

COURSE STRUCTURE (R23)

AND

DETAILED SYLLABUS

III Year

COMPUTER SCIENCE & SYSTEMS ENGINEERING

For
B. Tech., Four Year Degree Course
(Applicable for the batches admitted from 2025-2026)



LENDI INSTITUTE OF ENGINEERING AND TECHNOLOGY

An Autonomous Institution

Approved by AICTE & Permanently Affiliated to JNTUGV, Accredited by NAAC with “A”

Grade and NBA (CSE, ECE, EEE & ME)

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**DEPARTMENT OF COMPUTER SCIENCE AND SYSTEMS ENGINEERING
(CSSE)**

B. Tech III-Year Course Structure–R23

III Year I Semester						
S.No	Course Code	Course Name	L	T	P	Credits
1	R23CSS-PC3101	Design and Analysis of Algorithms	3	0	0	3
2	R23CSS-PC3102	Computer Networks	3	0	0	3
3	R23CSS-PC3103	Object Oriented Analysis and Software Engineering	3	0	0	3
4		Professional Elective-I	3	0	0	3
4	R23CSS-PE3101.1	1. Distributed Systems	3	0	0	3
4	R23CSS-PE3101.2	2. Mean Stack Technology	3	0	0	3
4	R23CSS-PE3101.3	3. Quantum Computing	3	0	0	3
5	R23CSS-OE3101	Open Elective- I	3	0	0	3
6	R23CSS-PC3104	Computer Networks Lab	0	0	3	1.5
7	R23CSS-PC3105	Object Oriented Analysis and Software Engineering Lab	0	0	3	1.5
8	R23CSS-ES3101	Tinkering Lab	0	0	2	1
9	R23CSS-SC3101	Prompt Engineering (Skill Oriented Course)	0	1	2	2
10	R23BSH-MC3101	English and Soft Skills for Job Seekers (Mandatory Course)	0	1	2	0
11	R23CSS-SI3101	Evaluation of Community Service Project Internship	0	0	0	2
Total			15	2	12	23

III Year II Semester

S. No	Course Code	Course Name	L	T	P	Credits
1	R23CSS-PC3201	Data Warehousing and Data Mining	3	0	0	3
2	R23CSS-PC3202	Web Technologies	3	0	0	3
3	R23CSS-PC3203	Introduction to Artificial Intelligence	3	0	0	3
4		Professional Elective-II	3	0	0	3
4	R23CSS-PE3201.1	Project Management Approaches	3	0	0	3
4	R23CSS-PE3201.2	GPU Computing	3	0	0	3
4	R23CSS-PE3201.3	Block chain and Crypto currency Technologies	3	0	0	3
5		Professional Elective-III	3	0	0	3
5	R23CSS-PE3202.1	1. Mobile Computing	3	0	0	3
5	R23CSS-PE3202.2	2. Network Design and Management	3	0	0	3
5	R23CSS-PE3202.3	3. Wearable Computing	3	0	0	3
6	R23CSS-OE3201	Open Elective - II	3	0	0	3
7	R23CSS-PC3204	Data Mining and Data Warehousing Lab	0	0	3	1.5
8	R23CSS-PC3205	Web Technology Lab	0	0	3	1.5
9	R23CSS-SC3201	Sales force Developer (Skill Oriented Course)	0	1	2	2
10	R23CSS-MC3201	Technical Paper Writing & IPR (Mandatory Course)	2	0	0	0
Total			20	1	8	23

Subject Code	Subject Name	L	T	P	C
R23CSS-PC3101	Design and Analysis of Algorithms	3	0	0	3

Course Objectives: The objectives of this course are to acquire knowledge on the

- Analyze the asymptotic performance of algorithms
- Write rigorous correctness proofs for algorithms
- Demonstrate a familiarity with major algorithms and data structures
- Apply important algorithmic design paradigms and methods of analysis
- Synthesize efficient algorithms in common engineering design situations

Course Outcomes: The students should be able to:

1. Analyze complexities of algorithms using asymptotic notations.
2. Apply the divide-and-conquer paradigm for searching and sorting techniques.
3. Understand the concepts greedy paradigm for connected and weighted graphs and spanning trees.
4. Apply the dynamic programming paradigm for solving complex problems
5. Make use of backtracking and branch and bound technique when an algorithmic design situation calls for it.

UNIT - I:

Introduction: What is an Algorithm, Algorithm Specification, Pseudo code Conventions Recursive Algorithm, Performance Analysis, Space Complexity, Time Complexity, Amortized Complexity, Amortized Complexity, Asymptotic Notation, Practical Complexities, Performance Measurement.

Learning Outcomes: student will be able to

- Understand Algorithm and performance analysis (L2)
- Apply asymptotic notations on various algorithms and calculate complexity (L3)

UNIT - II:

Decrease-and-Conquer: Insertion Sort Algorithms for Generating Combinatorial Objects Decrease-by-a-Constant-Factor Algorithms Variable-Size-Decrease Algorithms

Divide and Conquer: Merge Sort, Quick Sort, Multiplication of Large Integers and Strassen's Matrix Multiplication

Transform and conquer: Pre-sorting Balanced Search Trees, Heaps and Heap sort

Learning Outcomes: student will be able to

- Understand Decrease and Conquer algorithms like Insertion sort (L2)
- Understand Divide and Conquer Algorithms like Merge sort, Quick Sort (L2)
- Understand Transfer and Conquer Algorithm like Heap sort (L2)

UNIT - III:

The Greedy Method: The General Method, Knapsack Problem, Job Sequencing with Deadlines Minimum-cost Spanning Trees, Prim's Algorithm, Kruskal's Algorithms, An Optimal Randomized Algorithm, Optimal Merge Patterns, Single Source Shortest Paths.

Learning Outcomes: student will be able to

- Understand and Analyze Greedy Method (L2)
- Understand various algorithms with examples (L2)

UNIT - IV:

Dynamic Programming: The General Method Multistage graph, All - Pairs Shortest Paths, String Edition, 0/1 Knapsack, Reliability Design, optimal binary search trees.

Learning Outcomes: student will be able to

- Understand various algorithms on Dynamic Programming (L2)

UNIT - V:

Backtracking: The General Method, The S-Queens Problem, Sum of Subsets, Graph Coloring Hamiltonian Cycles

Branch and Bound: The Method, Least cost (LC) Search, The 15-Puzzle: an Example, Control Abstraction for LC-Search, Bounding, FIFO Branch-and-Bound, LC Branch and Bound, 0/1 Knapsack problem, LC Branch-and Bound Solution, FIFO Branch-and-Bound Solution, Traveling Salesperson problem.

Learning Outcomes: student will be able to

- Understand various Backtracking Algorithms and problems (L2)
- Understand various Branch and Bound Algorithms and problems (L2)

TEXT BOOKS:

- 1) Fundamentals of computer algorithms E. Horowitz S. Sahni, University Press
- 2) Introduction to the design and analysis of Algorithms Anany Levitin pearson ,3rd edition
- 3) Introduction to Algorithms Thomas H Cormen PHI Learning

REFERENCE BOOKS:

- 1) The Design and Analysis of Computer Algorithms, Alfred V Aho John E Hopcroft Jeffrey D Ullman
- 2) Algorithm Design, Jon Kleinberg, Pearson
- 3) Algorithms, by Dasgupta, Papadimitriou and Vazirani, McGraw-Hill Education,2006

E-Resources:

1. <https://www.coursera.org/specializations/algorithms>
2. <https://www.geeksforgeeks.org/fundamentals-of-algorithms/>
3. <https://ocw.mit.edu/courses/6-006-introduction-to-algorithms-fall-2011/>

Course code	Course Title	L	T	P	Credits
R23CSS-PC3102	Computer Networks	3	0	0	3

Course Objectives: The objectives of this course are to acquire knowledge on the

- Understand about the basic Networking Components and their functionality.
- Understand the functionalities of the Data Link Layer.
- Understand the protocols for data transfer.
- Analyse different protocols and architecture of IEEE 802.11

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

1. Understand and Compare the Reference Models.
2. Identify the Network Components and learn about their functionality.
3. Analyse the services provided by the Data Link Layer to the Network Layer.
4. Understand the use of Data Link Layer protocols.
5. Understand the architecture of IEEE 802.11

Unit I

Introduction: Components of a Data Communication system, Dataflow, Network Topologies LAN,MAN,WAN. Reference models- The OSI Reference Model- the TCP/IP Reference Model.

Learning Outcomes: Student will be able to

- Understand the components involved to form a Computer Network (L2).
- Understand the data flow in a Computer Network and the use of protocols.(L2)
- Analyze the importance of each layer in the reference models.(L4).

Applications: Conceptual Framework of a Network, ATM, Online reservation systems, reservation systems.

Unit II

Physical Layer and overview of PL Switching:

Transmission Media: Guided ,Unguided. Bandwidth, throughput, Latency.

Multiplexing: frequency division multiplexing, wavelength division multiplexing, synchronous time division multiplexing, statistical time division multiplexing,

Learning Outcomes: Student will be able to

- Understand the Connecting Devices.(L2).
- Analyze different types of Multiplexing. (L4)
- Understand the performance metrics of a Network. (L3).

Applications: Identify the use of different devices in real time computer networks and data processing tasks.

Unit III

Data Link Layer Design Issues:

Data link layer: Design issues, Framing: fixed size framing, variable size framing, flow control, error control, error detection and correction, CRC

Elementary Data Link Layer protocols:

simplex protocol, Simplex stop and wait, Simplex protocol for Noisy Channel. Sliding window protocol: One bit, Go back N, Selective repeat, Stop and wait protocol.

Data link layer in HDLC: configuration and transfer modes, frames, control field, Point to Point Protocol (PPP): framing transition phase, multiplexing.

Learning Outcomes: Student will be able to

- Understand Data Link Layer Services to the Network Layer. (L2)
- Understand Error Correction and Detection techniques. (L2)
- Apply Detecting Codes for sample data. (L3)

Applications: Error correction and detecting procedures on binary data.

UNIT-IV**Random Access:**

ALOHA, MAC addresses, Carrier sense multiple access (CSMA), CSMA with Collision Detection, CSMA with Collision Avoidance

Network Layer: Routing algorithm shortest path routing, Flooding, Hierarchical routing, Broad cast, Multi cast, distance vector routing.

The Transport Layer: addressing, establishing a connection, releasing connection, flow control and buffering and crash recovery, End to end protocols: UDP.

Learning Outcomes: Student will be able to

- Understand Network Layer services and Routing algorithms (L2)
- Understand Transport Layer protocols. (L2)

Applications: Used to implement Routing algorithms for a network

UNIT-V(10 hours)

Application layer: (WWW and HTTP): ARCHITECTURE : Client (Browser) ,Server, Uniform Resource Locator HTTP: HTTP Transaction, HTTP Operational Model and Client/Server Communication, HTTP Generic Message Format, HTTP Request Message Format, HTTP Response Message Format

Learning Outcomes: Student will be able to

- Understand the Data Link Layer protocols. (L2)
- Understand which protocols are used for Noisy and Noiseless Channels. (L2)

Applications: Used to implement data transfer and collision detection mechanisms.

Text Books:

1. Data Communications and Networking ,Behrouz A Forouzan,Fourth Edition.
2. Tanenbaum and David J Wetherall, Computer Networks, 5th Edition, Pearson Edu, 2010

References:

1. Computer Networks: A Top Down Approach, Behrouz A. Forouzan, Firouz Mosharraf, McGraw Hill Education
2. Larry L. Peterson and Bruce S. Davie, Computer Networks - A Systems Approach (5th ed), Morgan Kaufmann/ Elsevier, 2011

Course Code	Subject Name	L	T	P	C
R23CSS-PC3103	Object Oriented Analysis and Software Engineering	3	0	0	3

Course Objectives:

- Introduce the principles of object-oriented analysis and modeling in software engineering.
- Enable students to gather and analyze system requirements using object-oriented techniques.
- Teach students to model real-world systems using UML diagrams and design principles.
- Bridge the gap between analysis and design phases in the software development lifecycle.
- Prepare students to document, evaluate, and evolve object-oriented models for maintainable software systems.

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

1. Understand and explain the fundamentals of object-oriented analysis and its advantages over traditional approaches.
2. Identify, collect, and specify functional and non-functional requirements using object-oriented techniques.
3. Create accurate UML diagrams including use case, class, object, sequence, collaboration, and state diagrams for real-world systems.
4. Apply object-oriented principles to transition from analysis models to software design.
5. Document and maintain object-oriented analysis models to support system evolution and future enhancements.

Unit I: Introduction to Object-Oriented Analysis and Modeling

Importance of object-oriented analysis in modern software development, Comparison between structured and object-oriented approaches, Overview of modeling and its relevance in software engineering.

Case Study: Banking System – Identifying the need for object-oriented analysis in a banking application to manage customer accounts and transactions.

Learning Outcomes:

- Understand the relevance and benefits of object-oriented analysis in software engineering.
- Differentiate between traditional and object-oriented development methods.
- Explain the role of modeling in representing complex software systems.

Unit II: Requirements Analysis and Use Case Modeling

Functional and non-functional requirements gathering, Use case modeling using UML, Identifying actors and system boundaries.

Case Study: Online Ticket Booking System – Creating use case diagrams to identify functional requirements and user interactions.

Learning Outcomes:

- Gather and analyze system requirements from the user perspective.
- Develop use case models to define software functionality.
- Identify system actors, boundaries, and use case relationships.

Unit III: Static Modeling with UML

Class and object diagrams, Relationships (association, generalization, aggregation), Modeling attributes and operations in classes.

Case Study: Inventory Management System – Creating class diagrams to represent items, suppliers, and stock transactions.

Learning Outcomes:

- Design class and object diagrams for representing static system structure.
- Model relationships and hierarchies among system components.
- Define class attributes and operations based on system requirements.

Unit IV: Dynamic Modeling and Interaction Diagrams

Sequence diagrams to represent object interactions over time, Collaboration diagrams for communication modeling, State chart diagrams for dynamic behavior.

Case Study: Hotel Reservation System – Modeling object interactions and behavior during the room booking process.

Learning Outcomes:

- Illustrate interactions among system components using sequence diagrams.
- Use collaboration diagrams to capture communication patterns.
- Model state transitions and behavior of objects using state charts.

Unit V: From Analysis to Design & System Evolution

Transitioning from analysis to design, Refining models for implementation, Documenting analysis artifacts for maintainability.

Case Study: E-Learning Platform – Mapping analysis models to design structure and maintaining system consistency.

Learning Outcomes:

- Understand how analysis artifacts contribute to software design.
- Refine object-oriented models to guide software implementation.
- Document and evolve analysis models for long-term system maintenance.

Textbooks:

1. **Grady Booch, James Rumbaugh, and Ivar Jacobson,**
“*The Unified Modeling Language User Guide*”, 2nd Edition, Addison-Wesley, 2005.
2. **Ali Bahrami,**
“*Object Oriented Systems Development*”, McGraw-Hill, 1999.

Reference Books:

1. **Craig Larman,**
“*Applying UML and Patterns: An Introduction to Object-Oriented Analysis and Design and Iterative Development*”, 3rd Edition, Pearson Education, 2005.
2. **Roger S. Pressman,**
“*Software Engineering: A Practitioner’s Approach*”, 8th Edition, McGraw-Hill, 2014.
3. **Stephen R. Schach,**
“*Object-Oriented and Classical Software Engineering*”, 8th Edition, McGraw-Hill, 2007.
4. **Bernd Bruegge and Allen H. Dutoit,**
“*Object-Oriented Software Engineering Using UML, Patterns, and Java*”, 3rd Edition, Pearson Education, 2010.

Subject Code	Subject Name	L	T	P	C
R23CSS-PE3101.1	Distributed Systems (Professional Elective-1)	3	0	0	3

Course Objectives:

- Understand how systems will communicate through network and to understand the Architectural design of Distributed Systems.
- Understand and apply the various communication techniques and analyze the network IP address allocation.
- Understand the Local and Remote procedure calls between processes.
- Understand the role of operating Systems in Distributed Communication and the different technologies used for file sharing in Distributed Systems.
- Apply Distributed algorithms for communication and to understand the Distributed Deadlocks and Replication requirement.

Course Outcomes:

1. Understand the characteristics of Distributed architecture.
2. Apply inter process communication in a distributed environment.
3. Apply standard protocols (RMI&RPC) in distributed systems.
4. Understand the fundamentals of Distributed File systems.
5. Analyze the Transactions and replications in distributed systems.

UNIT I

Characterization of Distributed Systems: Introduction, Examples of Distributed Systems, Resource Sharing and the Web, Challenges.

System Models: Introduction, Architectural Models- Software Layers, System Architecture, Variations, Interface and Objects, Design Requirements for Distributed Architectures, Fundamental Models- Interaction Model, Failure Model, Security Model.

Learning Outcomes: Student will be able to

- Outline the characteristics of file systems.(L2)
- Understand the challenges of system models.(L2)
- Understand the Design Requirements of Distributed Architecture.(L2)

UNIT II

Inter process Communication: Introduction, The API for the Internet Protocols- The Characteristics of Interprocess communication, Sockets, UDP Datagram Communication, TCP Stream Communication; External Data Representation and Marshalling; Client Server Communication; Group Communication- IP Multicast- an implementation of group communication, Reliability and Ordering of Multicast.

Learning Outcomes: Student will be able to

- Understand the Inter process communication.(L2)
- Apply the TCP stream communication.(L3)
- Outline IP Multicast and its ordering.(L2)

UNIT III

Distributed Objects and Remote Invocation: Introduction, Communication between Distributed Objects- Object Model, Distributed Object Model, Design Issues for RMI, Implementation of RMI, Distributed Garbage Collection; Remote Procedure Call, Events and Notifications, Case Study: JAVA RMI

Learning Outcomes: Student will be able to

- Understand the communication between objects.(L2)
- Apply Java RMI to different applications.(L3)
- Experiment with Remote Procedure call.(L3)

UNIT IV

Operating System Support: Introduction, The Operating System Layer, Protection, Processes and Threads –Address Space, Creation of a New Process, Threads.

Distributed File Systems: Introduction, File Service Architecture; Peer-to-Peer Systems: Introduction, Napster and its Legacy, Peer-to-Peer Middleware, Routing Overlays.

Learning Outcomes: Student will be able to

- Understand Operating system Layers.(L2)
- Illustrate the file server Architecture.(L3)
- Understand Peer to Peer Middleware Routing.(L2)

UNIT V

Coordination and Agreement: Introduction, Distributed Mutual Exclusion, Elections, Multicast Communication.

Distributed Transactions: Introduction, Concurrency Control in Distributed Transactions , Distributed Dead Locks, Transaction Recovery .

Replication: System Model and Group Communication, Passive (Primary) Replication, Active Replication.

Learning Outcomes: Student will be able to

- Compare coordination and Agreement.(L2)
- Understand system Model and Group communication.(L2)
- Summarize the challenges of Replication.(L2)

TEXT BOOKS

1. Ajay DK shemkalyani, MukeshSighal, “Distributed Computing, Principles, Algorithms and Systems”,Cambridge
2. GeorgeCoulouris,JeanDollimore,TimKindberg,“DistributedSystems-Conceptsand Design”, Fourth Edition, PearsonPublication.

REFERENCE BOOKS

1. Distributed-Systems-Principles-Paradigms-Tanenbaum PHI

Course code	Course Title	L	T	P	Credits
R23CSS-PE3101.2	Mean Stack Technology (Professional Elective – 1)	3	0	0	3

Course Objectives:

- Understand the fundamentals of full-stack development using MEAN (MongoDB, Express.js, Angular, Node.js).
- Learn to build dynamic web applications using Angular for frontend and Node.js for backend.
- Understand and implement RESTful APIs using Express.js.
- Learn to work with Mongo DB as a NoSQL database in MEAN stack applications.
- Gain experience in deploying MEAN stack applications.

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

- Understand the components and architecture of MEAN Stack.
- Develop front-end applications using Angular.
- Build and manage backend services using Node.js and Express.js.
- Use MongoDB to store, retrieve, and manipulate data.
- Integrate and deploy MEAN Stack applications.

Unit-I

Introduction to MEAN Stack: Overview of Full Stack Development, Introduction to MEAN Stack – Architecture, Advantages, Installation of Node.js, MongoDB, Angular CLI. Introduction to Version Control with Git.

Learning Outcomes: Student will be able to

- Understand MEAN stack architecture and tools. *(L2)*
- Set up development environment. *(L3)*

Unit-II

Angular – Frontend Development: Angular components, modules, routing, services, directives, forms, and data binding. HTTP client for API calls. Angular Material for UI design.

