications of sensor networks- case study, enabling technologies for wireless sensor networks.

UNIT II ARCHITECTURES **9**

Single-node architecture - hardware components, energy consumption of sensor nodes, operating systems and execution environments, network architecture - sensor network scenarios, optimization goals and figures of merit, gateway concepts. Physical layer and transceiver design considerations.

UNIT III MAC AND ROUTING **9**

MAC protocols for wireless sensor networks, IEEE 802.15.4, Zigbee, low duty cycle protocols and wakeup concepts - s-MAC , the mediation device protocol, wakeup radio concepts, address and name management, assignment of MAC addresses, routing protocols-energy- efficient routing, geographic routing.

UNIT IV INFRASTRUCTURE ESTABLISHMENT **9**

Topology control, clustering, time synchronization, localization and positioning, sensor tasking and control.

UNIT V DATA MANAGEMENT AND SECURITY **9**

Data management in WSN, storage and indexing in sensor networks, query processing in sensor, data aggregation, directed diffusion, tiny aggregation, greedy aggregation, security in WSN, security protocols for sensor networks, secure charging and rewarding scheme, secure event and event boundary detection.

TOTAL:45 PERIODS

COURSE OUTCOMES

On successive completion of this course, the students should be able to

CO1: Design and implement simple wireless network concepts.
CO2: Design, analyze and implement different network architectures.
CO3: Implement MAC layer and routing protocols.
CO4: Deal with timing and control issues in wireless sensor networks.
CO5**:** Analyze and design secured wireless sensor networks.

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TEXT BOOKS

1. C. Siva Ram Murthy and B. S. Manoj, ―Ad Hoc Wireless Networks Architectures and Protocols‖, Prentice Hall, PTR, 2004.
2. Feng Zhao, Leonidas Guibas, ―Wireless Sensor Networks: an information processing approach‖, Elsevier publication, 2004.
3. Charles E. Perkins, ―Ad Hoc Networking‖, Addison Wesley, 2000.

REFERENCES BOOKS

1. Holger Karl & Andreas Willig, "Protocols and Architectures for Wireless Sensor Networks", John Wiley, 2005.
2. Erdal Çayirci , Chunming Rong, “Security in Wireless Ad Hoc and Sensor Networks”, John Wiley and Sons, 2009.
3. Kazem Sohraby, Daniel Minoli, & Taieb Znati, “Wireless Sensor Networks-S Technology, Protocols, and Applications”, John Wiley, 2007.
4. Yingshu Li, My T. Thai,Weili Wu, “Wireless Sensor Networks and Applications”, Springer, 2008.
5. I.F. Akyildiz, W. Su, Sankarasubramaniam, E. Cayirci, ―Wireless sensor networks: a survey‖, computer networks, Elsevier, 2002, 394 - 422.

24OEPE01 ELECTRIC VEHICLE TECHNOLOGY **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To understand the architecture and social importance of Electric Vehicles.
- To develop the knowledge about batteries used in Electric Vehicles.
- To design the motor and converters for Electric Vehicles.

UNIT I NEED FOR ELECTRIC VEHICLES **9**

History and need for electric and hybrid vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies, comparison of diesel, petrol, electric and hybrid vehicles, limitations, technical challenges.

UNIT II ELECTRIC VEHICLE ARCHITECHTURE **9**

Electric vehicle types, layout and power delivery, performance – traction motor characteristics, tractive effort, transmission requirements, vehicle performance, energy consumption, Concepts of hybrid electric drive train, architecture of series and parallel hybrid electric drive train, merits and demerits, mild and full hybrids, plug-in hybrid electric vehicles and range extended hybrid electric vehicles, Fuel cell vehicles.

UNIT III ENERGY STORAGE **9**

Batteries – types – lead acid batteries, nickel based batteries, and lithium based batteries, electrochemical reactions, thermodynamic voltage, specific energy, specific power, energy efficiency, Battery modeling and equivalent circuit, battery charging and types, battery cooling, Ultra-capacitors, Flywheel technology, Hydrogen fuel cell, Thermal Management of the PEM fuel.

UNIT IV ELECTRIC DRIVES AND CONTROL **9**

Types of electric motors – working principle of AC and DC motors, advantages and limitations, DCmotor drives and control, Induction motor drives and control, PMSM and brushless DC motor -drives and control , AC and Switch reluctance motor drives and control – Drive system efficiency –Inverters – DC and AC motor speed controllers.

UNIT V DESIGN OF ELECTRIC VEHICLES **9**

Materials and types of production, Chassis skate board design, motor sizing, power pack sizing,component matching, Ideal gear box – Gear ratio, torque–speed characteristics, Dynamic equationof vehicle motion, Maximum tractive effort – Power train tractive effort Acceleration performance,rated vehicle velocity – maximum gradability, Brake performance, Electronic control system, safetyand challenges in electric vehicles. Case study of Nissan leaf, Toyota Prius, tesla model 3, andRenault Zoe cars.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Explain the basic of electric vehicle history and components.

CO2: Explore the properties of batteries.

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CO3: Enumerate the electrical machine properties and classifications.
CO4: Explain the properties of electric vehicle drives systems.
CO5: Design the motor sizing of hybrid electric vehicles.

TEXT BOOKS

1. A.K. Babu, Khanna Publishing House, Electric & Hybrid Vehicles New Delhi, 2018.
2. Iqbal Hussain, Electric & Hybrid Vehicles – Design Fundamentals , Second Edition, CRCPress, 2011.
3. Electric Vehicle Battery Systems – Sandeep Dhameja, Newnes, 2000.

REFERENCE BOOKS

1. Deshpande.M. V. PHI Learning Pvt. Ltd., 2010, Design and Testing of Electrical Machines.
2. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric AndFuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004.
3. James Larminie, John Lowry, Electric Vehicle Technology Explained - Wiley, 2003.
4. Ehsani, M, "Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory AndDesign", CRC Press, 2005.
5. Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals – Mehrdad Ehsani,Yimin Gao, Ali Emadi, CRC Press, 2010.

24OEPE02 RENEWABLE ENERGY SYSTEMS **L T P C**
3 0 0 3

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COURSE OBJECTIVES

- To understand the different types of renewable energy technologies.
- To explain Standalone operation, grid connected operation of renewable energy systems.
- To design the structure of PV system.

UNIT I INTRODUCTION TO RENEWABLE ENERGY SYSTEMS **9**

Classification of energy sources – Co2 Emission - Features of Renewable energy – Renewable energy scenario in India -Environmental aspects of electric energy conversion: impacts ofrenewable energy generation on environment Per Capital Consumption - CO2 Emission -importance of renewable energy sources, Potentials – Achievements– Applications.

UNIT II SOLAR PHOTOVOLTAICS **9**

Solar Energy: Sun and Earth-Basic Characteristics of solar radiation- angle of sunrays on solar collector-Estimating Solar Radiation Empirically - Equivalent circuit of PV Cell-Photovoltaic cellcharacteristics:P-V and I-V curve of cell-Impact of Temperature and Insolation on I-Vcharacteristics-Shading Impacts on I-V characteristics-Bypass diode - Blocking diode.

UNIT III DESIGN OF PV SYSTEM **9**

Block diagram of solar photo voltaic system: Line commutated converters (inversion mode) - Boost and buck-boost converters - selection of inverter, battery sizing, array sizing - PV systems classification- standalone PV systems - Grid tied and grid interactive inverters- grid connection issues.

UNIT IV WIND ENERGY CONVERSION SYSTEMS **9**

Origin of Winds: Global and Local Winds- Aerodynamics of Wind turbine-Derivation of Betz's limit-Power available in wind-Classification of wind turbine: Horizontal Axis wind turbine and Verticalaxis wind turbine- Aerodynamic Efficiency-Tip Speed-Tip Speed Ratio-Solidity-Blade Count-Powercurve of wind turbine - Configurations of wind energy conversion systems: Type A, Type B, Type Cand Type D Configurations- Grid connection Issues - Grid integrated SCIG and PMSG basedWECS.

UNIT V OTHER RENEWABLE ENERGY SOURCES **9**

Qualitative study of different renewable energy resources: ocean, Biomass, Hydrogen energy systems, Fuel cells, Ocean Thermal Energy Conversion (OTEC), Tidal and wave energy, Geothermal Energy Resources.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Demonstrate the need for renewable energy sources.

CO2: Develop a stand-alone photo voltaic system and implement a maximum power point tracking in the PV system.

CO3: Design a stand-alone and Grid connected PV system.

CO4: Analyze the different configurations of the wind energy conversion systems.

CO5: Realize the basic of various available renewable energy sources.

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TEXT BOOKS

1. Gray, L. Johnson, "Wind energy system", prentice hall of India, 1995.
2. B.H.Khan, " Non-conventional Energy sources", , McGraw-hill, 2nd Edition, 2009.
3. Fang Lin Luo Hong Ye, " Renewable Energy systems", Taylor & Francis Group,2013

REFERENCE BOOKS

1. S.N.Bhadra, D. Kastha, & S. Banerjee "Wind Electrical Systems", Oxford UniversityPress,2009.
2. Rai. G.D, "Non conventional energy sources", Khanna publishes, 1993.
3. Rai. G.D," Solar energy utilization", Khanna publishes, 1993.
4. Chetan Singh Solanki, "Solar Photovoltaics: Fundamentals, Technologies and
5. Applications", PHI Learning Private Limited, 2012.
6. John Twideu and Tony Weir, "Renewal Energy Resources" BSP Publications, 2006

24OEPE03 POWER SEMICONDUCTOR DEVICES **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To understand the function of Power switching devices.
- To analyze characteristics of current controlled and voltage-controlled devices.
- To design the protection circuits.

UNIT I INTRODUCTION **9**

Power switching devices overview – Attributes of an ideal switch, application requirements , circuit symbols; Power handling capability – (SOA); Power diodes – Types, forward and reverse characteristics, switching characteristics – rating. Features and Brief History of Silicon Carbide-Promise and Demonstration of SiC Power Devices- Physical Properties of Silicon Carbide devices–Unipolar and Bipolar Diodes- GaN Technology Overview.