Learning Outcomes: Student will be able to

- Design UI with components and directives. *(L3)*
- Connect frontend with backend using HTTP client. *(L3)*

Unit-III

Node.js and Express.js – Backend Development: Introduction to Node.js – Modules, npm, event-driven programming. Express.js – Routing, middleware, RESTful API design.

Learning Outcomes: Student will be able to

- Create server-side logic using Node.js. *(L3)*
- Develop REST APIs using Express.js. *(L3)*

Unit-IV

MongoDB – NoSQL Database: MongoDB architecture, documents, collections, CRUD operations, indexing, aggregation. Connecting MongoDB with Node.js using Mongoose.

Learning Outcomes: Student will be able to

- Perform CRUD operations on MongoDB. *(L3)*
 - Use Mongoose for schema modelling. *(L3)*
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Unit–V

Integration and Deployment: Integrating Angular with Node.js backend and MongoDB. Authentication using JWT. Deployment on cloud (Heroku, Vercel, or Firebase). Performance and security considerations.

Learning Outcomes: Student will be able to

- Secure applications with JWT authentication. *(L3)*
- Deploy full-stack applications. *(L4)*

Applications:

- Develop real-time e-commerce, social media, chat, or blog applications.
- Use MEAN stack for scalable single-page web applications.
- Apply full-stack skills in startup and enterprise web projects.

Text Books:

1. "Pro MEAN Stack Development" – Elad Elrom, Apress, 2016.
2. "Getting MEAN with Mongo, Express, Angular, and Node" – Simon Holmes and Clive Harber, Manning, 2nd Edition, 2019.

Reference Books:

1. "Learning JavaScript Design Patterns" – Addy Osmani, O'Reilly Media.
 2. "MongoDB: The Definitive Guide" – Kristina Chodorow, O'Reilly Media.
 3. Official Angular, Node.js, Express, and MongoDB documentation.
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Course Code	Subject Name	L	T	P	C
R23CSS-PE3101.3	QUANTUM COMPUTING (Professional Elective – 1)	3	0	0	3

Course Objectives:

- To understand the foundational concepts of quantum mechanics relevant to computing.
- To explore quantum algorithms and their significance over classical counterparts.
- To study different models and architectures used in quantum computing.
- To analyze challenges related to quantum error correction, security, and scalability.
- To understand the future scope and implementation challenges of quantum systems.

Course Outcomes:

- Explain fundamental principles such as quantum measurements, entanglement, and superposition.
- Demonstrate understanding of quantum teleportation, algorithms, and circuit models.
- Analyze performance, error correction, and cryptographic aspects in quantum computing.
- Compare various quantum computing models and assess their implementation feasibility.

UNIT I: Introduction

Quantum Measurements, Density Matrices, Positive-Operator Valued Measure (POVM), Fragility of Quantum Information: Decoherence, Quantum Superposition and Entanglement, Quantum Gates and Circuits

Learning Outcomes: student will be able to

- Understand the concepts of quantum measurements and POVM (L2)
- Explain superposition and entanglement principles (L2)
- Construct basic quantum circuits (L3)

UNIT II: Quantum Basics and Principles

No Cloning Theorem, Quantum Teleportation, Bell's Inequality and Its Implications, Quantum Algorithms and Circuits

Learning Outcomes: student will be able to

- Describe the No Cloning Theorem and its consequences (L2)
- Explain and analyze the process of quantum teleportation (L3)
- Interpret the implications of Bell's inequality (L4)

UNIT III: Algorithms

Deutsch and Deutsch–Jozsa Algorithms, Grover's Search Algorithm, Quantum Fourier Transform, Shor's Factorization Algorithm

Learning Outcomes: student will be able to

- Understand and apply quantum search and factorization algorithms (L3)
- Analyze efficiency of quantum algorithms over classical ones (L4)

- Design basic quantum algorithm circuits (L3)

UNIT IV: Performance, Security, and Scalability

Quantum Error Correction and Fault Tolerance, Quantum Cryptography, Fidelity and Implementation Issues, Scalability in Quantum Computing

Learning Outcomes: student will be able to

- Evaluate error correction techniques and fault-tolerance mechanisms (L4)
- Understand principles of quantum cryptography (L2)
- Analyze scalability and performance limitations (L4)

UNIT V: Quantum Computing Models

NMR Quantum Computing, Spintronics and QED Model, Linear and Nonlinear Optical Approaches, Limits and Future of Quantum Computing

Learning Outcomes: student will be able to

- Compare different physical models of quantum computing (L4)
- Understand applications of QED and optical models (L2)
- Assess the practical limits and future directions of quantum technology (L5)

Textbooks:

1. Michael A. Nielsen and Isaac L. Chuang, Quantum Computation and Quantum Information, Cambridge University Press, 10th Anniversary Edition, 2010.
2. Mermin, N. David, Quantum Computer Science: An Introduction, Cambridge University Press, 2007.
3. Phillip Kaye, Raymond Laflamme, and Michele Mosca, An Introduction to Quantum Computing, Oxford University Press, 2007.

Reference Books:

4. Scott Aaronson, Quantum Computing Since Democritus, Cambridge University Press, 2013.
5. Eleanor Rieffel and Wolfgang Polak, Quantum Computing: A Gentle Introduction, MIT Press, 2011.
6. Shohini Ghose, Quantum Computing for Everyone, MIT Press, 2023.

E-Resources:

- NPTEL Course on Quantum Computing: <https://nptel.ac.in/courses/115/104/115104123/>
 - IBM Quantum Experience Tutorials: <https://quantum-computing.ibm.com/>
 - Microsoft Quantum Development Kit Documentation: <https://learn.microsoft.com/en-us/azure/quantum/>
 - Qiskit Tutorials by IBM: <https://qiskit.org/learn/>
 - Coursera - Introduction to Quantum Computing: <https://www.coursera.org/learn/quantum-computing/>
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Course code	Course Title	L	T	P	Credits
R23CSS-PC3104	Computer Networks Lab	0	0	3	1.5

Course Objectives: Understand the network architecture and applications.

- Understand the fundamentals of networking devices and cabling.
- Configure and troubleshoot basic network devices and IP addressing.
- Implement and verify static and dynamic routing protocols.
- Set up and configure network services such as DHCP, DNS, FTP, and HTTP.
- Design and simulate comprehensive network topologies using Cisco Packet Tracer.

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

1. Identify and configure networking cables and components.
2. Configure network devices and troubleshoot connectivity.
3. Implement routing protocols and VLANs.
4. Set up and configure networking services (DHCP, DNS, FTP, HTTP).
5. Design and simulate comprehensive network architectures.

Topics covered:

1. Study and identify various types of networking cables (straight-through, crossover, console) and their usage in different connection scenarios. Explore IP address classes (A, B, C) and their default ranges using Cisco Packet Tracer.
 2. Establish basic peer-to-peer communication between two PCs by assigning IP addresses and verifying connectivity using the ping command in Cisco Packet Tracer.
 3. Configure static IP addresses on end devices within a LAN and test communication between them using Cisco Packet Tracer.
 4. Simulate the functions of a hub, switch, and router in Cisco Packet Tracer, and compare how each device forwards packets within a network.
 5. Configure a router to connect two separate networks and enable inter-network communication by assigning IP addresses and routing interfaces in Cisco Packet Tracer.
 6. Implement static routing between routers to establish communication across different IP subnets in Cisco Packet Tracer.
 7. Configure and verify dynamic routing using the Routing Information Protocol (RIP) in a multi-router environment using Cisco Packet Tracer.
 8. Design and implement a network using the OSPF routing protocol with multiple routers and areas, and verify dynamic route updates in Cisco Packet Tracer.
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9. Create multiple VLANs on a switch, assign devices to VLANs, and test communication within and between VLANs using Cisco Packet Tracer.
10. Enable inter-VLAN communication using router-on-a-stick configuration with sub-interfaces and trunk ports in Cisco Packet Tracer.
11. Configure a router to act as a DHCP server and dynamically assign IP addresses to end devices in a network simulated with Cisco Packet Tracer.
12. Implement Network Address Translation (NAT) using static and dynamic NAT configurations to allow private IP networks to access external networks in Cisco Packet Tracer.
13. Set up an FTP server and client devices in Cisco Packet Tracer to simulate file sharing operations across a local network.
14. Configure a web server to host an internal website and enable client PCs to access it via HTTP using Cisco Packet Tracer.
15. Set up a DNS server to resolve domain names into IP addresses and validate DNS functionality from client systems in Cisco Packet Tracer.
16. Design and simulate a comprehensive enterprise network integrating VLANs, routing (static/dynamic), DHCP, ACLs, NAT, DNS, FTP, and web services using Cisco Packet Tracer, demonstrating end-to-end connectivity and functionality.

Textbook References:

- **"CCNA 200-301 Official Cert Guide" (Volumes 1 & 2)** by Wendell Odom ISBN-13: 978-0135792735
 - **"Cisco Networking All-in-One For Dummies"** by Edward Tetz ISBN-13: 978-1119288282
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Course code	Course Title	L	T	P	Credits
R23CSS-PC3105	Object Oriented Analysis and Software Engineering Lab	0	0	3	1.5

Course Objectives: Understand the network architecture and applications.

- Understand the fundamental principles of object-oriented analysis and its significance in software engineering.
- Learn to model functional and structural aspects of software systems using UML.
- Analyze real-world problems and extract functional and non-functional requirements.
- Apply object-oriented principles to design maintainable and scalable software systems.
- Bridge the gap between analysis and implementation by refining models and applying software design principles.

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

1. Explain the key concepts of object-oriented analysis and compare them with traditional approaches.
2. Identify and define system requirements using use case modeling and requirement engineering techniques.
3. Develop static and dynamic UML diagrams (Class, Object, Activity, Sequence, Collaboration, State, Component, Deployment) for various software systems.
4. Apply object-oriented design principles and design patterns to refine models for software development.
5. Map analysis models to implementation-level code structure and document system evolution for future enhancements.

Topics Covered:

1. Draw a use case diagram for an **ATM System** showing all possible user interactions and system functionalities.
 2. Create a class diagram for the **ATM System** capturing core entities like Account, Transaction, User, and ATM.
 3. Develop an object diagram for the **ATM System** based on the previously created class diagram.
 4. Model an activity diagram for the **Library Management System** illustrating the process of issuing and returning books.
 5. Draw a use case diagram for the **Online Ticket Booking System** identifying all actors and use cases.
 6. Design a class diagram for the **Online Ticket Booking System** including users, tickets, schedules, and payment.
 7. Create a sequence diagram for an **Online Shopping System** depicting the interaction during order placement.
 8. Model a collaboration diagram for the **Online Shopping System** representing the communication flow among objects.
 9. Draw a state chart diagram for **Order Processing** showing transitions from order placement to delivery.
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10. Create a component diagram for a **Hospital Management System** outlining major software components and their dependencies.
11. Draw a deployment diagram for the **Hospital Management System** mapping software artifacts to hardware nodes.
12. Design a use case and class diagram for the **Railway Reservation System** including reservation and cancellation functionalities.
13. Create a sequence and state chart diagram for the **Railway Reservation System** depicting user interaction and ticket status transitions.
14. Implement and model the **Singleton Design Pattern** using a UML class diagram.
15. Model the **Observer Design Pattern** using UML and demonstrate its applicability in a notification system.
16. Perform a mini project by selecting a real-world application (e.g., **Food Delivery System**) and create a complete UML model including use case, class, sequence, activity, component, and deployment diagrams.

Textbooks

1. **Ali Bahrami**, *Object Oriented Systems Development*, McGraw-Hill, 1999.
2. **Grady Booch, James Rumbaugh, and Ivar Jacobson**, *The Unified Modeling Language User Guide*, 2nd Edition, Addison-Wesley, 2005.

Reference Books

1. **Craig Larman**, *Applying UML and Patterns: An Introduction to Object-Oriented Analysis and Design and Iterative Development*, 3rd Edition, Pearson Education, 2005.
 2. **Stephen R. Schach**, *Object-Oriented and Classical Software Engineering*, 8th Edition, McGraw-Hill, 2007.
 3. **Bernd Bruegge and Allen H. Dutoit**, *Object-Oriented Software Engineering Using UML, Patterns, and Java*, 3rd Edition, Pearson Education, 2010.
-

Course code	Course Title	L	T	P	Credits
R23CSS-ES3101	Tinkering Lab	0	0	2	1

Course Objectives:

- To develop foundational awareness in students about innovation, design thinking, and the ATL ecosystem.
- To equip students with computational, analytical, and problem-solving skills using basic electronics and programming tools.
- To foster hands-on learning through the integration of hardware (sensors, circuits, microcontrollers) and software tools for prototyping.
- To encourage creativity and innovation by guiding students through real-world problem identification and solution development.
- To build entrepreneurial, leadership, and project management skills for applying technology solutions with social and community impact.

Course Outcomes:

1. Demonstrate an understanding of the ATL mission, design thinking principles, and innovation mindset.
2. Apply basic skills in electronics, sensors, and microcontrollers to build simple functional prototypes.
3. Use software tools like Tinkercad, Arduino IDE, and MIT App Inventor to design and simulate real-world projects.
4. Create innovative technological solutions to real-life problems through collaborative ideation and project-based learning.
5. Exhibit leadership, communication, and entrepreneurial abilities by presenting projects and participating in innovation challenges.

Unit 1: Pre-Tinker Level – Awareness & Ideation

Objective:

- To build foundational awareness about innovation, the ATL ecosystem, and foster creativity among students.

Topics Covered:

- **Introduction to ATL:** ATL mission and goals, Importance of innovation and creativity
- **Digital Literacy:** Safe internet usage, Basics of computers and mobile technology
- **Design Thinking Basics:** Stages of design thinking – Empathize, Define, Ideate, Prototype, Test with simple examples
- **Ideation and Brainstorming:** Problem identification, Collaborative idea generation
- **Innovation Mindset:** Developing growth mindset, curiosity, and resilience

Activities:

- ATL Orientation, Poster/Storytelling competitions, Problem-solving challenge

Tools Introduced:

- Paper prototyping, Basic digital tools: PowerPoint, Paint, Google Search

Unit 2: Tinker Club – Skill Development & Prototyping

Objective:

To equip students with basic technical and tinkering skills using ATL equipment.

Topics Covered:

- **Computational Thinking:** Algorithms, sequencing, flowcharts, and logic-building
- **Electronics & Circuits:** Series and parallel circuits, LEDs, resistors, breadboards
- **Sensors and Actuators:** IR sensor, ultrasonic sensor, buzzer, LDR
- **Microcontroller Introduction:** Arduino basics and simple connections
- **Tinkering Safety and Lab Etiquette**

Activities:

- Touchless sanitizer project, Line follower robot, Home automation demo

Tools Introduced:

- Arduino IDE, Tinkercad Circuits, Basic soldering tools

Unit 3: Tinker Lab – Advanced Prototyping & Innovation**Objective:**

To apply skills learned in real-world problem-solving using integrated technologies.

Topics Covered:

- **Physical Computing:** Basics of IoT with microcontrollers and Wi-Fi modules
- **3D Design & Printing:** Using Tinkercad / Fusion 360 and 3D printers
- **Advanced Sensors:** Gas, temperature, and motion sensors
- **Programming & Automation:** Embedded C / Scratch, real-time data processing

Projects:

- Smart streetlight, Air pollution monitor, Smart irrigation system

Tools Introduced:

- MIT App Inventor, Fusion 360, 3D printer software

Unit 4: Post Tinker Lab – Innovation & Community Impact**Objective:**

To transition students into innovators who can solve real-life problems and prepare for entrepreneurship.

Topics Covered:

- **Social Innovation:** Identifying and solving local/community issues
- **Entrepreneurship:** Business models, storytelling, and financial literacy
- **Intellectual Property Rights (IPR):** Understanding patents, copyrights, and trademarks
- **Leadership & Project Management:** Basics of leading innovation teams and managing ATL projects

Activities:

- Real-world deployments, ATL Marathon, Pitching ideas to mentors and experts

Tools Introduced:

- Canva, Google Workspace tools, Data collection tools

Textbooks

1. **Atal Innovation Mission (AIM) ATL Curriculum Guide**, NITI Aayog (Official ATL Handbook)
A foundational guide for ATL planning, curriculum integration, and project-based learning.
2. **Think Like a Programmer** by V. Anton Spraul, No Starch Press
Covers problem-solving and computational thinking for beginners.
3. **Getting Started with Arduino** by Massimo Banzi & Michael Shiloh, Maker Media
An easy-to-follow introduction to Arduino programming and basic electronics.

Reference Books

1. **Design Thinking for School Innovation** by Alyssa Gallagher & Kami Thordarson, Corwin
Helps educators and students implement design thinking strategies in ATL projects.
 2. **Learning IoT with Arduino and Raspberry Pi** by Pradeeka Seneviratne, Packt Publishing
Introduces Internet of Things concepts and hands-on experiments suitable for ATL labs.
 3. **Introduction to 3D Printing** by Andreas Gebhardt, Hanser Publications
A practical reference for understanding and using 3D design and printing tools like Tinkercad and Fusion 360.
 4. **Scratch Programming Playground** by Al Sweigart, No Starch Press
A beginner-friendly guide to creative coding using Scratch for automation and logic-building.
 5. **MIT App Inventor Projects** by Karen Lang & Paula Beer, Apress
Step-by-step mobile app development projects for use in ATL innovation labs.
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Course code	Course Title	L	T	P	Credits
R23CSS-SC3101	Prompt Engineering	0	1	2	2

Course Objectives: To understand how large language models (LLMs) respond to prompts and instructions.

- To develop skills in crafting effective prompts for diverse applications using tools like ChatGPT, Claude, or Gemini.
- To explore prompt tuning techniques such as zero-shot, few-shot, and role-based prompting.
- To apply prompts in domain-specific tasks such as summarization, Q&A, translation, and creative writing.
- To evaluate and refine prompts iteratively for clarity, accuracy, and efficiency.

Course Outcomes:

1. Understand how different prompt formats affect LLM responses.
2. Design and test prompts using zero-shot, few-shot, and chain-of-thought strategies.
3. Apply prompts in multiple domains like education, business, healthcare, and software development.
4. Evaluate prompt responses based on clarity, coherence, and relevance.
5. Build prompt-based mini tools (e.g., quiz generators, email writers, code assistants).

Topics Covered:

1. Create and compare zero-shot vs. few-shot prompts for a text classification task.
2. Design a prompt to generate summaries of news articles and optimize it for length and tone.
3. Create a Q&A chatbot prompt that acts like a history tutor and test it across different grade levels.
4. Build a role-based prompt where the AI acts as a doctor, teacher, or customer service agent.
5. Write a chain-of-thought prompt to solve a math word problem step-by-step.
6. Create a creative writing assistant prompt for story generation based on user input.
7. Develop a prompt to translate informal text to formal or professional email content.
8. Generate Python code from natural language instructions using prompt optimization.
9. Refine a prompt for safe and bias-free content generation using red-teaming principles.
10. Compare responses from ChatGPT and Gemini for the same prompt and analyze differences.
11. Create a prompt template that can be reused dynamically with user inputs (parameterized prompts).
12. Mini Project: Build a prompt-based micro-tool such as a quiz maker, resume helper, or report generator.

Textbooks:

1. *The Art of Prompt Engineering with ChatGPT* by Nathan Hunter
2. OpenAI Documentation and Prompt Engineering Guide (openai.com)
3. DeepLearning.AI – ChatGPT Prompt Engineering Course (Free)

Reference Materials:

1. Anthropic's Claude Prompting Guide
 2. Google's Gemini Prompting Guide
 3. LangChain documentation (for advanced prompt chaining)
 4. Prompting Resources from Hugging Face, Microsoft, and AI21
 5. Research papers on Prompt Engineering from arXiv.org
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Course code	Course Title	L	T	P	Credits
R23BSH-MC3101	English and Soft Skills for Job Seekers (Mandatory Course)	0	1	2	0

Course Objectives: Upon completion of this course, students will be able to:

- To develop proficiency in spoken and written English by effectively using a wide range of grammatical structures and vocabulary, and by mastering skills such as paraphrasing, report and résumé writing, and formal correspondence.
- Communicate fluently and confidently in English through active participation in informal group discussions and formal presentations, leveraging audio-visual aids.
- Understand and apply best practices for successful performance in job interviews, including visume (video resume) preparation.
- Develop essential self-learning, communication, and soft skills that enhance employability through group discussions, teamwork, and case-based tasks.
- To prepare students for international education by building competence in the admission process, application writing, interview skills, and awareness of visa, cultural, and financial aspects.

Course Outcomes:

1. Understand the grammatical forms of English and the use of these forms in specific communicative and professional writing.
2. Improve their speaking ability in English, both in terms of fluency and comprehensibility by participating in Group discussions and oral assignments CO3: master interview skills for effective preparation and confident performance in diverse job scenarios.
3. Demonstrate confidence and professionalism in job interviews and workplace interactions by effectively applying practiced soft skills.
4. Demonstrate readiness for Higher education by effectively navigating its admission process.

UnitI:

Grammar for Professional Writing: Initial Assessment Readiness Articles—Usage, context, and error correction, Prepositions—Functions and contextual use Tenses—Forms, purposes, and corrections, Subject-Verb Agreement (Concord)—Identification and Correction Voice—active and passive usage, conversions, Paraphrasing and Summarizing Techniques of paraphrasing, summarizing key ideas, Report Writing—Elements of formal reports, format and organization, Clarity and coherence in expression, Resume and Visume Creation,

Types of resumes: Chronological, Functional, hybrid Customizing resumes for job applications, Planning and scripting visumes, Recording and reviewing visumes, LOR (Letter of Recommendation)- Purpose, structure, tone, and content, SOP (Statement of Purpose)- Academic/professional goal alignment, personal background, clarity, coherence,

Proof reading and Editing: Common writing errors, strategies for self-editing, peer editing, and collaborative revision.

Learning Outcomes : At the end of the module, the learners will be able to

- Apply appropriate grammar structures—including articles, prepositions, tenses, voice, and subject – verb agreement—in a variety of professional and academic writing contexts.
- Paraphrase and summarise complex texts using accurate language and coherent structures.
- Prepare tailored resumes and visumes suited to specific job roles and presentation styles.
- Draft effective LORs and SOPs, and apply proof reading techniques and editing strategies

to identify and correct common writing errors through self-assessment and peer feedback.

UnitII:

Preparing for Oral Assessment:

Group Discussions: Techniques, etiquette, turn-taking, active listening,

Expressing Opinions: Polite agreement /disagreement, clarity in communication,

Oral Presentations: Structure (introduction, body, conclusion), use of transitions, logical flow,

Vocabulary Use: Selecting formal/ semi-formal expressions for interviews, academic and professional discussions,

Clarity & Confidence: Voice modulation, articulation, managing speaking pace, reducing fillers,

Public Speaking: Planning and delivering one –minute speeches, engaging openings and impactful conclusions.

Learning Outcomes: By the end of this unit, learners will be able to:

- Demonstrate effective group discussion skills, including appropriate techniques, turn-taking, active listening, and polite expression of opinions.
- Express agreement and disagreement politely in informal and semi-formal settings while maintaining clarity and professionalism in communication.
- Organise and deliver structured oral presentations using clear introductions, well-developed content, logical transitions, and strong conclusions.
- Select and use appropriate vocabulary suitable for academic discussions, professional interviews, and workplace communication.
- Plan and deliver short public speeches (e.g., one-minute talks) with engaging openings and impactful closing statements tailored to the audience.

UnitIII:

Mastering Interview Skills

Purpose of Interviews: Understand recruiter expectations, align personal goals, skills, and achievements.

Interview Preparation: Pre-interview research, behavior, and presentation. FAQs: Framing answers about self, family, strengths, and weaknesses.

Interview Dynamics: Understanding assessment areas and developing effective responses. **Types**

of Interviews: Awareness of formats: one-on-one, panel, telephonic, video/virtual, group discussions, and walk-in interviews; differences between HR and technical interviews. **Mock**

Interviews and Role Plays: Practising real-time interview scenarios, peer feedback, video recording for self-review, identifying areas of improvement in verbal and non-verbal communication.

Learning Outcomes : At the end of the module, the learners will be able to:

- Understand recruiter expectations and the interview process.
 - Prepare and behave appropriately during interviews.
 - Respond confidently to common personal and career-related questions.
 - Improve interview skills through mock interviews and feedback.
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UnitIV:

Employability through Soft Skills

Teamwork and Collaboration: Importance of teamwork in the workplace, Role-based team challenges and problem-solving tasks, Reflective journaling on team dynamics, Workplace Etiquette and Professionalism, Basics of workplace behavior and grooming, Punctuality, discipline, and digital etiquette,

Decision-Making and Conflict Resolution: Decision- making models and techniques, Conflict styles and resolution strategies,

Emotional Intelligence and Motivation: Self-awareness and empathy in the workplace, Identifying emotional triggers and responses, Time Management and Goal Setting: Prioritizing tasks using the Eisenhower Matrix, SMART goals (Specific, Measurable, Achievable, Relevant, Time-bound),

Adaptability and Flexibility: Managing change in the work place Developing resilience and growth mindset, networking, and building professional relationships.

Learning Outcomes: At the end of the module, the learners will be able to:

- Demonstrate effective teamwork and collaboration in professional settings.
- Exhibit professional behaviour, work place etiquette, and digital discipline.
- Apply decision-making techniques and resolve conflicts constructively.
- Build emotional intelligence, self-awareness, and motivation to perform in diverse work environments.
- Manage time effectively, set achievable goals, and adapt to change with resilience.

UnitV:

English for Abroad Education

Introduction to Studying Abroad: Overview of global education systems and Admission Process, Research and University Selection: How to research courses and universities, Creating an application calendar, Understanding course credits, intakes, and rankings,

Application Documents: SOP (Statement of Purpose): Structure, language, and sample writing ,LOR (Letters of Recommendation): Types, tone, and formatting, Admission and Visa Interview Skills Types of admission interviews (in-person, video), FAQs and model responses, Justifying candidature and demonstrating motivation,

Visa Process: Documentation, interview preparation,

English Proficiency and Entrance Tests: Overview of TOEFL, IELTS, GRE, GMAT, SAT, ACT, Preparation strategies and practice samples.

Learning Outcomes: By the end of the module, learners will be able to:

- Understand and plan the international university admission process.
- Research and shortlist suitable universities by evaluating courses, intakes, credits, and global rankings
- Prepare essential application documents such as SOPs ,LORs, and admission essays using appropriate academic language
- Demonstrate effective communication in admission and visa interviews by confidently responding to FAQs and justifying candidature

Gain awareness of visa procedures, cultural expectations, financial planning, and student safety for successful transition to higher education

R23 B.Tech III-year II-Semester Detailed Syllabus

Subject Code	Subject Name	L	T	P	C
R23CSS-PC3201	Data Ware housing and Data Mining	3	0	0	3

Course Objectives:

- To understand and implement classic almodels and algorithms in Data Ware housing and Mining.
- They will learn about different tools used in data mining.
- They will learn how to analyze the data, identify the problems, and choose the relevant models and algorithms to apply
- They will further be able to assess the strengths and weaknesses of various methods and algorithms and to analyze their behavior

Course Outcomes:

1. Understand stages in building a Data Ware house and correlate the various system architectures.
2. Understand the need and importance of reporting and query tools.
3. Understand the need and importance of data mining functionalities.
4. Understand the process of classification.
5. Apply the Clustering techniques on sample data.

UNIT I

Introduction To Data Mining: Motivation, Importance, Definition of Data Mining, Kind of Data, Data Mining Functionalities, Kinds of Patterns, Classification of Data Mining Systems, Data Mining Task Primitives, Integration of A Data Mining System With A Database or Data Warehouse System, Major Issues In Data Mining, Types of Data Sets and Attribute Values, Basic Statistical Descriptions of Data, Data Visualization, Measuring Data Similarity.

Preprocessing: Data Quality, Major Tasks in Data Preprocessing, Data Reduction, Data Transformation and Data Discretization, Data Cleaning and Data Integration

Learning Outcomes:

At the end of this module student will be able to:

- Summarize the process of Data Mining.(L2)
- Understand and apply data preprocessing techniques(L2)

UNIT II

Dataware housing:

Data warehousing Components –Building a Data warehouse – Mapping the Data Warehouse to a Multiprocessor Architecture – DBMS Schemas for Decision Support – Data Extraction, Cleanup, and Transformation Tools –Metadata

Learning Outcomes:

At the end of this module student will be able to:

- Differentiate a data ware house with data mining (L2)
- Understand different system Architectures. (L2)

UNIT III

BUSINESS ANALYSIS:

Reporting and Query tools and Applications – Tool Categories – The Need for Applications – Cognos Impromptu – Online Analytical Processing (OLAP) – Need –Multidimensional Data Model–
~~OLAPGuidelines–MultidimensionalversusMultirelational OLAP–CategoriesofTools – OLAP Tools and the Internet~~

Learning Outcomes:

At the end of this module student will be able to:

- Understand the OLAP architecture (L2)
- Recognize Various OLAP tools.(L2)

UNITIV

Association Rule Mining and Classification:

Mining Frequent Patterns, Associations and Correlations – Mining Methods – Mining various Kinds of Association Rules – Correlation Analysis – Constraint Based Association Mining – Classification and Prediction – Basic Concepts – Decision Tree Induction – Bayesian Classification – Rule Based Classification – Classification by Back propagation – Support Vector Machines – Associative Classification – Lazy Learners – Other Classification Methods – Prediction.

Learning Outcomes:

At the end of this module student will be able to:

- Experiment the process of classification on sample data.(L3)
- Construct a decision tree for any sample data.(L3)
- Apply Association rules on sample data.(L3)

UNITV

Clustering and Trends in Data Mining

Cluster Analysis – Types of Data – Categorization of Major Clustering Methods – K-means– Partitioning Methods – Hierarchical Methods – Density-Based Methods – Grid Based Methods – Model-Based Clustering Methods – Clustering High Dimensional Data – Constraint – Based Cluster Analysis – Outlier Analysis– Data Mining Applications.

Learning Outcomes:

At the end of this module student will be able to:

- Understand the concept of Clustering (L2)
- Apply the traditional clustering techniques on sample Data(L3).

Text Books:

1. Alex Berson and Stephen J. Smith, “Data Warehousing, Data Mining and OLAP”, Tata Mc Graw – Hill Edition, Thirteenth Reprint 2008.
2. Jiawei Han and Micheline Kamber, “Data Mining Concepts and Techniques”, Third Edition, Elsevier, 2012. AULibrary.com

Reference Books:

1. Pang-ni Tan, Michael Steinbach and Vipin Kumar, “Introduction to Data Mining”, Person Education, 2007.
 2. K.P. Soman Shyam Diwakar and V. Aja, “Insight into Data Mining Theory and Practice”, Eastern Economy Edition, Prentice Hall of India, 2006.
 3. G.K. Gupta, “Introduction to Data Mining with Case Studies”, Eastern Economy Edition, Prentice Hall of India, 2006.
 4. Daniel T. Larose, “Data Mining Methods and Models”, Wiley-Interscience, 2006.
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Course code	Course Title	L	T	P	Credits
R23CSS-PC3202	Web Technologies	3	0	0	3

Course Objectives: Understand the network architecture and applications.

- Understand the fundamental concepts of web technologies, including HTML, CSS, JavaScript, and PHP, and their role in web development.
- Develop the ability to create static and dynamic web pages using HTML5, CSS3, and JavaScript, focusing on user interaction and responsive design.
- Gain proficiency in server-side programming with PHP and integrate databases (MySQL) for dynamic web applications.
- Learn web security concepts and implement best practices to protect against common web vulnerabilities like XSS, SQL Injection, and CSRF.
- Explore advanced web development tools and techniques, including Web APIs, responsive web design, and continuous integration for modern web applications.

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

1. Students will be able to develop responsive, mobile-first websites using HTML5, CSS3, and JavaScript.
2. Students will acquire the skills to build dynamic web applications by integrating PHP with MySQL for backend development.
3. Students will implement web security best practices, ensuring protection against common vulnerabilities like XSS and SQL Injection.
4. Students will be capable of utilizing Web APIs and third-party integrations for enhanced functionality in web applications.
5. Students will deploy and host websites on modern platforms like AWS, Heroku, or Docker, using CI/CD practices to automate deployment.

Unit I

HTML & Web Fundamentals:

Introduction to Internet, Intranet, Extranet, Web browsers, Web servers, URL, URI, HTTP, HTTPS, Client-Server Architecture, Web application flow, Static web pages, Dynamic web pages, Frontend overview, Backend overview, Structure of HTML document, Basic HTML tags, Text formatting tags, Ordered lists, Unordered lists, Description lists, Hyperlinks tags, Image insertion tags, Tables tags, Forms tags.

CSS & Web Development Tools:

Introduction to CSS, Inline CSS, Internal CSS, External CSS, CSS syntax, Text formatting using CSS, Text alignment using CSS, Applying colors in CSS.

Learning Outcomes: Student will be able to

- **Understand** the fundamentals of Internet, web architecture, and protocols.
- **Develop** basic web pages using HTML elements like text, links, tables, and forms.
- **Apply** CSS to style web pages and use developer tools for testing.

Unit II

Introduction to JavaScript:

Overview of JavaScript, Variables, Data Types, and Operators, Functions, Loops, and Conditional Statements, Functions, Loops, and Conditional Statements, Event Handling in JavaScript, Understanding the DOM, Selecting Elements with JavaScript, Modifying Elements (text, attributes, styles), Event Listeners and Dynamic Content Update.

Learning Outcomes: Student will be able to

- **Understand** JavaScript fundamentals, including variables, data types, operators, and control structures.
- **Apply** JavaScript functions, loops, conditional statements, and event handling to create dynamic and interactive web pages.
- **Manipulate** the DOM to select, modify, and update HTML elements based on user actions.

Unit III

Introduction to Web APIs:

Working with Web APIs, Using the Fetch API for asynchronous requests, Parsing JSON data, Integrating third-party APIs (e.g., Google Maps, Weather API), XML.

Web Forms and Validation:

Creating forms with HTML, Form Input Types and Attributes, Client-Side Form Validation using JavaScript, Error Handling and User Feedback.

Learning Outcomes: Student will be able to

- Understand and work with Web APIs for fetching data asynchronously and integrating third-party services.
- Create responsive, mobile-first designs using CSS Flexbox and Grid.
- Develop and validate web forms using JavaScript for improved user interaction and data submission.

UNIT-IV

PHP, Backend Development, and Databases:

Introduction to PHP:

Overview of PHP syntax, Variables, Data types in PHP, Operators and Control Structures, Functions in PHP, Form Handling in PHP, File Handling in PHP.

PHP and Databases (My SQL):

Introduction to MySQL and relational databases, Connecting PHP to MySQL using mysqli and PDO, Basic SQL operations (SELECT, INSERT, UPDATE, DELETE), CRUD operations in PHP, Prepared Statements and Security (Preventing SQL Injection).

Learning Outcomes: Student will be able to

- Understand PHP and server-side programming concepts to build dynamic web pages.
- Work with MySQL databases to perform CRUD operations and handle form submissions securely.
- Build and deploy dynamic web applications using PHP and basic frameworks

UNIT-V

Web Security, Hosting, Deployment, and Advanced Tools:

Web Security:

Protecting against Cross-Site Scripting (XSS), SQL Injection, Cross-Site Request Forgery (CSRF), implementing secure coding practices, using HTTPS, and managing sessions securely.

Web Hosting and Deployment:

Exploring hosting options (shared, VPS, cloud), deploying websites on platforms like AWS, Heroku, and Docker, managing code with Git, and setting up CI/CD pipelines using GitHub Actions.

Learning Outcomes: Student will be able to

- Implement effective security measures to protect web applications.
 - Deploy web applications on cloud platforms, using Git for version control and CI/CD for continuous integration and delivery.
 - Utilize advanced development tools like Webpack, SASS, and Laravel for efficient development and testing.
-

Text Books:

1. HTML and CSS: Design and Build Websites, Jon Duckett, Wiley, 1st Edition (2011).
2. JavaScript and JQuery: Interactive Front-End Web Development, Jon Duckett, Wiley, 1st Edition (2014).
3. PHP and MySQL Web Development, Luke Welling, Laura Thomson, Addison-Wesley Professional, 5th.
4. Web Security for Developers, Malcolm McDonald, O'Reilly Media, 1st Edition (2015)

References:

1. **Responsive Web Design with HTML5 and CSS3** - Ben Frain, Packt Publishing, 2nd Edition (2015)
 2. **Learning JavaScript Design Patterns** - Addy Osmani, O'Reilly Media, 1st Edition (2012)
 3. **Modern PHP: New Features and Good Practices** - Josh Lockhart, O'Reilly Media, 1st Edition (2014)
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Course code	Course Title	L	T	P	Credits
R23CSS-PC3203	Introduction to Artificial Intelligence	3	0	0	3

Course Objectives:

- To develop basic proficiency in a traditional AI programming language and enable students to write, analyze, and understand simple to intermediate-level AI programs.
- To introduce foundational concepts of Artificial Intelligence, including problem-solving through blind and heuristic search strategies.
- To provide a comprehensive understanding of essential AI techniques such as knowledge representation, minimax algorithm, and logical inference through resolution.
- To expose students to various advanced domains in AI including machine learning, natural language processing, and intelligent agents.
- To familiarize students with specialized AI applications such as expert systems, robotics, and planning techniques used in real-world scenarios.

Course Outcomes:

1. Identify and categorize real-world problems that are suitable for AI-based solutions, and select appropriate AI techniques to solve them.
2. Represent and model problems using the appropriate AI methods, frameworks, and terminologies.
3. Implement fundamental AI algorithms such as standard search strategies and dynamic programming techniques.
4. Design and perform empirical evaluations of AI algorithms based on problem formalization and interpret the results to draw meaningful conclusions.
5. Develop simple Expert Systems by applying fuzzy logic and reasoning techniques.

Unit I: Introduction to Artificial Intelligence

History of AI, Intelligent systems, Foundations of AI, Applications of AI, Tic-Tac-Toe game playing, Development of AI programming languages, Current trends in AI.

Unit II: Problem Solving and Game Playing

State-space search, Control strategies, General problem solving, Exhaustive search methods (BFS, DFS), Heuristic search techniques (Greedy, A*), Constraint satisfaction problems, Problem reduction, Game playing, Alpha-beta pruning, Two-player perfect information games.

Unit III: Logic and Inference Mechanisms

Propositional calculus, Propositional logic, Natural deduction system, Axiomatic system, Semantic tableau, Resolution and refutation in propositional logic, Introduction to predicate logic.

Unit IV: Knowledge Representation Techniques

Approaches to knowledge representation, Semantic networks, Extended semantic networks, Frames, Conceptual dependency theory, Script structures, CYC theory, Case grammars, Semantic Web technologies.

Unit V: Expert Systems and Uncertainty Handling

Phases of expert system development, Expert systems vs traditional systems, Uncertainty management, Probability theory, Bayesian belief networks, Certainty factor theory, Dempster-Shafer theory, Fuzzy sets, Fuzzy logic, Membership functions, Multi-valued logic, Fuzzy propositions and inference rules, Linguistic variables, Fuzzy systems.

Textbooks

1. Saroj Kaushik, *Artificial Intelligence*, Cengage Learning
2. Stuart Russell and Peter Norvig, *Artificial Intelligence: A Modern Approach*, 2nd Edition, Pearson Education

Reference Books

1. Deepak Khemani, *Artificial Intelligence*, Tata McGraw Hill, 2013
 2. Dan W. Patterson, *Introduction to Artificial Intelligence*, PHI
 3. George F. Luger, *Artificial Intelligence: Structures and Strategies for Complex Problem Solving*, 5th Edition, Pearson Education
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Course code	Course Title	L	T	P	Credits
R23CSS-PE3201.1	Project Management Approaches (Professional Elective -II)	3	0	0	3

Course Objectives:

- To provide a comprehensive understanding of project management fundamentals, tools, and techniques.
- To explore various traditional and modern project management methodologies.
- To examine project lifecycle phases including initiation, planning, execution, monitoring, and closure.
- To analyze risk, scope, time, and cost management across different project approaches.
- To apply appropriate project management frameworks based on organizational and project-specific needs.

Course Outcomes: Upon successful completion of this course, students will be able to:

1. Understand and explain the principles and processes of project management.
2. Compare and contrast various project management methodologies such as Waterfall, Agile, and Hybrid models.
3. Apply project planning and execution strategies using tools like Gantt charts, CPM, PERT, and Kanban.
4. Evaluate and manage project risks, costs, resources, and stakeholder communications.
5. Select and implement suitable project management approaches for specific industry scenarios.

Unit I: Fundamentals of Project Management

Definition and characteristics of a project, Project lifecycle phases, Role of a project manager, Project selection methods, Stakeholder identification and engagement, Project charter and feasibility analysis.