UNIT II CURRENT CONTROLLED DEVICES **9**

BJT's – Construction, static characteristics, switching characteristics; Negative temperature coefficient and second breakdown; - Thyristors – Construction, working, static and transient characteristics, types, series and parallel operation; comparison of BJT and Thyristor – steady state and dynamic models of BJT &Thyristor- Basics of GTO, SiC based Bipolar devices-Applications- Building a GaN Transistor – GaN Transistor Electrical Characteristics.

UNIT III VOLTAGE CONTROLLED DEVICES **9**

Power MOSFETs and IGBTs – Principle of voltage controlled devices, construction, types, static and switching characteristics, steady state and dynamic models of MOSFET and IGBTs –and IGCT. New semiconductor materials for devices – Intelligent power modules - study of moduleslikeAPTGT100TL170G, MSCSM70TAM05TPAG. Integrated gate commutated thyristor (IGCT) –SiC based unipolar devices-applications.

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UNIT IV DEVICE SELECTION, DRIVING AND PROTECTING CIRCUITS **9**

Device selection strategy – On-state and switching losses – EMI due to switching. Necessity of isolation, pulse transformer, optocoupler – Gate drive integrated circuit: Study of Driver IC – IRS2110/2113. SCR, MOSFET, IGBTs and base driving for power BJT. – Over voltage, over currentand gate protections; Design of snubbers.

UNIT V THERMAL PROTECTION **9**

Heat transfer – conduction, convection and radiation; Cooling – liquid liquid cooling, vapour – phase cooling; Guidance for hear sink selection – Thermal resistance and impedance – Electrical analogy of thermal components, heat sink types and design – Mounting types-switching loss calculation for power device.

TOTAL : 45 PERIODS

COURSE OUTCOMES

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

CO1: Identify suitable device for the application and to learn the characteristics of voltage and current controlled power devices.

CO2: Explore the significance of Silicon Carbide devices and Galium Nitride devices.

CO3: Explain the principles and characteristics of Silicon devices, Silicon Carbide devices and Galium Nitride devices.

CO4: Design proper driving circuits and protection circuits.

CO5: Construct a proper thermal protective devices for power semiconductor devices.

TEXT BOOKS

1. Biswanath Paul, "Power Electronics", Universities Press 2019.
2. L. Umanand, "Power Electronics Essentials and Applications", Wiley India Ltd., 2009.
3. Muhammad H. Rashid , "Power Electronics Handbook", Elsevier, 3rd ed., 2011

REFERENCE BOOKS

1. Rashid M.H., "Power Electronics Circuits, Devices and Applications ", Pearson, Fourth Edition, 2021.
2. Ned Mohan, Undeland and Robins, "Power Electronics: Converters Applications and
3. Design", Media Enhanced Third Edition, Wiley, 2007.
4. Tsunenobu Kimoto and James A. Cooper, "Fundamentals of Silicon Carbide Technology: Growth, Characterization, Devices, and Applications", First Edition, 2014 John Wiley & Sons, Singapore Pte Ltd.
5. Alex Lidow, Johan Strydom, Michael de Rooij, David Reusch, "GaN Transistors for efficient power conversion", Second Edition, Wiley, 2015.

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24OEPE04 ENERGY STORAGE TECHNOLOGIES **L T P C**

3 0 0 3

COURSE OBJECTIVES

- To understand the various types of energy storage Technologies
- To develop the design of thermal storage system
- To understand the thermodynamics of Fuel Cell.

UNIT I INTRODUCTION **9**

Necessity of energy storage – types of energy storage –energy storage technologies – Applications.

UNIT II THERMAL STORAGE SYSTEM **9**

Thermal storage – Types – Modeling of thermal storage units – Simple water and rock bed storage system – Pressurized water storage system – Modelling of phase change storage system – Simple units, Packed bed storage units - Modelling using porous medium approach.

UNIT III ELECTRICAL ENERGY STORAGE **9**

Fundamental concept of batteries – Measuring of battery performance, charging and dis charging of a battery, storage density, energy density, and safety issues - Types of batteries: – Lead Acid, Nickel-Cadmium, Zinc-Manganese dioxide - Mathematical Modelling for Lead Acid Batteries – Flow Batteries.

UNIT IV FUEL CELL **9**

Fuel Cell – History of Fuel cell, Principles of Electrochemical storage – Types: Hydrogen oxygen cells, Hydrogen air cell, Hydrocarbon air cell, Alkaline fuel cell -Detailed analysis – Advantages and disadvantages –Fuel Cell Thermodynamics.

UNIT V ALTERNATE ENERGY STORAGE TECHNOLOGIES **9**

Flywheel, Super capacitors, Principles& Methods – Applications, Compressed air Energy storage, Concept of Hybrid Storage – Applications, Pumped Hydro Storage – Applications.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Explore the concept of various storage technologies.
CO2: Discuss the mechanical storage system.
CO3: Analysis of various battery energy storage System.
CO4: Analyze the operation of fuel cell.
CO5: Compare various types of alternate storage technologies.

TEXT BOOKS

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1. Frank S. Barnes and Jonah G. Levine, Large Energy Storage Systems Handbook (Mechanical and Aerospace Engineering Series), CRC press (2011).
2. Ralph Zito, Energy storage: A new approach, Wiley (2010).
3. Robert A. Huggins, Energy storage, Springer Science & Business Media (2010).