Unit II: Traditional Project Management Approaches

Waterfall model, Project planning tools (WBS, Gantt charts, Network diagrams), Critical Path Method (CPM), Program Evaluation and Review Technique (PERT), Time, cost, and quality trade-offs.

Unit III: Agile Project Management

Agile principles and manifesto, Scrum framework (roles, artifacts, ceremonies), Kanban methodology, Lean principles, Sprint planning and review, Agile metrics and burn-down charts.

Unit IV: Hybrid and Adaptive Approaches

Introduction to hybrid project management, Combining predictive and adaptive elements, Situational project management (SPM), Scaled Agile Framework (SAFe), Disciplined Agile Delivery (DAD), Choosing the right approach.

Unit V: Project Monitoring, Evaluation, and Closure

Performance measurement (EV, CV, SV), Risk management strategies, Change control processes, Project documentation, Post-project review, Lessons learned, Knowledge management in project closure.

Textbooks

1. Harold Kerzner, *Project Management: A Systems Approach to Planning, Scheduling, and Controlling*, Wiley.
2. PMI, *A Guide to the Project Management Body of Knowledge (PMBOK Guide)*, Latest Edition, Project Management Institute.

Reference Books

1. Kathy Schwalbe, *Information Technology Project Management*, Cengage Learning.
 2. Robert K. Wysocki, *Effective Project Management: Traditional, Agile, Extreme*, Wiley.
 3. Jim Highsmith, *Agile Project Management: Creating Innovative Products*, Addison-Wesley.
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Course Code	Subject Name	L	T	P	C
R23CSS-PE3201.2	GPU COMPUTING (Professional Elective – 2)	3	0	0	3

Course Objectives: The objectives of this course is to acquire knowledge on the

- To introduce students to the fundamental principles of GPU architecture and parallel computing.
- To enable students to design and implement parallel applications using GPU programming models like CUDA and OpenCL.
- To develop the ability to analyze and optimize performance in GPU-accelerated applications.

Course Outcomes: After completing this course, students will be able to:

- Explain the architecture and functioning of GPUs and their role in high-performance computing.
- Write and debug GPU programs using CUDA and understand memory hierarchies.
- Optimize GPU code for performance using memory and thread management techniques.
- Apply GPU programming techniques to real-world applications such as deep learning and scientific computing.
- Compare GPU programming with other parallel computing paradigms and tools.

UNIT I: Introduction to Parallel and GPU Computing

Motivation for Parallel Computing, Overview of Parallel Architectures: Multi-core, Many-core, SIMD, GPU Evolution and Architecture, CPU vs GPU: Design Philosophy, General Purpose GPU (GPGPU) Computing, Introduction to CUDA Programming Model

Learning Outcomes:

- Understand the fundamentals of GPU architecture (L2)
- Differentiate CPU and GPU computing models (L4)
- Write simple CUDA programs (L3)

UNIT II: CUDA Programming Model

CUDA Thread Hierarchy: Threads, Blocks, Grids, Memory Hierarchy: Shared, Global, Constant, Local Memory, CUDA API and Kernel Launch, Synchronization and Communication, Debugging and Profiling CUDA Applications, Performance Considerations

Learning Outcomes:

- Develop CUDA kernels using threads and blocks (L3)
- Use different types of GPU memory effectively (L4)
- Debug and profile CUDA code (L5)

UNIT III: GPU Memory and Optimization Techniques

Memory Coalescing, Shared Memory Optimization, Avoiding Bank Conflicts, Tiling Technique, Occupancy and Resource Utilization, Use of Streams and Concurrency

Learning Outcomes:

- Analyze memory access patterns for performance (L4)
- Optimize memory usage and execution time (L5)
- Implement concurrency using streams (L3)

UNIT IV: Advanced Topics in GPU Computing

Dynamic Parallelism, Unified Memory, Atomic Operations and Synchronization Primitives, Introduction to OpenCL Programming Model, Portability Across Platforms

Learning Outcomes:

- Understand advanced CUDA features like dynamic parallelism (L2)
- Implement GPU programs using OpenCL (L3)
- Compare CUDA and OpenCL for GPGPU programming (L4)

UNIT V: Applications and Case Studies

Matrix Multiplication and Convolution, Image and Signal Processing on GPU, Scientific Simulations, Deep Learning Acceleration with GPUs (CUDA in TensorFlow/PyTorch), Real-time Rendering and Graphics Processing, Case Studies and Project Discussions

Learning Outcomes:

- Apply GPU techniques to real-world problems (L3)
- Evaluate performance gains using GPU acceleration (L5)
- Design GPU-enabled applications for selected domains (L6)

Textbooks:

1. David B. Kirk and Wen-mei W. Hwu, *Programming Massively Parallel Processors: A Hands-on Approach*, Morgan Kaufmann, 3rd Edition, 2016.
2. Jason Sanders and Edward Kandrot, *CUDA by Example: An Introduction to General-Purpose GPU Programming*, Addison-Wesley, 1st Edition, 2010.
3. Michael J. Quinn, *Parallel Programming in C with MPI and OpenMP*, McGraw-Hill Education, 1st Edition, 2003.

Reference Books:

1. Wen-mei W. Hwu (Ed.), *GPU Computing Gems*, Morgan Kaufmann, 1st Edition, 2011.
2. Benedict Gaster, Lee Howes, David R. Kaeli, Perhaad Mistry, Dana Schaa, *Heterogeneous Computing with OpenCL*, Morgan Kaufmann, 2nd Edition, 2012.
3. Nicholas Wilt, *The CUDA Handbook: A Comprehensive Guide to GPU Programming*, Addison-Wesley, 1st Edition, 2013.

E-Resources:

1. NVIDIA CUDA Zone: <https://developer.nvidia.com/cuda-zone>
 2. NPTEL Course on High Performance Computing: <https://nptel.ac.in/courses/106/104/106104239/>
 3. Udacity Course - Intro to Parallel Programming with CUDA: <https://www.udacity.com/course/intro-to-parallel-programming--cs344>
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Course code	Course Title	L	T	P	Credits
R23CSS-PE3201.3	Block chain and Cryptography Technologies (Professional Elective – II)	3	0	0	3

Course Objectives:

- Understand the principles and fundamentals of block chain technology and its applications.
- Explore cryptographic techniques used in block chain for ensuring security, privacy, and data integrity.
- Learn various consensus mechanisms, smart contracts, and their implementation in blockchain networks.
- Study the integration of block chain with modern technologies, including IoT, supply chain management, and finance.
- Gain hands-on experience in developing blockchain applications and understanding cryptographic protocols.

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

1. Understand the fundamentals of block chain technology, its architecture, and components.
2. Analyse and implement cryptographic techniques used in blockchain for data integrity and security.
3. Develop and deploy block chain applications using smart contracts.
4. Explore consensus mechanisms and their role in blockchain security.
5. Evaluate the integration of block chain technology with IoT and supply chain management systems.

Unit-I

Introduction to Block chain Technology: Overview of block chain technology: Definition, history, and evolution. Key concepts: Blocks, chains, nodes, and decentralized ledgers. Types of blockchains: Public, private, consortium, and hybrid. Blockchain architecture: Components and structure. Applications of block chain in finance, supply chain, healthcare, and more.

Learning Outcomes: Student will be able to

- Understand the fundamental components of block chain technology. (L2)
- Explore different types of block chain and their applications. (L3)

Unit-II

Cryptographic Principles and Techniques: Basics of cryptography: Symmetric vs asymmetric encryption, hashing, digital signatures. Cryptographic algorithms used in blockchain: SHA-256, elliptic curve cryptography (ECC). Public Key Infrastructure (PKI) and its application in blockchain. Zero-knowledge proofs and their role in privacy and scalability.

Learning Outcomes: Student will be able to

- Analyse and implement cryptographic techniques for ensuring security in blockchain. (L4)
 - Understand the application of digital signatures and hashing in blockchain transactions. (L2)
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Unit–III

Block chain Consensus Mechanisms: Introduction to consensus algorithms: Proof of Work (PoW), Proof of Stake (PoS), Delegated Proof of Stake (DPoS), and Practical Byzantine Fault Tolerance (PBFT). Role of consensus in achieving decentralization and trust lessness in blockchain. Comparison of consensus algorithms: Strengths and weaknesses. Case studies: Bitcoin, Ethereum, and other blockchain platforms.

Learning Outcomes: Student will be able to

- Analyse different consensus mechanisms and their impact on blockchain security. (L4)
- Understand the working and applications of various consensus algorithms. (L2)

Unit–IV

Smart Contracts and Block chain Development: Introduction to smart contracts: Definition, creation, and deployment. Use cases of smart contracts in finance, supply chain, insurance, and more. Ethereum and Solidity for smart contract development. Blockchain platforms for application development: Ethereum, Hyperledger, and others.

Learning Outcomes: Student will be able to

- Develop and deploy smart contracts on blockchain platforms. (L3)
- Understand the role of smart contracts in automating processes in blockchain applications. (L2)

Unit–V

Blockchain Integration and Advanced Topics: Integration of blockchain with IoT, supply chain management, and other technologies. Blockchain scalability, interoperability, and security challenges. Future trends in blockchain: Layer 2 solutions, DeFi, and NFTs. Legal and ethical issues in blockchain adoption.

Learning Outcomes: Student will be able to

- Evaluate the integration of blockchain with IoT and supply chain systems. (L5)
- Understand the future challenges and trends in blockchain technology. (L2)

Applications:

- Decentralized Finance (DeFi) applications.
- Blockchain in healthcare, banking, and supply chain management.
- Cryptocurrency systems and wallet development.
- Smart cities and IoT integration using blockchain.
- NFTs (Non-Fungible Tokens) and digital ownership.

Text Books:

1. "Mastering Blockchain: Unlocking the Power of Cryptocurrencies, Smart Contracts, and Decentralized Applications" – Imran Bashir, Packt Publishing, 2017.
2. "Blockchain Basics: A Non-Technical Introduction in 25 Steps" – Daniel Drescher, Apress, 2017.

Reference Books:

1. "Blockchain Revolution: How the Technology Behind Bitcoin and Other Cryptocurrencies is Changing the World" – Don Tapscott and Alex Tapscott, Penguin, 2016.
 2. "Cryptography and Network Security" – William Stallings, Pearson, 2017.
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Course Code	Subject Name	L	T	P	C
R23CSS-PE3202.1	MOBILE COMPUTING (Professional Elective – 3)	3	0	0	3

Course Objectives: The objectives of this course is to acquire knowledge on the

- To understand the fundamentals of mobile communication
- To understand the architecture of various Wireless Communication Networks
- To understand the significance of different layers in mobile system Course Contents

Course Outcomes: The students should be able to:

1. Develop a strong grounding in the fundamentals of mobile Networks
2. Apply knowledge in MAC, Network, and Transport Layer protocols of Wireless Network
3. Comprehend, design, and develop a lightweight network stack
4. Analyze the Mobile Network Layer system working
5. Understand about the WAP Model

UNIT I

Introduction to Wireless Networks: Applications, History, Simplified Reference Model, Wireless transmission, Frequencies, Signals, Antennas, Signal propagation, Multiplexing, Modulation, Spread spectrum, Cellular Systems: Frequency Management and Channel Assignment, types of hand-off and their characteristics.

Learning Outcomes: student will be able to

- Understand the evolution and applications of wireless networks, comparing them with wired networks.
- Understand wireless signal transmission, including frequencies, antennas, and modulation techniques.
- Analyze cellular network operations, focusing on frequency management, channel assignment, and hand-off strategies.

UNIT II

MAC – Motivation, SDMA, FDMA, TDMA, CDMA, Telecommunication Systems, GSM: Architecture Location tracking and call setup, Mobility management, Handover, Security, GSM, SMS, International roaming for GSM, call recording functions, subscriber and service data management, DECT, TETRA, UMTS, IMT-2000.

Learning Outcomes: student will be able to

- Understand key components and functions of telecommunication systems.
 - Understand SDMA, FDMA, TDMA, and CDMA and their network roles.
 - Analyze location tracking and call setup processes in GSM.
 - Understand mobility management and the types of handovers.
 - Analyze security measures like authentication and encryption in GSM and various applications.
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UNIT III

Wireless LAN: Infrared vs. Radio transmission, Infrastructure, Ad hoc Network, IEEE 802.11 WLAN Standards, Architecture, Services, HIPERLAN, Bluetooth Architecture & protocols.

Learning Outcomes: student will be able to

- Understand the differences between infrared and radio transmission, and the principles of infrastructure and ad-hoc networks.
- Comprehend IEEE 802.11 WLAN standards, architecture, and services, including HIPERLAN.
- Grasp the architecture and protocols of Bluetooth.

UNIT IV

Mobile Network Layer: Mobile IP, Dynamic Host Configuration Protocol, Mobile Transport Layer, Traditional TCP, Indirect TCP, Snooping TCP, Mobile TCP, Fast retransmit/Fast recovery, Transmission/Time-out freezing, Selective retransmission, Transaction Oriented TCP.

Learning Outcomes: student will be able to

- Understand the principles and functionality of Mobile IP for seamless mobility in IP networks.
- Comprehend the role of DHCP in dynamically assigning IP addresses to mobile devices.
- Analyze techniques such as Fast retransmit/Fast recovery, Transmission/Time-out freezing, Selective retransmission, and Transaction Oriented TCP for improving performance and reliability in mobile networks.

UNIT V

Support for Mobility: Wireless Application Protocol: Architecture, Wireless Datagram Protocol, Wireless Transport Layer Security, Wireless Transaction Protocol, Wireless Session Protocol, Wireless Application Environment, Wireless Markup Language, WML Scripts, Wireless Telephone Application.

Learning Outcomes: student will be able to

- Understand WAP Architecture and Protocols
- Grasp the role of WML and WML Scripts in developing mobile applications for WAP. Evaluate strategies for enhancing performance and user experience in wireless environments using WAP standards.

Text Books:

1. Jochen Schiller, "Mobile Communication", Second Edition, Pearson Education, 2008.

Reference Books:

1. William Stallings, "Wireless Communications and Networks", Second Edition, Pearson Education, 2004.
 2. C. Siva Ram Murthy, B. S. Manoj, "Adhoc Wireless Networks: Architectures and Protocols", Second Edition, Pearson Education, 2008.
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Course code	Course Title	L	T	P	Credits
R23CSS-PE3202.2	Network Design and Management (Professional Elective – 3)	3	0	0	3

Course Objectives:

- Understand the concepts and principles of network design and management.
- Explore network topologies, architectures, protocols, and performance considerations.
- Study network design strategies using simulation tools.
- Learn about network management protocols, SNMP, and performance monitoring.
- Understand fault, configuration, and security management in modern networks.

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

- Understand various network topologies, design goals, and layered architectures.
- Analyse the design considerations for network performance and scalability.
- Apply simulation tools to design and evaluate networks.
- Understand the components and functions of network management systems and protocols like SNMP.
- Evaluate fault, configuration, performance, and security management in network administration.

Unit-I

Introduction to Network Design: Overview of computer networks and need for network design. Goals of network design: Scalability, performance, reliability, and cost-efficiency. Network topologies (star, mesh, hybrid), architectures (client-server, peer-to-peer), and design models. OSI and TCP/IP models in network design.

Learning Outcomes: Student will be able to

- Understand the goals and basic principles of network design. (L2)
- Identify different network topologies and architectures. (L2)

Unit-II

Network Design Process and Tools: Network design life cycle and structured design approach. Requirements gathering and analysis: traffic patterns, application needs, user behaviour. Capacity planning and bandwidth estimation. Simulation and modelling tools: Cisco Packet Tracer, GNS3, NS2/NS3. Case study-based design of small-to-medium enterprise networks.

Learning Outcomes: Student will be able to

- Apply systematic design approaches to build efficient network solutions. (L3)
- Use tools like Packet Tracer to simulate network scenarios. (L4)

Unit-III

Network Management Concepts: Introduction to Network Management and its objectives. Network Management Architecture: FCAPS Model (Fault, Configuration, Accounting, Performance, Security). Management Information Base (MIB), Structure of Management Information (SMI). SNMP (Simple Network Management Protocol): SNMPv1, SNMPv2, SNMPv3.

Learning Outcomes: Student will be able to

- Understand the architecture and functions of network management. (L2)
 - Analyse the working of SNMP and related management protocols. (L4)
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Unit-IV

Fault, Configuration, and Performance Management: Fault detection and isolation techniques.

Configuration management: Device configuration, change management. Performance metrics: Throughput, delay, jitter, and packet loss. Tools for performance monitoring: Wireshark, SolarWinds, PRTG. Proactive vs reactive management techniques.

Learning Outcomes: Student will be able to

- Evaluate methods for detecting and handling network faults. (L5)
- Monitor and analyse performance parameters using real-time tools. (L3)

Unit-V

Security and Future Trends in Network Management: Security management: Intrusion detection systems (IDS), firewalls, VPNs. Role-based access and policy management. Emerging trends: SDN (Software Defined Networking), Network Function Virtualization (NFV), cloud-based network management. Challenges in modern network management.

Learning Outcomes: Student will be able to

- Understand the role of security in network design and management. (L2)
- Evaluate emerging trends and technologies in network management. (L5)

Applications:

- Enterprise network design and simulation.
- Smart campus and smart city network planning.
- ISP-level network monitoring and performance management.
- Data centre and cloud infrastructure network configuration.
- Security policies and access control in managed networks.

Textbooks:

1. “Network Management: Principles and Practice” – Mani Subramanian, Pearson, 2010.
2. “Computer Networks” – Andrew S. Tanenbaum and David J. Wetherall, Pearson, 2011.

Reference Books:

1. “Top-Down Network Design” – Priscilla Oppenheimer, Cisco Press, 2011.
 2. “Data and Computer Communications” – William Stallings, Pearson, 10th Edition.
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Course code	Course Title	L	T	P	Credits
R23CSS-PE3202.3	Wearable Computing (Professional Elective – 3)	3	0	0	3

Course Objectives:

- Understand the fundamentals of wearable computing and the evolution of wearable devices.
- Explore the different types of wearable devices and their applications in healthcare, fitness, and entertainment.
- Learn the technologies behind wearable computing, such as sensors, wireless communication, and embedded systems.
- Understand the role of wearable computing in the Internet of Things (IoT) ecosystem.
- Gain hands-on experience in developing simple wearable computing applications.

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

1. Understand the components and architecture of wearable computing systems.
2. Develop applications using wearable devices for healthcare, fitness, and entertainment.
3. Design and implement sensor-based systems for wearable devices.
4. Integrate wearable devices with cloud services and IoT systems.
5. Deploy and manage wearable computing systems in real-world applications.

Unit–I

Introduction to Wearable Computing: Overview of wearable computing, historical development, and current trends. Types of wearable devices: Smartwatches, fitness trackers, health monitoring devices, and augmented reality glasses. Wearable computing architecture: Sensors, communication technologies, and data processing. Introduction to embedded systems in wearables.

Learning Outcomes: Student will be able to

- Understand wearable computing systems and their components. (L2)
- Explore the application domains of wearable devices. (L3)

Unit–II

Sensors and Communication in Wearables: Types of sensors used in wearable devices: Accelerometers, gyroscopes, heart rate sensors, and environmental sensors. Wireless communication protocols in wearable devices: Bluetooth, Wi-Fi, NFC, and Zigbee. Power management and energy harvesting in wearables.

Learning Outcomes: Student will be able to

- Implement sensor-based data collection systems for wearables. (L3)
- Understand communication protocols for wearable devices. (L2)

Unit–III

Wearable Computing for Healthcare and Fitness: Healthcare applications: Monitoring vital signs, chronic disease management, and rehabilitation. Fitness applications: Activity tracking, step counting, and sleep monitoring. Case studies: Fitness trackers (e.g., Fitbit, Apple Watch), smart clothing, and medical wearables.

Learning Outcomes: Student will be able to

- Design wearable applications for healthcare and fitness. (L3)
 - Integrate sensors with wearable computing systems for health monitoring. (L3)
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Unit–IV

Wearable Computing and IoT Integration: Wearables and the Internet of Things (IoT) ecosystem. Cloud computing for wearable devices: Data storage, analytics, and remote monitoring. Privacy and security concerns in wearable computing. Real-time data processing and analysis in wearable applications.

Learning Outcomes: Student will be able to

- Integrate wearable devices with IoT systems and cloud services. (L4)
- Understand privacy and security challenges in wearable computing. (L2)

Unit–V

Application Development and Deployment: Developing applications for wearable devices using platforms like Android Wear, Tizen, and watchOS. Integration of wearable devices with smartphones and cloud-based services. Deployment and real-time monitoring of wearable applications.

Learning Outcomes: Student will be able to

- Develop applications for wearable devices. (L3)
- Deploy wearable applications in real-world settings. (L4)

Applications:

- Healthcare monitoring (e.g., heart rate monitoring, glucose level tracking).
- Fitness and wellness (e.g., step counters, activity trackers).
- Wearable AR/VR devices for entertainment and education.
- Smart clothing and textile-based sensors.
- Sports and activity monitoring for athletes.

Text Books:

1. "Wearable Computing: A First Step Towards Personal Imaging" – Steve Mann, MIT Press, 2015.
2. "Wearable Technologies: Smart Devices, Wearables, and IoT" – Michael A. R. Shiffer, CRC Press, 2018.

Reference Books:

1. "Wireless Health: Applications, Networks, and Systems" – S. S. Iyengar, CRC Press, 2015.
 2. "Internet of Things: A Hands-On Approach" – Arshdeep Bahga and Vijay Madisetti, VPT, 2014.
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Subject Code	Subject Name	L	T	P	C
R23CSS-PC3204	Data Mining and Data Warehousing Lab	0	0	3	1.5

Course Objectives:

- Practical exposure on implementation of well known data mining tasks.
- Exposure to real life data sets for analysis and prediction.
- Learning performance evaluation of data mining algorithms in a supervised and An Unsupervised setting.
- Handling a small data mining project for a given practical domain.

Course Outcomes:

1. Understand the Environment of weka tool and prepare Data sets.
2. Understand various pre-processing Techniques.
3. Analyze Various classification Algorithms.
4. Apply the Association rule mining to various data sets to Extract Patterns.
5. Analyze various clustering Algorithms

System/ Software Requirements: Intel based desktop PC WEKA TOOL

1. Demonstration of preprocessing on data set student.arff
 2. Demonstration of preprocessing on dataset labor. arff
 3. Demonstration of Association rule process on dataset contact lenses.arff using a priori algorithm
 4. Demonstration of Association rule process on data set test.arf fusing apriori algorithm
 5. Demonstration of classification rule process on data set student.arffusingj48 algorithm
 6. Demonstration of classification rule process on data set employee.arffusingj48 algorithm
 7. Demonstration of classification rule process on data set employee.arffusingid3 algorithm
 8. Demonstration of classification rule process on data set employee.arffusingnaive bayes algorithm
 9. Demonstration of clustering rule process on data set iris.arff using simplek-means
 10. Demonstration of clustering rule process on data set student.arff using simplek-means.
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Course code	Course Title	L	T	P	Credits
R23CSS-PC3205	Web Technology Lab	0	0	3	1.5

Course Objectives: Understand the network architecture and applications.

- Understand the fundamentals of web development technologies such as HTML, CSS, JavaScript, and PHP.
- Design and build static and dynamic web pages using HTML and CSS.
- Apply client-side and server-side validation techniques to ensure secure and functional forms.
- Implement basic web security measures to protect web applications from common vulnerabilities like XSS and SQL Injection.
- Deploy websites and web applications on platforms like GitHub, Heroku, and Netlify.

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

1. Students will learn how to create basic web pages using HTML, CSS, and JavaScript.
2. Students will be able to develop simple web applications using both frontend and backend technologies like PHP and MySQL.
3. Students will understand common web security issues and how to protect websites from attacks like SQL injection and XSS.
4. Students will learn how to publish their websites on platforms like GitHub, Heroku, and Netlify.
5. Students will learn how to connect their websites to databases and fetch data from external APIs.

LAB EXPERIMENTS:

1. Designing a Static Web Page with HTML:

Design a complete static web page using HTML that includes a proper document structure, text formatting, different types of lists, hyperlinks (internal and external), embedded images, tabular data, and a form for user input, demonstrating the use of fundamental HTML tags.

2. Styling Web Pages with CSS:

Develop a styled web page by applying inline, internal, and external CSS to demonstrate text formatting, background properties, border styling, color schemes, alignment, and the CSS box model, using a professional code editor and browser developer tools for testing and debugging.

3. Building a Personal Portfolio Web Page:

Create a multi-section personal or portfolio web page using HTML and CSS that includes a navigation menu, image gallery, content sections (like About and Projects), and a contact form, styled with consistent layout and color schemes to reflect a professional web design approach.

4. Basic JavaScript Program with Variables and Loops:

Create a simple JavaScript program embedded in an HTML page that demonstrates the use of variables, different data types, arithmetic and comparison operators, conditional statements (if-else), and loops (for or while). Display the output dynamically within the HTML page using the DOM.

5. Interactive Web Page with JavaScript Events:

Develop an interactive web page using JavaScript where user actions (such as clicking a button or entering text) trigger events that modify the content, attributes, or styles of HTML elements dynamically. Use appropriate DOM selection methods and event listeners to demonstrate real-time updates and interaction.

6. Using the Fetch API to Retrieve and Display Data:

Create a web page that uses JavaScript's fetch() API to retrieve data asynchronously from a public API (such as a weather API or JSON placeholder). Parse the received JSON data and dynamically display selected information on the page using DOM manipulation.

7. Creating and Validating HTML Forms with JavaScript:

Design an HTML form that includes various input types (e.g., text, email, number, checkbox) and implement client-side validation using JavaScript. Ensure proper error handling and display custom feedback messages when invalid input is detected.

8. Parsing and Displaying XML Data:

Create an XML document that stores structured data (such as a list of books, students, or products), and write a JavaScript or PHP script to parse and display the data in a formatted HTML table. Ensure proper XML structure and demonstrate how to access and render XML elements and attributes programmatically.

9. Building a CRUD Web Application with PHP and MySQL:

Develop a web application in PHP that accepts user input through an HTML form and performs CRUD (Create, Read, Update, Delete) operations on a MySQL database. Use mysqli or PDO to connect to the database and apply proper input validation, prepared statements, and error handling to ensure security and reliability.

10. Building a Secure Login System with PHP and MySQL:

Create a login system using PHP and MySQL that allows users to register and authenticate securely. Implement session management to maintain user login state and apply role-based access control. Display personalized content based on the user's login status, and handle form validation and errors on the server side.

11. Deploying a Web Project Online using Git and Hosting Platforms:

Take a small website or project and host it online using GitHub and a free hosting platform like Heroku or Netlify. Use Git to push your code and try out automatic deployment.

12. Securing a Login Form against SQL Injection and XSS:

Create a basic login form and write code to protect it from common attacks like SQL Injection and Cross-Site Scripting (XSS). Use simple validation and safe methods to handle user input securely.

Course code	Course Title	L	T	P	Credits
R23CSS-SC3201	Sales force Developer Lab (Skill Oriented Course)	0	1	2	2

Course Objectives:

- To introduce the Salesforce platform, architecture, and developer tools.
- To enable students to work with Sales force Data Model and Object Relationships.
- To provide hands-on experience with Apex programming and SOQL.
- To build and customize user interfaces using Visual force and Lightning Components.
- To develop and deploy custom applications on the Sales force platform.

Course Outcomes: Upon successful completion of the lab, students will be able to:

1. Navigate and configure the Salesforce Developer environment.
2. Create and manage custom objects, fields, and relationships.
3. Write and execute Apex classes, triggers, and SOQL queries.
4. Design user interfaces using Visualforce and Lightning Web Components.
5. Develop and test complete applications within the Salesforce ecosystem.

List of Lab Experiments :

Setup Salesforce Developer Account and Navigate the Environment – **Explore App Launcher, Object Manager, Setup Menu.**

1. **Create Custom Objects, Fields, and Validation Rules** – Define custom schema using declarative tools.
2. **Establish Object Relationships** – Lookup, Master-Detail relationships, and schema builder usage.
3. **Introduction to Apex** – Write simple Apex classes and methods using Developer Console.
4. **Apex Triggers** – Implement before and after insert/update/delete triggers.
5. **SOQL and SOSL Queries** – Retrieve records using filters, joins, and wildcards.
6. **DML Operations in Apex** – Insert, update, delete records through Apex logic.
7. **Build Visual force Pages** – Create a basic page to display account/contact data.
8. **Integrate Apex with Visualforce** – Pass parameters, use controllers, and handle user input.
9. **Lightning Web Components (LWC) Basics** – Create a simple component using HTML, JS, and metadata files.
10. **Event Handling and Data Binding in LWC** – Use Lightning Data Service and component communication.
11. **Mini Project** – Build a Salesforce App (e.g., Student Management, Helpdesk, Event Booking) integrating Apex, Visualforce/LWC, and object model.

Recommended Tools/Platforms:

- Salesforce Developer Edition (<https://developer.salesforce.com>)
- Salesforce CLI and VS Code with Salesforce Extensions
- Developer Console, Setup Menu, App Builder, Object Manager

Textbooks:

1. “Learning Sales force Development with Apex” by Paul Battison, Packt Publishing
 2. Sales force Documentation and Trailhead Modules – <https://trailhead.salesforce.com>
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Reference Materials

1. *Apex Developer Guide, Visual force Developer Guide, Lightning Web Components Dev Guide* – Available at developer.salesforce.com
 2. Trailhead Trails: *Apex Basics, Lightning Web Components Basics, Data Modeling, Build Apps Fast with LWC*
 3. Blogs and tutorials from Salesforce Ben, SFDC99, and Medium
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Subject Code	Subject Name	L	T	P	C
R23CSS-MC3201	Technical Paper Writing & Intellectual Property Rights (Mandatory Course)	2	0	0	0

Course Objectives:

- Build the knowledge on principles and characteristics of technical writing, including clarity, conciseness, and precision. (L3)
- Formulate clear and focused research objectives and research proposal(L2)
- Outline the significance of Intellectual Property Rights (L2)
- Provide knowledge of Copyright and patent law, registration process and grants, protects in India and abroad.(L3)
- Assess and maintain the protection of trademark and trade secret in the organisation and also emerging trends in cyber security(L2)

Course Outcomes:

1. Develop the technical writing skills, evaluate sources and properly cite references using appropriate citation styles.(L3)
2. Construct clear and focused research proposal that address a specific gap in the advancement of knowledge in their field of study.(L2)
3. Assess needful elements, agencies responsible for Registration of Intellectual Property elements (L2)
4. Analyze Copyright subject matters, Patent requirements, Infringement and Litigation.(L3)
5. Outline the registration Processes of Trade Mark and Legal procedures to prevent cyber crimes. (L2)

UNIT-I: Introduction To Technical Paper Writing:

Technical paper writing-Objectives-Components-Pre-requisites of good technical report- Format of technical report and its applicability- Significance of technical report and its applicability to end users-Types of technical writing

Learning Outcomes: At the end of this unit student will be able to

- Analyse key aspects of structural technical paper writing effectively.(L2)
- Recognize how to plan and complete report for maximum impact.(L2)

Application: Apply while preparing user manual, technical reports, proposals, online help documentations, and scientific articles.

UNIT-II: Information and Communication of Technical paper writing:

7 C's of technical writing- Difference between technical writer and technical editor-Legal and ethical communication and its description in technical paper-Usage of contemporary technologies in technical paper writing

Learning Outcomes: At the end of this unit student will be able to

- Technical editing as about refining and polishing that content to ensure it is clear, error-free, and effective in covering the intended message. (L2)
- Apply report writing techniques that will reduce their report writing time and improve the quality of their writing.

Application: Analyse accurate information for ethical decision making process.

Unit-III: Introduction to Intellectual Property Rights:

Introduction to Intellectual Property Rights –International Instruments and IPR - WIPO - TRIPS -Laws Relating to IPR - IPR Tool Kit -Agencies for IPR Registration – Emerging trends in IPR.

Learning Outcomes: At the end of this unit student will be able to:

- Knowledge about the elements of IPR (L2)
- Learn International Instruments and emerging areas of IPR (L1)

Application: Applicability and relativity between elements of Intellectual property rights and Creating innovative ideas.

Unit-IV: Copyrights and Patents

Introduction to Copy rights –Principles of Copy right Protection– Copy Registration Process - Subject Matters of Copyright – Right to Copy rights – Copyright Infringement - Patents – Patent Search-Patent Registration and Granting of Patent- Infringement of Patent— Patent Cooperation Treaty –New developments in Patents.

Learning Outcomes: At the end of this unit student will be able to:

- Support the various concepts related to protection, promotion and enforcement of copy rights (L2)
- Describe the registration process of Patents (L2)
- Gain knowledge of infringement of patents and their remedies (L3)

Applications:

- Practice of copy rights case and Identification of the infringement.
- Checking the eligibility for several patents and suggest remedies for problems through case study.

Unit V: Trademarks, Trade secrets and Cyber crimes:

Introduction to Trademarks–Trade Mark Registration– Transfer of rights-Trademarks Claims and Infringement–Remedies- Trade Secrets –Physical Security – Employee Confidentiality Agreements – Breach of Contract – Trade Secret Litigation. Introduction to Cyber Law –Cyber Crimes- Prevention and Punishment.

Learning Outcomes: At the end of this unit student will be able to:

- Knowledge on registration and maintenance of trade marks (L3)
- Outline Physical security and Employee Confidentiality Agreements(L2)
- Gain knowledge of prevention and punishment of cyber crimes(L3)

Application:

1. Compare and contrast different trademarks and know how to register trade mark
2. Identify the physical protection of trade secret.

Contemporary Practices:

- E-filing Applications
 - Digital Piracy
-

Text Books:

1. Fundamentals of IPR for Engineers- Kompal Bansal & Parishit Bansal, B. S. Publications, 2013
2. Research Methodology –C .R. Kothari, Gaurav Garg, NEW AGE International Publishers, 2019
3. Developing Research Proposals (Paperback-2023), Pam Denicolo, Sage Publications 2023
4. Intellectual Property-Deborah E.Bouchoux, Cengage Learning, New Delhi.,2012
5. V.Scople Vinod, Managing Intellectual Property, Prentice Hall of India pvt Ltd, 2012
6. Essentials of Technical Communication- Elizabeth Tebeaux Sam Dragga, Oxford University Press, 4th edition

Reference Books:

1. Intellectual property rights- Prabuddha Ganuli., Tata McGraw hill, 2012.
2. Intellectual property rights M.Ashok kumar and Mohd.Iqbal Ali:, Serials Publications, 2015
3. Developing Research Proposals -English, Paperback, Denicolo Pam ,Sage South Asia edition,2012
4. Intellectual Property Rights (Patents & Cyber Law), Dr.A. Srinivas. Oxford University Press, New Delhi, 2015.
5. Intellectual Property- Richard Stim, Cengage Learning, New Delhi, 2012.
6. S.V.Satakar,—Intellectual Property Rights and Copy Rights, Ess Ess Publications, New Delhi, 2002
7. Technical Communication – Mike Markel-Publisher: Bedford/St. Martin's, 12th Edition.

Web links:

1. <http://www.ipindia.gov.in/patents.htm>
2. <http://www.ipindia.gov.in/trade-marks.htm>
3. <https://copyright.gov.in/>
4. <http://www.wipo.int/portal/en/index.html>
5. <https://indiankanoon.org/>

COURSE OUT COMES VS PO s MAPPING (DETAILED; HIGH:3; MEDIUM:2;LOW:1):

SNO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	2	1	-	-	-	-	1	-	1	
CO2	-	-	-	-	-	2	1	1	-	-	-	1	-	1	
CO3	-	-	-	-	-	2	2	2	-	-	-	1	-	1	
CO4	-	-	-	-	-	2	2	1	-	-	-	1	-	1	
CO5	-	-	-	-	-	2	1	2	-	-	-	1	-	1	
CO*	-	-	-	-	-	2	2	2	-	-	-	1	-	1	

R23_CSSE (Honors)

Track-I (Cloud Computing)							
S.No	Year & Semester	Course Code	Subject title	L	T	P	C
1	III-I	R23CSS-HN3101	Cloud Infrastructure and Services	3	0	0	3
2	III-II	R23CSS-HN3201	Cloud Security and Governance	3	0	0	3
3	II Year to IV Year	R23CSS-HM0001	Honors MOOCS-1	0	0	0	3
4	II Year to IV Year	R23CSS-HM0002	Honors MOOCS-2	0	0	0	3
Total							18

Track- II (Data Science)							
S.No	Year & Semester	Course Code	Subject title	L	T	P	C
1	III-I	R23CSS-HN3102	Data Analysis and Visualization	3	0	0	3
2	III-II	R23CSS-HN3202	Advanced Data Analysis Techniques	3	0	0	3
3	II Year to IV Year	R23CSS-HM0001	Honors MOOCS-1	0	0	0	3
4	II Year to IV Year	R23CSS-HM0002	Honors MOOCS-2	0	0	0	3
Total							18

Course code	Course Title	L	T	P	Credits
R23CSS-HN3101	Cloud Infrastructure and Services Honors Course-2 (Track-1)	3	0	0	3

Course Objectives: Understand the network architecture and applications.

- To introduce cloud computing models and architecture
- To understand virtualization and data center components
- To explore cloud deployment and service models
- To use public cloud platforms and services for real-world scenarios.
- To provide practical exposure to cloud configuration and deployment tools.

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

1. Understand cloud computing concepts, architecture, and service models.
2. Explain the role of virtualization in enabling cloud infrastructure.
3. Use Infrastructure as a Service (IaaS) and Platform as a Service (PaaS) in practice.
4. Set up, manage, and monitor services on public cloud platforms.
5. Design simple cloud-based applications and deploy them using real tools.

Unit I

Introduction to Cloud Computing:

Definition and characteristics of cloud computing, Benefits and challenges of cloud adoption, Cloud deployment models: Public, Private, Hybrid, Community, Cloud service models: Infrastructure as a Service (IaaS), Platform as a Service (PaaS), Software as a Service (SaaS), Use cases in various domains

Learning Outcomes: Student will be able to

- Students will be able to explain different cloud service and deployment models along with their real-world applications.

Lab 1: Explore Google Cloud or AWS Free Tier Console

- **Question:**
Create a free-tier account on AWS or Google Cloud Platform. Explore the web console interface and identify available cloud services.
- **Tool:** AWS Free Tier / Google Cloud Console
- **Outcome:** Students will familiarize with cloud portals and service dashboards.

Lab 2: Simulate Cloud Services using Cloud Sim or Eucalyptus

- **Question:**
Install and run CloudSim or Eucalyptus to simulate a basic cloud environment. Create virtual instances and analyze resource allocation.
 - **Tool:** CloudSim / Eucalyptus
 - **Outcome:** Students will understand simulated cloud infrastructure and resource provisioning.
-

Unit II

Virtualization in Cloud

Virtualization concepts and types: hardware, OS-level, and application, Hypervisors: Type 1 and Type 2, Virtual Machines (VMs) and containers, Benefits of virtualization in cloud environments, Introduction to containerization (Docker).

Learning Outcomes: Student will be able to

- Students will be able to demonstrate how virtualization and containerization support cloud infrastructure.

Lab 1: Create and Manage Virtual Machines using VirtualBox

- **Question:**
Install VirtualBox and create virtual machines for different operating systems. Allocate resources and simulate multi-tenant environments.
- **Tool:** VirtualBox
- **Outcome:** Students will be able to configure and run multiple VMs.

Lab 2: Containerization with Docker

- **Question:**
Install Docker and deploy containerized applications. Create and manage Docker images and volumes.
- **Tool:** Docker
- **Outcome:** Students will learn basic containerization and image management.

Unit III

Infrastructure as a Service (IaaS):

Concept and features of IaaS, Virtual networks, storage, compute, and load balancing, Resource provisioning and scaling, Use of AWS EC2, Azure VMs, Google Compute Engine

Learning Outcomes: Student will be able to

- Students will be able to provision and manage virtual machines, storage, and networks using a public cloud platform.

Lab 1: Creating Basic Charts

Lab 1: Deploy an EC2 Instance on AWS

- **Question:**
Launch an EC2 instance in AWS. Install a web server and access the service via public IP.
- **Tool:** AWS EC2
- **Outcome:** Students will understand how to provision and use compute resources.

Lab 2: Setup a Virtual Network and Load Balancer

- **Question:**
Create a virtual network and deploy multiple VMs behind a load balancer using Azure or GCP.
- **Tool:** Azure / GCP
- **Outcome:** Students will learn cloud network architecture and traffic distribution.

UNIT-IV

Platform as a Service (PaaS) and SaaS:

PaaS concepts and features. Application hosting and runtime environments, examples: Google App Engine, AWS Elastic Beanstalk, Heroku, SaaS overview: cloud-based software services, Benefits and risks of SaaS adoption

Learning Outcomes: Student will be able to

- Students will be able to deploy applications using cloud-based platforms and evaluate the role of software services delivered via SaaS.