REFERENCE BOOKS

1. David Linden, Thomas B.Reddy, “Handbook of Batteries”, Third Edition, Tata Mc-Graw Hill,2002.
2. James Larminie, Andrew Dicks, “Fuel cell Systems Explained”, Third Edition, Wiley, 2018.
3. Ru-Shi Liu, Lei Zhang and Xueliang Sun, “Electrochemical Technologies for Energy Storage and Conversion”, First Edition, Wiley, 2012.
4. P.Jayarama Reddy, “Principles of Energy Storage Systems”, BS Publications, Hyderabad,First Edition, 2022.
5. G.D.Rai, “Non-Conventional Energy Sources”, VI Edition Khanna Publishes, First Edition, 2017.

24OEPE05 CONTROL SYSTEM DESIGN **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To analyze the models of various linear systems.
- To design the compensators and controllers for SISO systems.
- To design state space forms to continuous and discrete systems

UNIT I ANALYSIS OF LINEAR SYSTEMS **9**

Review of system models –Transfer function and state space form– Time and Frequency Response – stability- Discretization –Need for Discretization –Sample and Hold devices – Effect of sampling on transfer function and state models – Analysis – Test for controllability and Observability.

UNIT II DESIGN OF SISO SYSTEM **9**

Design Specifications –In continuous domain – Limitations – Controller Structure – Multiple degrees of freedom – PID controllers and Lag-lead compensators- Design – Discretization and direct discrete design - Design in continuous and discrete domain.

UNIT III STATE SPACE DESIGN **9**

Pole assignment design – State and Output Feedback – observers – Estimated State Feedback – Design Examples (Continuous and Discrete).

UNIT IV OPTIMAL CONTROL **9**

Introduction: Classical control and optimization, formulation of optimal control problem, Typical performance measures – Linear quadratic regulator problem – solution – Application examples.

UNIT V OPTIMAL FILTERING **9**

Filtering – Linear system and estimation – System noise smoothing and prediction – Kalman Filter –Recursive estimation.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Analyze controllers for linear systems defined in transfer function and state space forms.
CO2: Design controllers for linear systems defined in transfer function and state space forms.
CO3: Apply state space forms to continuous and discrete systems.
CO4: Apply optimal control to linear systems in continuous and discrete systems
CO5: Apply filtering concepts to linear systems in continuous and discrete systems.

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TEXT BOOKS

1. M.Gopal, "Digital Control and State Variable Methods", 4th edition, McGraw Hill India,2012
2. K. Ogata, 'Modern Control Engineering', 5th Edition, Pearson, 2012.
3. K. P. Mohandas, "Modern Control Engineering", Sanguine Technical Publishers, 2006.

REFERENCE BOOKS

1. M.Gopal, Modern Control System Theory, 3rd edition, New Age International Publishers, 2014.
2. William S Levine, "Control System Fundamentals," The Control Handbook, CRC Press, Taylor and Francis Group, 2011.
3. AshishTewari, 'Modern Control Design with Matlab and Simulink', John Wiley, New Delhi, 2002.
4. T. Glad and L. Ljung, "Control Theory –Multivariable and Non-Linear Methods", Taylor & Francis, 2002.
5. M. Chidambaram and R. Padma Sree, "Control of Unstable Single and Multi Variable Systems",Narosa Publishing, 2017.

24OEPE06 ENERGY MANAGEMENT AND AUDITING **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To study the concepts behind economic analysis and load management
- To emphasize the energy management of various electrical equipment and metering
- To illustrate the concept of energy management technologies.

UNIT I ENERGY SCENARIO **9**

Basics of Energy and its various forms - Conventional and non-conventional sources – Energy policy - Energy conservation act 2001, Amedments (India) in 2010 - Need for energy management- Designing and starting an energy management program - Energy managers and energy auditors - Roles and responsibilities of energy managers - Energy labelling and energy standards.

UNIT II ENERGY COST AND LOAD MANAGEMENT **9**

Important concepts in an economic analysis - Economic models-Time value of money-Utility rate structures- Cost of electricity-Loss evaluation- Load management: Demand control techniques-Utility monitoring and control system-HVAC and energy management-Economic justification.

UNIT III ENERGY MANAGEMENT **9**

Demand side management (DSM)– DSM planning – DSM techniques – Load management as a DSM strategy – Energy conservation – Tariff options for DSM.

UNIT IV ENERGY AUDITING **9**

Definition – Energy audit methodology: audit preparation, execution and reporting – Financial analysis – Sensitivity analysis – Project financing options - Instruments for energy audit – Energy audit for generation, distribution and utilization systems – Economic analysis.

UNIT V ENERGY EFFICIENT TECHNOLOGIES **9**

Energy saving opportunities in electric motors - Power factor improvement benefit and techniques-Shunt capacitor, Synchronous Condenser and Phase Advancer - Energy conservation in industrial drives, electric furnaces, ovens and boilers - Lighting techniques: Natural, CFL, LED lighting sources and fittings.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Explore the present energy scenario and role of energy managers.
CO2: Comprehend the Economic Models for cost and load management.
CO3: Configure the Demand side energy management through its control Techniques, Strategy And Planning.
CO4: Discuss the process of energy auditing.
CO5: Analyse the energy level of industrial electrical systems.