Lab 1: Deploy a Web Application using Heroku or GCP App Engine

- **Question:**
Deploy a sample Flask or Node.js application using Heroku or Google App Engine. Enable logging and performance monitoring.
- **Tool:** Heroku / GCP App Engine
- **Outcome:** Students will deploy and manage applications using PaaS.

Lab 2: SaaS Case Study Analysis (Google Workspace / Office 365)

- **Question:**
Explore a SaaS application like Google Workspace or Office 365. List its services, features, and usage scenarios in organizations.
- **Tool:** Google Workspace / Office 365 (Trial/Free)
- **Outcome:** Students will analyze SaaS offerings and evaluate benefits.

UNIT-V (10 hours)

Cloud Security and Emerging Trends:

Cloud security challenges and best practices, Identity and Access Management (IAM), Data privacy and compliance, Cloud monitoring and auditing tools, Trends: Edge computing, serverless, multi-cloud, hybrid cloud.

Learning Outcomes: Student will be able to

- Students will be able to apply identity and access management techniques and monitor cloud resources securely.

Lab 1: Configure IAM Roles and Policies in AWS/GCP

- **Question:**
Create custom users and roles with restricted permissions in AWS IAM or GCP IAM. Test access control on cloud resources.
- **Tool:** AWS IAM / GCP IAM
- **Outcome:** Students will learn cloud access control mechanisms.

Lab 2: Cloud Monitoring and Alerts with CloudWatch or Stackdriver

- **Question:**
Set up cloud monitoring using AWS CloudWatch or GCP Cloud Monitoring. Create alerts for resource usage thresholds.
- **Tool:** AWS CloudWatch / GCP Operations Suite
- **Outcome:** Students will configure real-time cloud monitoring and alerts.

Text Books:

1. *Cloud Computing: Concepts, Technology & Architecture* – Thomas Erl
2. *Cloud Computing: Principles and Paradigms* – Rajkumar Buyya
3. *Amazon Web Services in Action* – Michael Wittig, Andreas Wittig

References:

1. *Architecting Cloud Computing Solutions* – Kevin L. Jackson
 2. *Cloud Native DevOps with Kubernetes* – John Arundel
 3. *Learning Docker* – Pethuru Raj, Jeeva S. Chelladhurai
-

Course code	Course Title	L	T	P	Credits
R23CSS-HN3201	Cloud Security and Governance Honors Course-3(Track-1)	3	0	0	3

Course Objectives:

1. To understand cloud-specific security challenges and threat models
2. To explore security solutions and best practices across cloud service models
3. To evaluate cloud governance frameworks and compliance requirements
4. To gain practical skills in configuring access controls, encryption, and monitoring in cloud environments
5. To learn how to integrate risk management and policy enforcement into cloud operations

Course Outcomes: Upon successful completion of the course, students will be able to

1. Identify and analyze security risks associated with cloud computing
2. Implement security controls across different cloud deployment and service models
3. Evaluate governance frameworks and apply compliance strategies in cloud systems
4. Use open-source tools to configure and monitor cloud security features
5. Recommend governance policies and practices to ensure secure cloud adoption

UNIT I

Cloud Security Fundamentals and Threat Landscape

Shared responsibility model, Cloud deployment and service models, Cloud-specific threat landscape, Data breaches, Misconfigured storage, Insecure APIs, Denial of service attacks in cloud environments

Learning Outcome:

Students will be able to describe cloud computing models and evaluate emerging security threats specific to cloud platforms.

Lab Programs

Lab 1: *Analyze Cloud Security Incidents*

Tool: Online case studies or MITRE ATT&CK for Cloud

Task: Analyze at least two real-world cloud security breaches and identify the root causes and impacted layers.

Lab 2: *Identify Cloud Threats using Threat Modeling Tools*

Tool: OWASP Threat Dragon

Task: Build a basic threat model for a cloud-based web application and classify risks.

UNIT II

Identity and Access Management in Cloud

Identity and Access Management principles, Role-based and attribute-based access control, Single Sign-On, Multi-factor authentication, Identity federation, OAuth and OpenID Connect

Learning Outcome:

Students will be able to configure and evaluate identity and access control mechanisms in cloud environments.

Lab Programs

Lab 1: *Configure IAM Policies for Virtual Resources*

Tool: MinIO or OpenStack Keystone

Task: Create IAM users and define granular permissions for buckets or instances.

Lab 2: *Implement OAuth2 Authorization Flow*

Tool: Authlib or Keycloak

Task: Simulate an OAuth2 login flow and demonstrate secure token handling.

UNIT III

Cloud Data Protection and Encryption

Data-at-rest and data-in-transit encryption, Key management systems, Cloud cryptographic services, Tokenization and masking, Secure file storage and sharing, Open-source encryption standards

Learning Outcome:

Students will be able to apply encryption techniques and manage cryptographic keys for secure cloud data storage.

Lab Programs

Lab 1: *Encrypt and Store Files Securely in the Cloud*

Tool: Rclone with GPG or Cryptomator

Task: Encrypt files before uploading to a cloud storage service and verify data integrity.

Lab 2: *Configure a Key Management Service*

Tool: HashiCorp Vault

Task: Set up and use Vault to generate, store, and access encryption keys securely.

UNIT IV

Monitoring, Logging, and Incident Response in the Cloud

Cloud-native monitoring tools, Logging and audit trails, Real-time threat detection, SIEM integration, Incident response lifecycle, Alerts and log correlation

Learning Outcome:

Students will be able to implement cloud logging and monitoring for early threat detection and incident analysis.

Lab Programs

Lab 1: *Set Up Cloud Audit Logging and Alerting*

Tool: Wazuh or Elastic Stack (ELK)

Task: Monitor access logs and configure alerts for unusual user behavior or file changes.

Lab 2: *Simulate a Cloud Incident and Generate a Response Plan*

Tool: MITRE ATT&CK Navigator

Task: Simulate a credential compromise scenario and document a structured response.

UNIT V

Cloud Governance, Compliance, and Risk Management

Governance in cloud environments, Cloud security posture management, Regulatory compliance (GDPR, HIPAA, ISO 27017), Risk management frameworks, Policy-based governance, Audits and reporting

Learning Outcome:

Students will be able to evaluate cloud compliance frameworks and implement governance policies for secure and regulated cloud usage.

Lab Programs

Lab 1: *Perform a Cloud Security Gap Assessment*

Tool: Cloud Security Alliance (CSA) CCM Toolkit

Task: Assess a cloud setup against standard controls and identify compliance gaps.

Lab 2: *Develop a Cloud Security Governance Policy Document*

Tool: Markdown or LibreOffice

Task: Write a governance document outlining policies for access, data handling, and incident reporting.

Textbooks

1. Cloud Security and Privacy by Tim Mather, Subra Kumaraswamy, and Shahed Latif
2. Cloud Security Handbook by Eyal Estrin
3. Applied Cloud Security by Chris Dotson

Reference Books

1. NIST Special Publication 800-144: Guidelines on Security and Privacy in Public Cloud Computing
2. CSA Security Guidance for Critical Areas of Focus in Cloud Computing v4.0

3. Architecting Cloud Computing Solutions by Kevin L. Jackson
4. Cloud Governance Frameworks – ISACA publications and whitepapers

Course code	Course Title	L	T	P	Credits
R23CSS-HN3102	Data Analysis and Visualization Honors Course-2(Track-2)	3	0	0	3

Course Objectives: Understand the network architecture and applications.

- To understand data collection, cleaning, and preparation processes.
- To perform data analysis using statistical and computational tools.
- To create meaningful visualizations for data interpretation.
- To communicate insights effectively using dashboards and reports.

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

1. Understand various types of data and apply appropriate preprocessing techniques.
2. Perform exploratory and statistical data analysis.
3. Apply visualization techniques using charts, plots, and dashboards.
4. Work with real-world datasets and draw meaningful insights.
5. Use tools like Python, Tableau, and Power BI for data analysis and presentation.

Unit I

Introduction to Data and Pre-processing:

Types of data: structured, unstructured, semi-structured, Data collection methods, Data pre-processing: cleaning, handling missing values, normalization, Data transformation: encoding, scaling, Tools: Python (Pandas, NumPy)

Learning Outcomes: Student will be able to

- Identify and differentiate between structured, semi-structured, and unstructured data.
- Apply appropriate methods for collecting and importing data from various sources.

Lab 1: Data Cleaning using Pandas

- **Question:**
Load a CSV dataset using Pandas. Perform data cleaning tasks including handling missing values, renaming columns, removing duplicates, and formatting data types.
- **Tool:** Python (Pandas)
- **Expected Outcome:** Students will understand how to clean raw datasets for analysis.

Lab 2: Data Transformation Techniques

- **Question:**
Use a sample dataset and perform label encoding, normalization, and standardization. Show the effect of scaling on numerical data.
 - **Tool:** Python (Pandas, Scikit-learn)
 - **Expected Outcome:** Students will apply transformation techniques to prepare data for analysis.
-

Unit II

Exploratory Data Analysis (EDA)

Descriptive statistics: mean, median, mode, standard deviation, Distribution analysis, Outlier detection, Correlation and data patterns, Tools: Python (Pandas, Seaborn, Matplotlib).

Learning Outcomes: Student will be able to

- Analyze the distribution of data and detect patterns using EDA techniques.

Lab 1: Statistical Summary and Correlation Matrix

- **Question:**
Load a dataset and compute basic statistics. Generate a correlation matrix and identify strongly related variables.
- **Tool:** Python (Pandas, Seaborn)
- **Expected Outcome:** Students will summarize data and explore variable relationships.

Lab 2: Outlier Detection using Boxplots

- **Question:**
Visualize numerical features using boxplots. Detect and handle outliers using statistical techniques like IQR method.
- **Tool:** Python (Matplotlib, Seaborn)
- **Expected Outcome:** Students will identify outliers and understand their effect on data distribution.

Unit III

Data Visualization Techniques:

Basic charts: bar chart, histogram, pie chart, Advanced plots: boxplot, violin plot, scatter plot, heatmap, Customizing plots with titles, labels, legends, Visualization for categorical and numerical data

Learning Outcomes: Student will be able to

- Develop advanced plots like boxplots, scatter plots, violin plots, and heatmaps.
- Interpret visual representations to understand data trends and relationships.

Lab 1: Creating Basic Charts

- **Question:**
Using a dataset, create bar charts, histograms, and pie charts to represent categorical and numerical features.
- **Tool:** Python (Matplotlib, Seaborn)
- **Expected Outcome:** Students will visualize data using standard chart types.

Lab 2: Advanced Plots and Plot Customization

- **Question:**
Create scatter plots and heatmaps to show relationships between variables. Customize the plots with labels, grids, and color palettes.
- **Tool:** Python (Seaborn)
- **Expected Outcome:** Students will gain skills in producing attractive and informative visualizations.

UNIT-IV

Dashboard Design and Interactive Visualization:

Introduction to dashboards, Designing interactive charts, Dashboard development using Tableau Public or Power BI, Filters, slicers, and drill-down features, Storytelling with data.

Learning Outcomes: Student will be able to

- Design simple and interactive dashboards using tools like Tableau and Power BI.
- Create multiple linked visualizations with filters and slicers for data exploration.

Lab 1: Interactive Dashboard with Tableau Public

- **Question:**
Import a CSV file into Tableau Public. Create an interactive dashboard with filters and multiple visualizations.
- **Tool:** Tableau Public (Free)
- **Expected Outcome:** Students will create a working dashboard using drag-and-drop visual elements.

Lab 2: Dashboard in Power BI Desktop

- **Question:**
Load a dataset into Power BI Desktop. Use slicers and charts to create a data storytelling report.
- **Tool:** Power BI Desktop (Free)
- **Expected Outcome:** Students will understand dynamic visual exploration using Microsoft's BI tool.

UNIT-V (10 hours)

Real-World Data Analysis and Project:

Working with open datasets (Kaggle, UCI ML repo), Case study: finance, health, retail, or transport data, End-to-end data analysis project, Report generation and result presentation

Learning Outcomes: Student will be able to

- Work with real-world open datasets from domains such as health, finance, or e-commerce.
- Perform complete data analysis workflows including preprocessing, EDA, and visualization.

Lab 1: Mini Project – End-to-End Data Analysis

- **Question:**
Select a real-world dataset. Perform all stages: data cleaning, EDA, visualization, and conclusion reporting.
- **Tool:** Python, Tableau/Power BI
- **Expected Outcome:** Students will complete a small independent data project.

Lab 2: Presentation and Insight Communication

- **Question:**
Prepare a slide/report presentation summarizing the findings of your mini project. Include visualizations, statistics, and business insight.
 - **Tool:** PowerPoint or Google Slides + Visualization Exports
 - **Expected Outcome:** Students will learn to present data findings clearly and convincingly.
-

Text Books:

1. *Python for Data Analysis – Wes McKinney*
2. *Storytelling with Data – Cole Nussbaumer Knafl*
3. *Data Visualization with Python and JavaScript – Kyran Dale*

References:

1. *Data Science from Scratch – Joel Grus*
 2. *Practical Statistics for Data Scientists – Peter Bruce*
 3. *Learning Tableau – Joshua N. Milligan*
-

Course code	Course Title	L	T	P	Credits
R23CSS-HN3202	Advanced Data Analysis Techniques Honors Course-3(Track-2)	3	0	0	3

Course Objectives:

- To deepen understanding of statistical, machine learning, and probabilistic methods for data analysis
- To introduce advanced analytical techniques for modeling complex and high-dimensional data
- To enhance practical skills in data cleaning, transformation, and feature engineering
- To apply model evaluation and validation strategies for robust analysis
- To enable application of data analysis to real-world domains such as health, finance, and social science

Course Outcomes: Upon successful completion of this course, students will be able to:

1. Apply advanced statistical and machine learning techniques for data modeling
2. Perform dimensionality reduction and feature selection for high-dimensional data
3. Evaluate models using appropriate metrics and cross-validation methods
4. Solve real-world problems using predictive, descriptive, and prescriptive analytics
5. Use open-source tools to implement scalable and interpretable analytical solutions

UNIT I

Advanced Statistical Analysis and Data Preparation

Multivariate data exploration, Outlier detection techniques, Feature transformation and normalization, Feature selection methods, Hypothesis testing for large datasets, Advanced correlation analysis

Learning Outcome:

Students will be able to clean and transform complex datasets and apply statistical tests for exploratory analysis.

Lab Programs

Lab 1: *Multivariate Data Exploration and Outlier Detection*

Tool: Python (Pandas, Seaborn, SciPy)

Task: Analyze a dataset using boxplots, Mahalanobis distance, and Z-scores to identify outliers.

Lab 2: *Feature Transformation and Selection*

Tool: Python (Scikit-learn)

Task: Apply normalization, log transformation, and feature selection using variance threshold or mutual information.

UNIT II

Dimensionality Reduction and Clustering Techniques

Principal Component Analysis (PCA), Linear Discriminant Analysis (LDA), t-distributed Stochastic Neighbor Embedding (t-SNE), K-means clustering, Hierarchical clustering, Silhouette analysis

Learning Outcome:

Students will be able to reduce dimensionality and uncover patterns using unsupervised learning techniques.

Lab Programs

Lab 1: *Dimensionality Reduction with PCA and t-SNE*

Tool: Python (Scikit-learn, Matplotlib)

Task: Reduce dimensions of a high-dimensional dataset and visualize using PCA and t-SNE.

Lab 2: *Clustering with K-means and Evaluation*

Tool: Python or Orange Data Mining

Task: Apply K-means and hierarchical clustering and evaluate using silhouette score and inertia.

UNIT III

Predictive Modeling and Regression Techniques

Multiple linear regression, Ridge and Lasso regression, Decision trees, Random forests, Gradient boosting, Model overfitting and regularization

Learning Outcome:

Students will be able to build and evaluate predictive models for numerical and categorical outcomes.

Lab Programs

Lab 1: *Regularized Regression (Lasso and Ridge)*

Tool: Python (Scikit-learn)

Task: Fit Lasso and Ridge regression models and compare their performance on multicollinear data.

Lab 2: *Random Forest for Classification*

Tool: R (randomForest package) or Python

Task: Train a random forest classifier and interpret feature importance

UNIT IV

Time Series and Text Data Analysis

Time series decomposition, Autoregression and ARIMA, Sentiment analysis, Text vectorization (TF-IDF, word embeddings), Topic modeling using LDA, Forecasting and trend detection

Learning Outcome:

Students will be able to analyze time-dependent and textual datasets using appropriate models.

Lab Programs

Lab 1: *Time Series Forecasting with ARIMA*

Tool: Python (statsmodels, Pandas)

Task: Perform trend and seasonality analysis and build a forecasting model using ARIMA.

Lab 2: Sentiment Analysis using TF-IDF and Logistic Regression

Tool: Python (NLTK, Scikit-learn)

Task: Preprocess text, vectorize with TF-IDF, and classify sentiments using logistic regression.

UNIT V

Model Evaluation, Interpretation, and Applications

Cross-validation techniques, Confusion matrix, ROC-AUC, Precision-recall tradeoff, Model explainability (SHAP, LIME), Real-world case studies in health, finance, and marketing

Learning Outcome:

Students will be able to evaluate models, interpret predictions, and apply analytics to domain-specific problems.

Lab Programs**Lab 1: Model Evaluation using Cross-validation and ROC Curves**

Tool: Python (Scikit-learn, Matplotlib)

Task: Apply k-fold cross-validation and plot ROC-AUC for multiple classifiers.

Lab 2: Explainable Machine Learning with SHAP or LIME

Tool: SHAP or LIME libraries in Python

Task: Use SHAP or LIME to interpret a black-box classifier's predictions on a real dataset.

Textbooks

1. Applied Predictive Modeling by Max Kuhn and Kjell Johnson
2. Python Machine Learning by Sebastian Raschka
3. Data Science from Scratch by Joel Grus

Reference Books

1. Introduction to Statistical Learning by Gareth James, Daniela Witten
 2. The Elements of Statistical Learning by Trevor Hastie, Robert Tibshirani
 3. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow by Aurélien Géron
 4. Practical Time Series Analysis by Aileen Nielsen
-

Course code	Course Title	L	T	P	Credits
R23CSS-HN3103	Defensive Security Honors Course-2 (Track-3)	3	0	0	3

Course Objectives: Understand the network architecture and applications.

- To introduce methods and tools used to protect computer systems and networks from cyber threats.
- To explain how to monitor systems for security issues and respond to incidents.
- To provide knowledge of malware behavior and how to study it safely.
- To familiarize students with real-time threat analysis and automation in security operations.

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

- Understand layered security design for protecting digital systems.
- Configure and use tools to monitor and protect systems.
- Apply response procedures to handle cyber attacks and incidents.
- Perform basic malware analysis and threat detection.
- Use threat intelligence to improve security and automation.

Unit I

Layered Security Approach:

Introduction to Defensive Security, Concept of layered security (multiple levels of protection), Zero Trust Architecture (always verify access, even inside the network), Security policies and system hardening, Network segmentation to isolate critical parts of a system.

Learning Outcomes: Student will be able to

- Understand the concept of layered (multi-level) security to protect systems.
- Apply basic system hardening and security policy techniques.

Lab 1: System Hardening using Lynis

- **Aim:** To perform a security audit and harden a Linux system using CIS benchmarks.
- **Tool Required:** Lynis (open-source security auditing tool)
- **Question:**
Install and run the Lynis tool on a Linux machine. Perform a full system audit and generate a report. Identify and implement at least five recommendations to improve system security.
- **Expected Outcome:**
Students will be able to analyze system vulnerabilities and apply recommended hardening techniques.

Lab 2: Network Segmentation using pfSense

- **Aim:** To create segmented firewall zones and apply rule-based access control.
- **Tool Required:** pfSense (open-source firewall)
- **Question:**
Set up a pfSense firewall with at least three zones (LAN, WAN, DMZ). Create and test firewall rules to allow or block traffic between the zones.
- **Expected Outcome:**
Students will understand firewall-based network segmentation and rule enforcement.

Unit II

Network and Computer Protection Techniques

Use of firewalls to control traffic flow, Intrusion Detection Systems (IDS) and Intrusion Prevention Systems (IPS), Endpoint Detection and Response (EDR) solutions, Secure configuration and system baseline management, Monitoring system logs for suspicious behavior.

Learning Outcomes: Student will be able to

- Demonstrate the use of firewalls and access control lists to manage network traffic.
- Analyze system logs to detect suspicious activities.