TEXT BOOKS

1. Anil Kumar, Om Prakash, Prashant Singh Chauhan "Energy Management: Conservation and Audits, CRC Press, 2020.
2. Barney L. Capehart, Wayne C. Turner, William J. Kennedy, "Guide to Energy Management", CRC press, Taylor & Francis group, Eighth Edition, 2016.
3. S.C. Bhatia and Sarvesh Devraj, "Energy Conservation", Woodhead Publishing India Pvt. Ltd, 2016.

REFERENCE BOOKS

1. Barney L. Capehart, Wayne C. Turner, William J. Kennedy, "Guide to Energy Management", CRC press, Taylor & Francis group, Eighth Edition, 2016.
2. https://prsindia.org/files/bills_acts/bills_parliament/2010/The_Energy_Conservation_Amendment_Bill_2010.pdf
3. Eastop T.D and Croft D.R, "Energy Efficiency for Engineers and Technologists", Logman Scientific & Technical, 1990.
4. IEEE Recommended Practice for Energy Management in Industrial and Commercial Facilities, IEEE, 1996.
5. Amit K. Tyagi, "Handbook on Energy Audits and Management", TERI, 2003. Https://www.eeeguide.com/power-factor-improvement.

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24OEST01 INTEGRATED WATER RESOURCES MANAGEMENT **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To understand the principles, key elements, and global challenges of Integrated Water Resources Management.
- To examine the economic, legal, health, and agricultural dimensions of water management within the IWRM framework.
- To learn global practices, case studies, and policy instruments for effective implementation of IWRM.

UNIT I CONTEXT FOR IWRM **9**

Water as a global issue: key challenges – Definition of IWRM within the broader context of development – Key elements of IWRM - Principles – Paradigm shift in water management - Complexity of the IWRM process – UN World Water Assessment - SDGs.

UNIT II WATER ECONOMICS **9**

Economic view of water issues: economic characteristics of water good and services – Nonmarket monetary valuation methods – Water economic instruments – Private sector involvement in water resources management: PPP objectives, PPP models, PPP processes, PPP experiences through case studies.

UNIT III LEGAL AND REGULATORY SETTINGS **9**

Basic notion of law and governance: principles of international and national law in the area of water management - Understanding UN law on non-navigable uses of international water courses – International law for groundwater management – World Water Forums – Global Water Partnerships - Development of IWRM in line with legal and regulatory framework.

UNIT IV WATER AND HEALTH WITHIN THE IWRM CONTEXT **9**

Links between water and health: options to include water management interventions for health – Health protection and promotion in the context of IWRM – Global burden of Diseases - Health impact assessment of water resources development projects – Case studies.

UNIT V AGRICULTURE IN THE CONCEPT OF IWRM **9**

Origin of groundwater - Classification and types - Properties of aquifers - Darcy's law - Governing equations – Artificial recharge - RWH in rural and urban areas - Irrigation modernization – Rehabilitation – Command Area Development - Participatory Irrigation Management – Water Users' Association - Economic aspects of irrigation.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Identify and explain the global challenges related to water resources and the need for Integrated Water Resources Management (IWRM).

CO2: Apply economic principles and valuation methods to assess water as an economic good and evaluate water pricing and PPP models.

CO3: Interpret and analyze legal and regulatory frameworks, including international water laws, for sustainable water governance.

CO4: Evaluate the interconnections between water and health, and apply health impact assessment tools in water-related projects.

CO5: Assess the role of water in agriculture, including concepts like virtual water, water footprint, and irrigation efficiency within the IWRM context.

TEXT BOOKS

1. Gupta, R.S., Hydrology and Hydraulic Systems, 4th Edition, Standard Publishers, 2021.
2. Biswas, A.K., Integrated Water Resources Management: A Reassessment, Routledge, 2004.
3. Subramanya, K., Engineering Hydrology, 5th Edition, McGraw Hill, 2020.

REFERENCE BOOKS

1. Batchelor, C., Water Governance and IWRM, Stockholm Environment Institute, 2007.
2. David Keith Todd and Larry W. Mays, "Groundwater Hydrology", 3rd Third Edition, John Wiley & Sons, 2004.
3. Molden, D. (Ed.), Water for Food, Water for Life: A Comprehensive Assessment of Water Management in Agriculture, Earthscan, 2007.
4. UN-Water, The United Nations World Water Development Report 2023: Partnerships and Cooperation for Water, UNESCO, 2023.
5. Chatterjee, R. and Ray, P., Groundwater Governance and Management in India, CRC Press, 2020.

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24OEST02 WATER, SANITATION AND HEALTH **L T P C**

3 0 0 3

COURSE OBJECTIVES

- To understand the fundamentals of WASH, including the links between water, sanitation, health, hygiene, equity, and sustainability.
- To examine the challenges, impacts, and management issues related to WASH, with focus on social, economic, environmental, and political factors.
- To explore governance strategies, development initiatives, and case studies, highlighting policies, community participation, and sustainable solutions at local and global levels.

UNIT I FUNDAMENTALS WASH **9**

Meanings and Definition: Safe Water- Health, Nexus: Water- Sanitation - Health and Hygiene – Equity issues - Water security - Food Security. Sanitation And Hygiene (WASH) and Integrated Water Resources Management (IWRM) - Need and Importance of WASH.

UNIT II MANAGERIAL IMPLICATIONS AND IMPACT **9**

Third World Scenario – Poor and Multidimensional Deprivation--Health Burden in Developing Scenario -Factors contribute to water, sanitation and hygiene related diseases- Social: Social Stratification and Literacy Demography: Population and Migration- Fertility - Mortality- Environment: Water Borne-Water Washed and Water Based Diseases - Economic: Wage - Water and Health Budgeting -Psychological: Non-compliance - Disease Relapse - Political: Political Will.

UNIT III CHALLENGES IN MANAGEMENT AND DEVELOPMENT **9**

Common Challenges in WASH - Bureaucracy and Users- Water Utilities -Sectoral Allocation: - Infrastructure- Service Delivery: Health services: Macro and Micro- level: Community and Gender Issues- Equity Issues - Paradigm Shift: Democratization of Reforms and Initiatives.

UNIT IV GOVERNANCE **9**

Public health -Community Health Assessment and Improvement Planning (CHA/CHIP) Infrastructure and Investments on Water, (WASH) - Cost Benefit Analysis – Institutional Intervention-Public Private Partnership - Policy Directives - Social Insurance -Political Will vs Participatory Governance.

UNIT V INITIATIVES **9**

Management vs Development -Accelerating Development- Development Indicators Inclusive Development-Global and Local- Millennium Development Goal (MDG) and Targets – Five Year Plans - Implementation - Capacity Building - Case studies on WASH.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Describe the basic concepts of water, sanitation, health, hygiene, and their importance in sustainable development.

CO2: Identify the social, economic, environmental, and political factors affecting WASH in developing contexts.

CO3: Recognize common challenges in WASH management and suggest possible solutions considering community and equity aspects.

CO4: Understand governance frameworks, policies, and institutional approaches related to WASH implementation.

CO5: Analyze global and national WASH initiatives, development plans, and case studies to propose sustainable strategies.

TEXTBOOKS

1. Bonitha R., Beaglehole R., Kjellstrom T. (2006), Basic Epidemiology, 2nd Edition, World Health Organization.
2. National Research Council (2009), Global Issues in Water, Sanitation, and Health: Workshop Summary, The National Academies Press, Washington, DC.
3. Howard, G. and Bartram, J. (2003), Domestic Water Quantity, Service Level and Health, World Health Organization.

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REFERENCE BOOKS

1. Van Note Chism, N. and Bickford, D. J. (2002), Improving the Environment for Learning: An Expanded Agenda, New Directions for Teaching and Learning, 2002:
2. Sen, Amartya. (1997), On Economic Inequality, Enlarged Edition, with annex by James Foster and Amartya Sen, Oxford: Clarendon Press.
3. World Bank (2000), Intersectoral Water Allocation Planning and Management, World Bank Publishers.
4. UNICEF/WHO Joint Monitoring Programme (JMP) – Progress Reports on Drinking Water, Sanitation and Hygiene, Multiple Editions.
5. Third World Network, Policy Briefs and Research Articles.

24OEST03 PRINCIPLES OF SUSTAINABLE DEVOLOPMENT **L T P C**

3 0 0 3

COURSE OBJECTIVES

- To understand the meaning of sustainability and major development challenges.
- To learn about international frameworks, goals, and actions for sustainable development.
- To explore sustainable living methods, resource protection, and progress measurement tools.

UNIT I SUSTAINABILITY AND DEVELOPMENT CHALLEGES **9**

Definition of sustainability – environmental, economical and social dimensions of sustainability - sustainable development models – strong and weak sustainability – defining development- millennium development goals – mindsets for sustainability: earthly, analytical, precautionary, action and collaborative– syndromes of global change: utilisation syndromes, development syndromes, and sink syndromes – core problems and cross cutting Issues of the 21 century - global, regional and local environmental issues – social insecurity - resource degradation - climate change – desertification.

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UNIT II PRINCIPLES AND FRAME WORK **9**

History and emergence of the concept of sustainable development - our common future - Stockholm to Rio plus 20– Rio Principles of sustainable development – Agenda 21 natural step- peoples earth charter – business charter for sustainable development –UN Global Compact - Role of civil society, business and government – United Nations' 2030 Agenda for sustainable development – 17 sustainable development goals and targets, indicators and intervention areas.

UNIT III SUSTAINABLE DEVELOPMENT AND WELLBEING **9**

The Unjust World and inequities - Quality of Life - Poverty, Population and Pollution - Combating Poverty - - Demographic dynamics of sustainability - Strategies to end Rural and Urban Poverty and Hunger – Sustainable Livelihood Framework- Health, Education and Empowerment of Women, Children, Youth, Indigenous People, Non-Governmental Organizations, Local Authorities and Industry for Prevention, Precaution , Preservation and Public participation.

UNIT IV SUSTAINABLE SOCIO-ECONOMIC SYSTEMS **10**

Sustainable Development Goals and Linkage to Sustainable Consumption and Production – Investing in Natural Capital- Agriculture, Forests, Fisheries - Food security and nutrition and sustainable agriculture- Water and sanitation - Biodiversity conservation and Ecosystem integrity Ecotourism - Sustainable Cities – Sustainable Habitats- Green Buildings - Sustainable Transportation — Sustainable Mining - Sustainable Energy– Climate Change – Mitigation and Adaptation - Safeguarding Marine Resources - Financial Resources and Mechanisms.