Lab 3: Network Traffic Analysis using Wireshark

- **Aim:** To monitor and analyze network traffic for malicious patterns.
- **Tool Required:** Wireshark
- **Question:**
Capture network traffic using Wireshark. Identify at least three types of suspicious activity (e.g., SYN flood, ARP spoofing, DNS tunneling) and explain the findings.
- **Expected Outcome:**
Students will learn to interpret packet captures and detect common attack signatures.

Lab 4: Intrusion Detection using Suricata

- **Aim:** To detect and log intrusion attempts using a rule-based IDS.
- **Tool Required:** Suricata
- **Question:**
Install and configure Suricata on a test machine. Simulate a network scan using Nmap and verify if Suricata detects and logs the activity.
- **Expected Outcome:**
Students will understand how intrusion detection systems monitor and alert on suspicious traffic.

Unit III

Security Operations and Incident Response:

Role of Security Operations Center (SOC), Security Information and Event Management (SIEM), Incident handling lifecycle: preparation, detection, containment, recovery, Basics of digital forensics, Introduction to MITRE ATT&CK Framework.

Learning Outcomes: Student will be able to

- Understand the functions and structure of a Security Operations Center (SOC).
- Use SIEM tools to collect and analyze security event data.

Lab 1: Log Monitoring and Alerting with Splunk

- **Aim:** To use a SIEM tool for real-time log analysis and security alerting.
 - **Tool Required:** Splunk Free
 - **Question:**
Ingest system logs into Splunk. Create alerts and dashboards for detecting brute-force login attempts and failed sudo access attempts.
-

- **Expected Outcome:**
Students will be able to design and use SIEM dashboards for detecting system intrusions.

Lab 2: Incident Management using TheHive

- **Aim:** To record and manage an incident response case.
- **Tool Required:** TheHive
- **Question:**
Simulate a phishing attack scenario. Use TheHive to create a new incident, document the response steps, assign tasks, and close the case.
- **Expected Outcome:**
Students will understand the documentation and workflow of security incident management.

UNIT-IV

Malware Analysis and Threat Detection:

Understanding malware types and behaviours, Static and dynamic malware analysis, Identifying Indicators of Compromise (IOCs), Threat hunting concepts and techniques, Use of online analysis tools.

Learning Outcomes: Student will be able to

- Identify various types of malware and their characteristics.
- Detect and interpret Indicators of Compromise (IOCs).

Lab 1: Static Malware Analysis using Cuckoo Sandbox

- **Aim:** To analyze malware behavior in a safe sandbox environment.
- **Tool Required:** Cuckoo Sandbox
- **Question:**
Submit a sample malware file to Cuckoo Sandbox. Analyze the report to identify files created, registry keys modified, and network behavior.
- **Expected Outcome:**
Students will gain hands-on experience in safely analyzing malicious software.

Lab 2: Writing Detection Rules using YARA

- **Aim:** To write and apply custom malware detection rules.
- **Tool Required:** YARA
- **Question:**
Write a YARA rule to detect a specific malware signature in a file. Test the rule against a sample dataset and document the results.
- **Expected Outcome:**
Students will understand how to write pattern-matching rules for malware detection.

UNIT-V (10 hours)

Threat Intelligence and Security Automation:

Introduction to threat intelligence platforms, Sharing threat data using STIX and TAXII, Security Orchestration, Automation, and Response (SOAR), Red Team vs. Blue Team roles in security exercises, Purple Teaming for collaborative defense strategies.

Learning Outcomes: Student will be able to

- Understand the role of threat intelligence in cybersecurity defense.
 - Compare Red Team, Blue Team, and Purple Team strategies in security operations.
-

Lab 1: Threat Feed Integration using MISP

- **Aim:** To collect and analyze threat intelligence using a sharing platform.
- **Tool Required:** MISP (Malware Information Sharing Platform)
- **Question:**
Install and configure MISP. Import a threat feed and correlate Indicators of Compromise (IOCs) with a known attack campaign.
- **Expected Outcome:**
Students will be able to interpret and apply real-time threat intelligence.

Lab 2: Automated IOC Response using Cortex and Sigma

- **Aim:** To automate threat detection and response.
- **Tool Required:** Cortex, Sigma rules
- **Question:**
Create Sigma rules to detect specific IOCs in logs. Use Cortex to run automated playbooks based on rule matches.
- **Expected Outcome:**
Students will understand the basics of security automation and how it improves response time.

Text Books:

5. *Blue Team Handbook: Incident Response Edition* – Don Murdoch
6. *Cybersecurity Blue Team Toolkit* – Nadean H. Tanner
7. *The Practice of Network Security Monitoring* – Richard Bejtlich

References:

4. *Incident Response & Computer Forensics* – Jason Luttgens
 5. *Applied Network Security Monitoring* – Chris Sanders
 6. *SOC Team Guidebook* – John Strand.
-

Course code	Course Title	L	T	P	Credits
R23CSS-HN3203	Risk Management and Governance Honors Course-3 (Track-3)	3	0	0	3

Course Objectives:

1. To introduce fundamental principles and methodologies of IT risk management
2. To understand the importance of governance in organizational cybersecurity strategy
3. To identify, assess, and prioritize risks using structured models
4. To apply governance and compliance frameworks in real-world settings
5. To gain practical experience in risk analysis, control implementation, and policy creation

Course Outcomes : Upon completion of this course, students will be able to:

1. Define and classify risks in an IT context and explain governance principles
2. Apply risk management methodologies to assess and mitigate risks
3. Analyze policies and procedures related to compliance and security governance
4. Use open-source tools to perform risk assessments and develop governance reports
5. Design basic IT governance structures aligned with business and regulatory needs

UNIT - 1

Introduction to Risk Management and Governance

Definition of risk, Risk types in IT systems, Components of risk (asset, threat, vulnerability, control), Risk management lifecycle, Governance principles, Role of accountability and leadership, Governance vs management, Risk appetite and tolerance

Learning Outcome:

Students will be able to define core risk and governance concepts and explain the risk management lifecycle in an enterprise context.

Lab Programs

Lab 1: Risk Identification and Categorization from a Case Scenario

Tool: LibreOffice Calc or Google Sheets (for risk register)

Task: Identify assets, threats, and vulnerabilities; create a risk matrix

Outcome: Students will be able to document a basic risk register

Lab 2: Risk Assessment using OCTAVE Allegro Methodology

Tool: OCTAVE Allegro Worksheets (open source)

Task: Conduct a basic risk assessment on a hypothetical organization

Outcome: Students will learn how to assess operational risk using a recognized methodology

UNIT II

Risk Assessment and Analysis Techniques

Qualitative and quantitative risk analysis, Risk likelihood and impact analysis, Risk matrices, Risk prioritization, ISO 31000 risk assessment process, Threat modeling basics

Learning Outcome:

Students will be able to evaluate and prioritize risks using qualitative and quantitative analysis techniques.

Lab Programs

Lab 1: *Build a Risk Matrix for Prioritizing IT Risks*

Tool: RRA Toolkit or SimpleRisk (open-source web-based risk assessment tool)

Task: Assign probability and impact scores, generate a color-coded matrix

Outcome: Students will learn visual risk prioritization

Lab 2: *Perform Threat Modeling using OWASP Threat Dragon*

Tool: OWASP Threat Dragon

Task: Model a sample application and identify threats using STRIDE

Outcome: Students will create a threat model and suggest mitigation strategies

UNIT III

Governance Frameworks and Standards

Introduction to COBIT, NIST CSF, ISO/IEC 27001, ITIL governance principles, Roles of CISOs, Internal audit and governance functions, Maturity models in governance

Learning Outcome:

Students will be able to compare governance frameworks and apply control sets based on organizational needs.

Lab Programs

Lab 1: *Map Organizational Controls to NIST Cybersecurity Framework*

Tool: NIST CSF Excel Template or CSF Toolkits

Task: Create a basic control matrix mapped to the five NIST CSF functions

Outcome: Students will learn to map and categorize controls

Lab 2: *Governance Gap Analysis using OpenControl or GRC Mapping Sheets*

Tool: OpenControl YAML or GRC Mapping (CSV/Markdown format)

Task: Perform a governance readiness assessment

Outcome: Students will evaluate maturity and compliance alignment

UNIT IV – Risk Mitigation and Control Design

Risk response strategies (avoid, reduce, transfer, accept), Designing preventive and detective controls, Security policies and standards, Control testing and effectiveness, Defense in depth

Learning Outcome:

Students will be able to design and evaluate appropriate security controls for identified risks.

Lab Programs

Lab 1: *Design and Document Technical and Administrative Controls*

Tool: Markdown editors or Git-based policy repositories (e.g., GitBook, HedgeDoc)

Task: Create control statements for a small IT system

Outcome: Students will design usable policy and control documentation

Lab 2: *Simulate Control Testing Using Security Onion Logs*

Tool: Security Onion (open-source SIEM and monitoring platform)

Task: Analyze event logs to validate whether controls triggered alerts

Outcome: Students will learn control monitoring and effectiveness evaluation

UNIT V – Compliance, Audit, and Risk Governance Reporting

Regulatory compliance (GDPR, HIPAA, PCI-DSS), IT audit planning, Evidence collection and audit trails, Reporting risks to stakeholders, Metrics and key risk indicators, Role of board and governance committees

Learning Outcome:

Students will be able to perform basic audits and prepare risk governance reports for stakeholders.

Lab Programs

Lab 1: *Create a Compliance Checklist and Audit Log*

Tool: GRC Toolkit Templates or LibreOffice Calc

Task: Map controls to compliance requirements and document evidence

Outcome: Students will simulate basic audit documentation

Lab 2: *Build a Risk Dashboard using Grafana with Loki Logs*

Tool: Grafana with open-source log data (e.g., Loki, Promtail)

Task: Visualize incident data and build a basic risk indicator dashboard

Outcome: Students will understand how risk metrics and trends are reported

Textbooks

1. Information Security Risk Analysis by Thomas R. Peltier
2. Governance of IT: An Executive Guide to ISO/IEC 38500 by Gad J. Selig
3. Risk Management Framework by James Broad and Andrew Bindner

Reference Books

1. COBIT 2019 Framework: Introduction and Methodology – ISACA
 2. IT Governance: How Top Performers Manage IT Decision Rights by Peter Weill and Jeanne W. Ross
 3. The Security Risk Assessment Handbook by Douglas J. Landoll
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Course code	Course Title	L	T	P	Credits
R23CSS-HN3104	Network Penetration Testing Honors Course-2 (Track-4)	3	0	0	3

Course Objectives: Understand the network architecture and applications.

- To introduce the fundamentals and methodology of penetration testing.
- To analyze vulnerabilities in networks, services, and systems.
- To gain hands-on experience with tools used in reconnaissance, exploitation, and reporting.
- To develop skills to ethically test and secure computer networks.
- To simulate real-world attacks and defensive measures.

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

- Understand the penetration testing life cycle and phases.
- Perform reconnaissance and information gathering on target networks.
- Identify and exploit vulnerabilities in systems and services.
- Document and report findings with remediation strategies.
- Use ethical hacking tools in controlled lab environments.

Unit I

Introduction to Penetration Testing:

Ethical hacking vs. penetration testing, Legal considerations and scope definition, Penetration testing process: Planning, Scanning, Gaining Access, Maintaining Access, Reporting, Types of penetration testing: black box, white box, gray box, Lab setup using Kali Linux and vulnerable machines

Learning Outcomes: Student will be able to

- Students will be able to describe the phases of penetration testing and set up a secure testing environment using ethical guidelines.

Lab 1: Setting Up a Penetration Testing Lab

- **Question:**
Install and configure a virtual lab environment using VirtualBox or VMware with Kali Linux and Metasploitable. Document the setup process.
- **Tool:** Kali Linux, Metasploitable, VirtualBox
- **Outcome:** Students will understand how to build a safe environment for penetration testing.

Lab 2: Footprinting and Target Profiling

- **Question:**
Use tools like whois, nslookup, and theHarvester to gather open-source intelligence (OSINT) on a target domain.
 - **Tool:** theHarvester, Netcraft, DNS tools
 - **Outcome:** Students will collect and analyze basic information about a target.
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Unit II

Scanning and Enumeration:

Network scanning: types of scans, scanning tools, Port scanning and service enumeration, Banner grabbing and OS detection, Identifying live hosts and services, Tools: Nmap, Netcat, Unicorn scan

Learning Outcomes: Student will be able to

- Students will be able to conduct active and passive network scanning to identify live hosts, open ports, and running services.

Lab 1: Port Scanning with Nmap

- **Question:**
Perform a full TCP and UDP scan on a target machine using Nmap. Interpret results including open ports and service versions.
- **Tool:** Nmap
- **Outcome:** Students will learn network reconnaissance techniques.

Lab 2: Service Enumeration and OS Fingerprinting

- **Question:**
Use Nmap and Netcat to enumerate running services and detect the operating system of a target host.
- **Tool:** Nmap, Netcat
- **Outcome:** Students will identify system characteristics and vulnerabilities.

Unit III

Vulnerability Analysis and Exploitation:

Vulnerability databases and scanners, Exploiting common services: SMB, FTP, SSH, Exploiting web services and misconfigurations, Password attacks: brute force, dictionary attacks, Tools: Nessus, Nikto, Metasploit

Learning Outcomes: Student will be able to

- Students will be able to identify system vulnerabilities and exploit them using standard penetration testing frameworks.

Lab 1: Vulnerability Scanning using OpenVAS or Nessus

- **Question:**
Scan a vulnerable machine using OpenVAS or Nessus. Identify and report critical vulnerabilities with CVE references.
- **Tool:** OpenVAS / Nessus
- **Outcome:** Students will identify known security weaknesses.

Lab 2: Exploitation using Metasploit Framework

- **Question:**
Use Metasploit to exploit a vulnerable service on Metasploitable. Document the payload, exploit method, and shell access.
- **Tool:** Metasploit Framework
- **Outcome:** Students will understand exploitation of real-world vulnerabilities.

UNIT-IV

Web Application Penetration Testing:

OWASP Top 10 vulnerabilities overview, SQL Injection, Cross-Site Scripting (XSS), Cross-Site Request Forgery (CSRF), File inclusion, insecure direct object references, Tools: Burp Suite, OWASP ZAP, SQLMap, DVWA

Learning Outcomes: Student will be able to

- Students will be able to detect and exploit common web application vulnerabilities such as SQL injection and cross-site scripting.

Lab 1: Testing SQL Injection and XSS in DVWA

- **Question:**
Use DVWA to test and exploit SQL Injection and XSS vulnerabilities. Demonstrate how user input can compromise a site.
- **Tool:** DVWA, SQLMap, OWASP ZAP
- **Outcome:** Students will gain hands-on experience with web-based attacks.

Lab 2: Intercepting Web Requests with Burp Suite

- **Question:**
Use Burp Suite to intercept, modify, and replay HTTP requests. Demonstrate login bypass or manipulation.
- **Tool:** Burp Suite
- **Outcome:** Students will learn how attackers manipulate web traffic.

UNIT-V (10 hours)

Reporting and Defense Mechanisms:

Documentation and report writing, Risk rating: CVSS scoring, Countermeasures and security best practices, Defense in depth, patch management, Legal and ethical implications of testing

Learning Outcomes: Student will be able to

- Students will be able to prepare a professional penetration test report and recommend mitigation strategies based on test findings.

Lab 1: Writing a Penetration Test Report

- **Question:**
~~*Prepare a detailed penetration testing report for one of your lab activities. Include executive summary, findings, impact, and recommendations.*~~

- **Tool:** Report Template (Word/PDF)
- **Outcome:** Students will learn professional reporting and risk communication.

Lab 2: Applying Security Controls and Patching

- **Question:**
Simulate the patching of a vulnerable service or apply configuration changes to mitigate a known exploit.
- **Tool:** Linux terminal / patch management tools
- **Outcome:** Students will understand mitigation techniques and secure configuration.

Text Books:

1. *The Basics of Hacking and Penetration Testing* – Patrick Engebretson
2. *Penetration Testing: A Hands-On Introduction to Hacking* – Georgia Weidman
3. *Kali Linux Revealed* – Raphaël Hertzog, Jim O’Gorman

References:

1. *Metasploit: The Penetration Tester’s Guide* – David Kennedy
 2. *Web Application Hacker’s Handbook* – Dafydd Stuttard, Marcus Pinto
 3. *Hacking: The Art of Exploitation* – Jon Erickson
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Course code	Course Title	L	T	P	Credits
R23CSS-HN3204	Web Application Penetration Testing Honors Course-2 (Track-4)	3	0	0	3

Course Objectives

1. To understand the structure and security challenges of modern web applications
2. To identify and exploit common web application vulnerabilities
3. To analyze application behavior through interception, input manipulation, and session analysis
4. To use open-source tools for scanning, enumeration, and exploitation
5. To document findings with proper impact analysis and mitigation strategies

Course Outcomes: Upon successful completion of the course, students will be able to:

1. Understand how web applications work and where vulnerabilities typically arise
2. Detect and exploit web application vulnerabilities using open-source tools
3. Perform manual testing of authentication, input validation, and session handling
4. Use testing frameworks to automate vulnerability scanning and reporting
5. Document findings with mitigation plans aligned with OWASP Top 10

UNIT I

Introduction to Web Security and Testing Setup

Web application architecture, HTTP and HTTPS protocols, Common vulnerabilities in web applications, OWASP Top 10 overview, Setting up a penetration testing lab, Legal and ethical considerations in testing

Learning Outcome:

Students will be able to explain web application attack surfaces and prepare a secure lab environment for testing.

Lab Programs

Lab 1: *Set Up a Web Penetration Testing Lab Using DVWA*

Tool: DVWA (Damn Vulnerable Web Application)

Task: Install DVWA on a local server and configure security settings for different levels.

Lab 2: *Intercept and Analyze HTTP Requests*

Tool: Burp Suite Community Edition

Task: Use Burp Suite to capture and analyze web traffic between client and server.

UNIT II

Input Validation and Injection Vulnerabilities

SQL injection, Command injection, HTML and JavaScript injection, Cross-site scripting (XSS), Cross-site request forgery (CSRF), Parameter tampering

Learning Outcome:

Students will be able to identify and exploit input-related vulnerabilities in web applications.

Lab Programs

Lab 1: *Test for SQL Injection in DVWA*

Tool: SQLMap or Burp Suite

Task: Exploit SQL injection to bypass login or extract data from the database.

Lab 2: *Perform Stored and Reflected XSS Attacks*

Tool: DVWA, Burp Suite

Task: Inject scripts in input fields to demonstrate stored and reflected XSS.

UNIT III

Authentication and Session Management Attacks

Insecure authentication, Broken access controls, Session fixation, Session hijacking, Cookie manipulation, Token management issues

Learning Outcome:

Students will be able to evaluate authentication mechanisms and identify session-related vulnerabilities.

Lab Programs

Lab 1: *Bypass Login using Credential Stuffing and Brute Force*

Tool: Hydra or Burp Suite Intruder

Task: Attempt credential guessing using common username-password combinations.

Lab 2: *Session Hijacking through Cookie Theft*

Tool: DVWA, Browser DevTools

Task: Capture session cookies and reuse them to impersonate a user.

UNIT IV

File Handling, Upload, and Security Misconfigurations

File upload vulnerabilities, Directory traversal, Insecure file storage, Path disclosure, Server misconfigurations, Error message leakage

Learning Outcome:

Students will be able to exploit insecure file handling and misconfiguration issues in web servers.

Lab Programs

Lab 1: *Exploit a File Upload Vulnerability to Upload a Web Shell*

Tool: DVWA or bWAPP

Task: Upload a PHP reverse shell and execute commands on the server.

Lab 2: *Perform Directory Traversal to Read Sensitive Files*

Tool: bWAPP or OWASP Juice Shop

Task: Access unauthorized files by manipulating file paths in URL parameters.

UNIT V

Reporting, Secure Coding, and Remediation Strategies

Writing effective vulnerability reports, Impact analysis, Recommendations and mitigations, Secure coding guidelines, Input validation, Output encoding, Patch management

Learning Outcome:

Students will be able to document security issues with evidence and recommend remediation strategies following secure coding principles.

Lab Programs

Lab 1: *Write a Professional Penetration Test Report*

Tool: Markdown editors or LibreOffice

Task: Report vulnerabilities found in previous labs including CVSS scores and fixes.

Lab 2: *Review and Patch Insecure Code Snippets*

Tool: Code editors (VS Code), OWASP Secure Coding Guidelines

Task: Identify and correct insecure practices in sample HTML and PHP or Python code.