UNIT V ASSESSING PROGRESS AND WAY FORWARD **8**

Nature of sustainable development strategies and current practice- Sustainability in global, regional and national context –Approaches to measuring and analysing sustainability– limitations of GDP- Ecological Footprint- Human Development Index- Human Development Report – National initiatives for Sustainable Development - Hurdles to Sustainability - Science and Technology for sustainable development –Performance indicators of sustainability and Assessment mechanism – Inclusive Green Growth and Green Economy – National Sustainable Development Strategy Planning and National Status of Sustainable Development Goals.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Explain the concept of sustainability and recognize major global issues such as pollution, climate change, and resource degradation.

CO2: Explain global goals and agreements like the UN Sustainable Development Goals and related principles.

CO3: Describe the importance of health, education, and poverty reduction in sustainable development.

CO4: Discuss sustainable practices in agriculture, energy, water, cities, and environmental protection.

CO5: Identify tools and indicators used to measure sustainability and suggest steps for future improvement.

TEXT BOOKS

1. Karel Mulder, Sustainable Development for Engineers - A Handbook and Resource Guide, Rouledge Taylor and Francis, 2017.
2. Tom Theis and Jonathan Tomkin, Sustainability: A Comprehensive Foundation, Rice University, Houston, Texas, 2012.
3. Barry Dalal Clayton and Stephen Bass, Sustainable Development Strategies- a resource book", Earthscan Publications Ltd, London, 2002.

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REFERENCE BOOKS

1. The New Global Frontier - Urbanization, Poverty and Environment in the 21st Century George Martine, Gordon McGranahan, Mark Montgomery and Rogelio Fernández-Castilla, IIED and UNFPA, Earthscan, UK, 2008.
2. Nolberto Munier, Introduction to Sustainability: Road to a Better Future, Springer, 2006.
3. A guide to SDG interactions: from science to implementation, International Council for Science, Paris,2017.
4. Jeffrey D. Sachs, The Age of Sustainable Development, Columbia University Press, 2015.
5. K. Mather, Environmental Management, New Age International Publishers, India, Reprint 2012.

24OEST04 ENVIRONMENTAL IMPACT ASSESSMENT **L T P C**

3 0 0 3

COURSE OBJECTIVES

- To make the students to understand environmental clearance.
- To provide knowledge on overall methodology of EIA, prediction tools and models.
- To Understand environmental management plan and case studies.

UNIT I INTRODUCTION **9**

Historical development of Environmental Impact Assessment (EIA). Environmental Clearance- EIA in project cycle. legal and regulatory aspects in India – types and limitations of EIA –EIA process- screening – scoping - terms of reference in EIA- setting – analysis – mitigation. Cross sectoral issues –public hearing in EIA- EIA consultant accreditation.

UNIT II IMPACT INDENTIFICATION AND PREDICTION **9**

Matrices – networks – checklists – cost benefit analysis – analysis of alternatives – expert systems in EIA. prediction tools for EIA – mathematical modeling for impact prediction – assessment of impacts – air – water – soil – noise – biological — cumulative impact assessment.

UNIT III SOCIO-ECONOMIC IMPACT ASSESSMENT **9**

Socio-economic impact assessment - relationship between social impacts and change in community and institutional arrangements. factors and methodologies- individual and family level impacts. communities in transition-rehabilitation.

UNIT IV EIA DOCUMENTATION AND ENVIRONMENTAL MANAGEMENT PLAN **9**

Environmental management plan - preparation, implementation and review – mitigation and rehabilitation plans – policy and guidelines for planning and monitoring programmes – post project audit – documentation of EIA findings – ethical and quality aspects of environmental impact assessment.

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UNIT V CASE STUDIES **9**

Mining, power plants, cement plants, highways, petroleum refining industry, storage & handling of hazardous chemicals, common hazardous waste facilities, CETPs, CMSWMF, building and construction projects.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Explain the need for environmental clearance, its legal procedure, need of EIA, its types, stakeholders and their roles.

CO2: Explore various impact identification methodologies, prediction techniques and model of impacts on various environments.

CO3: Relate social impacts and change in community due to development activities and rehabilitation methods.

CO4: Document the EIA findings and prepare environmental management and monitoring plan.

CO5: Identify, predict and assess impacts of similar projects based on case studies.

TEXT BOOKS

1. Canter, L.W., Environmental Impact Assessment, McGraw Hill, New York. 1996.
2. Van Note Chism, N. and Bickford, D. J., Improving the environment for learning, 2002.
3. Lawrence, D.P., Environmental Impact Assessment – Practical solutions to recurrent problems, Wiley-Interscience, New Jersey. 2003.

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REFERENCE BOOKS

1. EIA Notification 2006 including recent amendments, by Ministry of Environment, Forest and Climate Change, Government of India.
2. Sectoral Guidelines under EIA Notification by Ministry of Environment, Forest and Climate Change, Government of India.
3. Lee N. and George C. 2000. Environmental Assessment in Developing and Transitional Countries. Chichester: Willey.
4. World Bank –Source book on EIA ,1999.
5. Sam Mannan, Lees' Loss Prevention in the Process Industries, Hazard Identification Assessment and Control, 4th Edition, Butterworth Heineman, 2012.

24OEST05 ENVIRONMENTAL SUSTAINABILITY **L T P C**

3 0 0 3

COURSE OBJECTIVES

- To understand the concept of environmental sustainability.
- To understand the significance of biodiversity.
- To understand environmental economics.

UNIT I INTRODUCTION **9**

Valuing the Environment: Concepts, Valuing the Environment: Methods, Property Rights, Externalities, and Environmental Problems.

UNIT II CONCEPT OF SUSTAINABILITY **9**

Sustainable Development: Defining the Concept, the Population Problem, Natural Resource Economics: An Overview, Energy, Water, Agriculture.

UNIT III SIGNIFICANCE OF BIODIVERSITY **9**

Biodiversity, Forest Habitat, Commercially Valuable Species, Stationary - Source Local Air Pollution, Acid Rain and Atmospheric Modification, Transportation.

UNIT IV POLLUTION IMPACTS **9**

Water Pollution, Solid Waste and Recycling, Toxic Substances and Hazardous Wastes, Global Warming.

UNIT V ENVIRONMENTAL ECONOMICS **9**

Development, Poverty, and the Environment, Visions of the Future, Environmental economics and policy by Tom Tietenberg, Environmental Economics.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Explain the concept of environmental problems.
CO2: Enumerate the sustainability concept.
CO3: Explain the significance of biodiversity.
CO4: Explain the impacts of population.
CO5: Assess impacts of Environmental economics.

TEXT BOOKS

1. Robert Brinkmann., Introduction to Sustainability, Wiley-Blackwell., 2016.
2. Niko Roorda., Fundamentals of Sustainable Development, 3rd Edn, Routledge, 2020.
3. Bhavik R Bakshi., Sustainable Engineering: Principles and Practice, Cambridge University Press, 2019.

REFERENCE BOOKS

1. Andrew Hoffman, Competitive Environmental Strategy - A Guide for the Changing Business Landscape, Island Press.
2. Stephen Doven, Environment and Sustainability Policy: Creation, Implementation, Evaluation, the Federation Press.
3. George C. Environmental Assessment in Developing and Transitional Countries. Chichester: Willey, 2000.
4. Sectoral Guidelines under EIA Notification by Ministry of Environment, Forest and Climate Change, Government of India, 2005.
5. EIA Notification 2006 including recent amendments, by Ministry of Environment, Forest and Climate Change, Government of India.

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24OEST06 GREEN BUILDING DESIGN **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To learn the fundamentals of sustainable and energy-efficient building design.
- To familiarize students with building envelopes, operational energy reduction and net zero building concepts.
- To expose the students to passive house standards and building rating systems.

UNIT I INTRODUCTION **9**

Embodied energy, Operational energy in Building and Life cycle energy. Ecological footprint, Bio-capacity and calculation of planet equivalent.

UNIT II ROLE OF MATERIAL **9**

Carbon from Cement, alternative cements and cementitious material - Sustainability issues for concrete – Green steel.

UNIT III OPERATIONAL ENERGY IN BUILDING **9**

Role of materials and thermal conductivity - Building envelopes - Building systems and operations (HVAC, lighting, water supply, sewage, garbage disposal, recycling and composting) Clean & renewable energy in buildings - Rainwater harvesting - Effects of trees and microclimatic modification through greening.

UNIT IV RECYCLE AND REUSE METHODS OF BUILDING DESIGN **9**

Recycling of industrial and other waste for concrete production – reuse of steel members for new buildings – case studies.

UNIT V SMART BUILDINGS **9**

Smart buildings -Sensing and control systems.Net Zero buildings, Passive house standards and Building Rating systems.

TOTAL:45 PERIODS

COURSE OUTCOMES

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

CO1: Discuss the embodied energy and operational energy in buildings.
CO2: Explain the role of building materials in sustainable design.
CO3: Enumerate the operational energy in building design.
CO4: Evaluate recycling and reuse strategies in sustainable building design.
CO5: Identify the building rating systems.

TEXT BOOKS

1. J Newman, B S Choo, Advanced Concrete Technology-Processes, 1st Edition, Elsevier, 2003.
2. S Kubba, LEED Practices, Certification, and Accreditation Hand book, 1st ed. Elsevier, 2010.
3. Energy Conservation Building Code, Revised Version, Ministry of Power, Bureau of Energy Efficiency, 2018.

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REFERENCE BOOKS

1. Building Envelope Stringency Analysis, Architectural Energy Corporation, International Institute for Energy Conservation, 2004.
2. Practical Handbook on Energy Conservation in Buildings, Indian Building Congress, 1st edition, Nabhi Publication, 2008.
3. F C McQuiston, J D Parker, Heating, Ventilating, and Air Conditioning, Analysis and Design, Fourth Ed. John Wiley & Sons, 1994.
4. A H Buchanan, G Brian, Energy and carbon dioxide implications of building construction, Energy and Buildings, 1994.
5. C J Kibert, Sustainable Construction: Green Building Design and Delivery, 3rd edition, Wiley, 2022.

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