Textbooks

1. The Web Application Hacker's Handbook by Dafydd Stuttard and Marcus Pinto
2. OWASP Testing Guide – OWASP Foundation
3. Web Application Security: Exploitation and Countermeasures by Andrew Hoffman

Reference Books

1. Hacking: The Art of Exploitation by Jon Erickson
 2. Penetration Testing: A Hands-On Introduction to Hacking by Georgia Weidman
 3. Real-World Bug Hunting by Peter Yaworski
 4. OWASP Top 10 Reports and Cheat Sheets (owasp.org)
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R23_Open Electives Courses for CSSE

Offering Department: Electronics and Communications Engineering						
S.No	Course Code	Course Name	L	T	P	Credits
1	R23ECE-OE0001	Basics of Communication Systems	3	0	0	3
2	R23ECE-OE0002	Micro Processors and Interfacing	3	0	0	3
3	R23ECE-OE0003	Digital System Design using Verilog	3	0	0	3
4	R23ECE-OE0004	Fundamentals of Digital Image Processing	3	0	0	3
5	R23ECE-OE0005	Introduction to Internet of Things	3	0	0	3
6	R23ECE-OE0006	Wireless Sensor Networks	3	0	0	3
7	R23ECE-OE0007	Satellite Communication	3	0	0	3
8	R23ECE-OE0008	Fundamentals of Embedded Systems	3	0	0	3

Offering Department: Electrical and Electronics Engineering						
S.No	Course Code	Course Name	L	T	P	Credits
1	R23EEE-OE0001	Renewable Energy Sources	3	0	0	3
2	R23EEE-OE0002	Energy Conservation and Management	3	0	0	3
3	R23EEE-OE0003	Electrical Safety & Standards	3	0	0	3
4	R23EEE-OE0004	Utilization of Electrical Energy	3	0	0	3

Offering Department: Mechanical Engineering						
S.No	Course Code	Course Name	L	T	P	Credits
1	R23MEC-OE0001	Operations Research	3	0	0	3
2	R23MEC-OE0002	3D Printing Technology	3	0	0	3
3	R23MEC-OE0003	Statistical quality control	3	0	0	3
4	R23MEC-OE0004	Hybrid Vehicle Technologies	3	0	0	3
5	R23MEC-OE0005	Industrial Robotics	3	0	0	3
6	R23MEC-OE0006	Nano Materials	3	0	0	3
7	R23MEC-OE0007	AI and ML In Manufacturing	3	0	0	3
8	R23MEC-OE0008	Automation in Manufacturing	3	0	0	3

Offering Department: Computer Science and Engineering & Allied Branches

S.No	Course Code	Course Name	L	T	P	Credits
1	R23CSE-OE0001	Python Programming	3	0	0	3
2	R23CSE-OE0002	Data Structures Using C	3	0	0	3
3	R23CSE-OE0003	Operating System Concepts	3	0	0	3
4	R23CSE-OE0004	Introduction to Java Programming	3	0	0	3
5	R23CSE-OE0005	Database Management Systems Concepts	3	0	0	3
6	R23CSE-OE0006	Unix & Shell Programming	3	0	0	3
7	R23CSE-OE0007	Software Engineering	3	0	0	3
8	R23CSE-OE0008	Introduction to Data mining	3	0	0	3
9	R23CSE-OE0009	Fundamentals of Web Technologies	3	0	0	3
10	R23CSE-OE0010	Fundamentals of Computer Networks	3	0	0	3
11	R23CSE-OE0011	Basics of Cloud Computing	3	0	0	3
12	R23CSE-OE0012	Introduction to Machine Learning	3	0	0	3
13	R23CSE-OE0013	Essentials of Cyber Security	3	0	0	3
14	R23CSE-OE0014	Introduction to React JS	3	0	0	3
15	R23CSE-OE0015	Deep Learning	3	0	0	3
16	R23CSE-OE0016	DevOps	3	0	0	3
17	R23CSE-OE0017	Mobile Computing	3	0	0	3
18	R23CSE-OE0018	Java Full Stack Development	3	0	0	3
19	R23CSE-OE0019	Human Computer Interface	3	0	0	3
20	R23CSE-OE0020	Cryptography and Network Security	3	0	0	3
21	R23CSE-OE0021	Quantum Computing	3	0	0	3
22	R23CSE-OE0022	Big data Analytics	3	0	0	3
23	R23CSE-OE0023	Block Chain Technology	3	0	0	3
24	R23CSE-OE0024	Multimedia Application Development	3	0	0	3
25	R23CSE-OE0025	Mobile Adhoc Networks	3	0	0	3
26	R23CIT-OE0001	Basics of Computer Networks	3	0	0	3
27	R23CIT-OE0002	Cryptography and Network Security	3	0	0	3
28	R23CIT-OE0003	Mobile Computing	3	0	0	3
29	R23CIT-OE0004	Wireless sensor networks	3	0	0	3
30	R23CSM-OE0001	An Introduction to Artificial Intelligence	3	0	0	3
31	R23CSM-OE0002	Introduction to Machine Learning with Python	3	0	0	3
32	R23CSM-OE0003	Foundation of Deep Learning for Engineering Applications	3	0	0	3
33	R23CSM-OE0004	Natural Language Processing- Frontiers Approach	3	0	0	3

OPEN ELECTIVES

Course code	Course Title	L	T	P	Credits
R23ECE-OE0001	Basics of Communication Systems (Open Elective)	3	0	0	3

Course Objectives:

- Introduce the fundamental principles of analog and digital communication systems.
- Understand the representation and transmission of signals.
- Learn the basics of amplitude, frequency, and phase modulation techniques.
- Study noise performance in communication systems.
- Introduce multiplexing and multiple access techniques.

Course Outcomes:

1. Understand the fundamental elements of communication systems. (L2)
2. Explain various analog and digital modulation techniques. (L2)
3. Analyze the effect of noise on communication signals. (L4)
4. Understand bandwidth and power requirements in modulation schemes. (L2)
5. Describe basic multiplexing techniques and system applications. (L2)

UNIT – I

Introduction to Communication Systems: Basic block diagram of a communication system, types of communication (analog and digital), electromagnetic spectrum, frequency bands, and applications in daily life.

UNIT – II

Amplitude Modulation: Principles of amplitude modulation (AM), modulation index, power and bandwidth of AM, generation and detection of AM signals, DSB-SC and SSB modulation.

UNIT – III

Angle Modulation: Frequency modulation (FM) and phase modulation (PM), modulation index, bandwidth of FM (Carson's Rule), generation and demodulation techniques of FM signals.

UNIT – IV

Noise and Performance Analysis: Types of noise, noise figure, signal-to-noise ratio (SNR), effect of noise on AM and FM systems, pre-emphasis and de-emphasis.

UNIT – V

Multiplexing and Digital Communication Basics: Time Division Multiplexing (TDM), Frequency Division Multiplexing (FDM), basic digital communication concepts (PCM, ASK, FSK, PSK), comparison of analog and digital systems.

Textbooks

1. Simon Haykin, Communication Systems, Wiley.
 2. B.P. Lathi, Modern Digital and Analog Communication Systems, Oxford University Press.
 3. Sanjay Sharma, Communication Systems, S.K. Kataria & Sons. (Indian Author)
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Course code	Course Title	L	T	P	Credits
R23ECE-OE0002	Micro Processors and Interfacing (Open Elective)	3	0	0	3

Course Objectives: students are provided with

- 8085 8-bit architecture and register organization.
- 8086 architecture, memory segmentation & organization and features of minimum and maximum mode operations.
- Programming of 8086 in assembly language and tools.
- Interfacing memory and various peripheral control devices with 8086.

Course Outcomes: Student is able to

1. Outline the architecture and working diagram of 8085 microprocessors. **(L2)**
2. Interpret the 8086 functioning in minimum mode and maximum mode with its architecture, memory segmentation and organization. **(L2)**
3. Construct Assembly language program for 8086 using assembler directives, addressing modes and instruction set. **(L3)**
4. Develop Interface circuits with various peripheral control ICs for 8086 system. **(L3)**
5. Designing various memory interfacing Circuits with 8086 system. **(L3)**

UNIT 1

Introduction to 8085 Microprocessor: Basic microprocessor system-working, 8085 Microprocessor Architecture, register organization, Pin Diagram, Flag Register, Instruction Cycle, Timing Diagram, Interrupts of 8085.

UNIT 2

8086 Microprocessor: Evolution of Microprocessors, Register Organization of 8086, Architecture, Pin Diagram, Memory segmentation and organization, Stack implementation, Interrupt structure of 8086. minimum and maximum mode microprocessor system, Timing diagram and General Bus operation.

UNIT 3

8086 Programming: Addressing Modes, Instruction Set of 8086, Assembly Language Programming: Assembler Directives, Simple programs, Procedures and Macros Program.

UNIT 4

Data Transfer Schemes and Principle Interfacing: IO Interfacing: Programmable Peripheral Interface 8255 and its applications, Programmable Interrupt Controller 8259 with examples, Programmable Communication Interface 8251 USART, DMA Controller 8257, Programmable Keyboard and Display Interface 8279.

UNIT-5

Memory and IO Interfacing 8086: Address decoding techniques, Interfacing Static RAM and ROM chips, ADC and DAC Interfacing.

Text Books:

1. Microprocessor Architecture Programming and Applications with the 8085, 6th edition, Ramesh S Gaonkar, Penram International Publishing, 2013
2. Advanced Microprocessors and Peripherals, 3e, K M Bhurchandi, A K Ray, McGraw Hill Education, 2017.

References:

1. The Intel Microprocessors: Architecture, Programming and Interfacing, Barry B.Brey, PHI, 6th Edition.
2. Microprocessors and Interfacing, 2e, Douglas.V.Hall, Tata McGrawhill.

Course code	Course Title	L	T	P	Credits
R23ECE-OE0003	Digital System Design using Verilog (Open Elective)	3	0	0	3

Course Objectives:

- To introduce the basics and programming fundamentals of Verilog HDL
- To describe the primitive instances of gates and explain the various modeling constructs of Verilog.
- To familiarize various behavioral modeling constructs of Verilog essential for designing digital circuits.
- To Design and implement various combinational logic circuits in Verilog HDL
- To Design and implement various sequential logic circuits in Verilog HDL.

Course Outcomes:

At the end of the Course, the Student will be able to:

1. Understand the fundamentals of Digital System Design flow using Verilog HDL. (L2)
2. Construct logic circuits with the concept of Gate Level and Dataflow modelling (L3)
3. Construct logic circuits with the concept of Behavioral modelling. (L3)
4. Make use of Verilog programming to design Combinational digital circuits. (L3)
5. Develop synthesizable Verilog codes for sequential digital circuits. (L3)

UNIT-I

Introduction to Verilog HDL: Introduction, Verilog as HDL, Basic elements: Keywords, Identifiers, Comments, Tasks and functions, Numbers, Strings, Logic Values, Data Types, Scalars and Vectors, Parameters, Operands and Operators. Simulation and Synthesis Tools.

UNIT-II

Gate Level Modeling: Introduction, Module Structure, Different Gate Primitives, Array of Instances of Primitives, Illustrative Examples,

Data Flow Modeling: Introduction, Continuous Assignment Structure, Delays, and Assignment to Vectors, Operators and different Examples.

UNIT-III

Behavioral Modeling: Blocking and Non-Blocking Assignments, Simulation Flow : if and if-else constructs, case statement, Assign-De-Assign construct, different loop constructs, Examples

UNIT IV

Design of combinational circuits Elements using HDL models: Logic gates, Half Adders, Full Adders, Subtractors, Decoders, Encoders, Multiplexers, and De-multiplexers & Comparators,

UNIT-V

Design of Sequential circuits Elements using HDL models: RS, D, T, JK Latches & Flip Flops, Registers and Counters.

Text Books

1. T.R Padmanabhan, B.Bala Tripura Sundari Design through Verilog HDL, Wiley India Publications, 2009
2. J.Bhaskar, A Verilog HDL Primer, BS Publications, 3rd Edition.

Reference Books

1. Verilog HDL – Samir Palnitkar, 2nd Edition, Pearson Education, 2009
2. John F.Wakerly , Digital Design, Pearson, 4th Edition.
3. Zainalabdien Navabi, Verilog Digital System Design, TMH, 2nd Edition.

Course code	Course Title	L	T	P	Credits
R23ECE-OE0004	Fundamentals of Digital Image Processing (Open Elective)	3	0	0	3

Course Objectives:

- Introduce the basic concepts and techniques of digital image processing.
- Understand image acquisition, sampling, and quantization processes.
- Study image enhancement and filtering techniques in spatial and frequency domains.
- Explore image segmentation and representation techniques.
- Learn the basics of morphological processing and image compression.

Course Outcomes:

1. Understand image formation, sampling, and quantization techniques. (L2)
2. Apply spatial and frequency domain enhancement methods. (L3)
3. Analyze filtering and edge detection techniques. (L4)
4. Understand image segmentation and morphological operations. (L2)
5. Identify compression techniques and their applications. (L2)

UNIT – I

Introduction and Image Fundamentals: Definition of digital image, image sensing and acquisition, image sampling and quantization, basic relationships between pixels, color image fundamentals, and image file formats.

UNIT – II

Image Enhancement in Spatial Domain: Intensity transformations, histogram processing, spatial filtering, smoothing and sharpening filters, and contrast enhancement techniques.

UNIT – III

Image Enhancement in Frequency Domain: Fourier Transform, frequency domain filtering, low-pass and high-pass filters, homomorphic filtering, and enhancement using Discrete Cosine Transform (DCT).

UNIT – IV

Image Segmentation and Morphology: Edge detection using gradient operators, thresholding techniques, region-based segmentation, morphological operations like dilation, erosion, opening, and closing.

UNIT – V

Image Compression and Representation: Lossless and lossy compression techniques, run-length coding, Huffman coding, JPEG, wavelet-based compression, and basics of image representation and description.

Textbooks:

1. Rafael C. Gonzalez & Richard E. Woods, Digital Image Processing, Pearson.
 2. Anil K. Jain, Fundamentals of Digital Image Processing, PHI Learning. (Indian Author)
 3. S. Jayaraman, S. Esakkirajan, and T. Veerakumar, Digital Image Processing, McGraw-Hill. (Indian Author)
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Course code	Course Title	L	T	P	Credits
R23ECE-OE0005	Introduction to Internet of Things (Open Elective)	3	0	0	3

Course Objectives:

- To Understand the Architectural Overview of IoT and layers involved in Architecture.
- To Understand Real World Design Constraints of IOT and Various Protocols.
- To familiarize the students to the basics of Internet of things and protocols.
- To expose the students to some of the hardware and Software applications areas where Internet of Things can be applied.

Course Outcomes:

The students should be able to:

1. Understand the architecture of IoT systems, including the components and their roles.(L2)
2. Interface various electronic components, including LEDs, push buttons, buzzers, and LCD displays, with the Arduino board.(L3).
3. Establish remote access to the Raspberry Pi for control and management.(L3)
4. Apply knowledge to develop basic IoT applications using the ESP8266.(L3)

Understand the fundamentals of virtualization and cloud computing architecture.(L2)

UNIT - I

Introduction to IOT: Understanding IoT fundamentals, IOT Architecture and protocols, Various Platforms for IoT, Real time Examples of IoT , Overview of IoT components and IoT Communication Technologies ,Challenges in IOT.

UNIT - II

Arduino Simulation Environment: Arduino Uno Architecture, Setup the IDE, Writing Arduino Software, Arduino Libraries, Basics of Embedded C programming for Arduino, Interfacing LED, push button and buzzer with Arduino, Interfacing Arduino with LCD. Sensor & Actuators with Arduino

UNIT - III

Raspberry Pi Programming: Installing and Configuring the Raspberry Pi, Getting Started with the Raspberry Pi, Using the Pi as a Media Centre, Productivity Machine and Web Server, Remote access to the Raspberry Pi. Preparing Raspberry Pi for IoT Projects.

UNIT - IV

Basic Networking with ESP8266 WiFi module : Basics of Wireless Networking, Introduction to ESP8266 Wi-Fi Module ,Various Wi-Fi library , Web server introduction, installation, configuration ,Posting sensor(s) data to web server .IoT Protocols ,M2M vs. IOT Communication Protocols.

UNIT - V

Cloud Platforms for IOT : Virtualization concepts and Cloud Architecture , Cloud computing, benefits ,Cloud services -- SaaS, PaaS, IaaS , Cloud providers & offerings ,Study of IOT Cloud platforms , ThingSpeak API and MQTT , interfacing ESP8266 with Web services

Text Books:

1. Simon Monk, Programming Arduino: Getting Started with Sketches, Second Edition McGraw- Hill Education
2. Peter Waher, Learning Internet of Things, Packt publishing.
3. Ovidiu Vermesan, Peter Friess, IoT-From Research and Innovation to Market deployment, River Publishers

Reference Books:

1. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, "From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence", 1st Edition, Academic Press, 2014.
2. Peter Waher, "Learning Internet of Things", PACKT publishing, BIRMINGHAM – MUMBAI
3. Bernd Scholz-Reiter, Florian Michahelles, "Architecting the Internet of Things", ISBN 978-3-642-19156-5 e-ISBN 978-3-642-19157-2, Springer.

Course code	Course Title	L	T	P	Credits
R23ECE-OE0006	Wireless Sensor Networks (Open Elective)	3	0	0	3

Course Objectives:

- Emphasize the basic WSN technology and sensor node architecture with its unique constraints and challenges in design of WSN for different applications.
- Summarize the transceiver design and network technologies used in wireless sensor and networks.
- Explains various key MAC protocols for sensor networks with their merits and demerits.
- Provide knowledge of different routing protocols with their advantages.
- Create awareness on transport layer protocols, security considerations, sensor network platforms and tools with a brief study of different WSN applications.

Course Outcomes:

1. Illustrate the wireless sensor node architectures.
2. Outline the physical layer design.
3. Inspect MAC protocols of wireless sensor and networks.
4. Infer various network layer routing protocols of wireless sensors.
5. Summarize the network security requirements.

UNIT-I

Overview of Wireless Sensor Networks: Key definitions of sensor networks, advantages of sensor networks, unique constraints and challenges, driving application, enabling technologies for wireless sensor networks.

Architectures:

Single-node architecture - hardware components, energy consumption of sensor nodes, operating system and execution environments, network architecture- sensor network scenarios, optimization goals and figures of merit, gateway concepts.

UNIT - II

Networking Technologies: Physical layer and transceiver design consideration, personal area networks (PANs), hidden node and exposed node problem, topologies of PANs, MANETs, and WANETs.

UNIT - III

MAC Protocols for Wireless Sensor Networks: issues in designing a MAC protocol for Ad Hoc Wireless Networks, Design goals of a MAC protocol for Ad Hoc Wireless Networks, Classifications of MAC Protocols, Contention -Based Protocols, contention - based protocols with reservation mechanism, contention - based MAC protocols with scheduling Mechanisms, MAC protocols that use directional antennas, others MAC protocols.

UNIT - IV

Routing Protocols: introduction, issues in designing a routing protocols for Ad Hoc Wireless Networks, classification of routing protocols, table- driven routing protocols, On-Demand routing protocols, Hybrid routing protocols, routing protocols with efficient flooding mechanisms, hierarchical routing protocols, power- aware routing protocols, proactive routing.

UNIT-V

Transport Layer and Security Protocols: Introduction, issues in designing a transport layer protocol for Ad Hoc wireless networks, design goals of a transport layer protocol for Ad Hoc wireless networks, Security in Ad Hoc wireless networks, network security requirements, issues and challenges in security provisioning, network security attacks, key management, secure routing in Ad Hoc wireless Networks.

Sensor Network Platforms and Tools:

Sensor node hardware - Berkeley motes, programming challenges, node- level software platforms, node-level simulators, state - centric programming.

Textbooks

1. Ad Hoc wireless networks: Architectures and protocols - C.Siva Ram Murthy and B.S.Manoj, 2004, PHI.
2. Wireless Ad - Hoc and Sensor Networks: Protocols, Performance and Control - Jagannathan Sarangapani, CRC Press.
3. Holger Karl & Andreas Willig, Protocol and Architectures for Wireless Sensor Networks, John Wiley, 2005.

References

1. Kazem Sohraby, Daniel Minoli, & Taieb Zanti, "Wireless Sensor Networks - Technology, Protocols and Applications", John Wiley, 2007.
 2. Feng Zhao & Leonidas J.Guibas, "Wireless Sensor Networks - An Information Processing Approach", Elsevier, 2007.
 3. Ad Hoc Mobile Wireless Networks: Protocols & Systems, C.K.Toh, 1ed, Pearson Education.
 4. Wireless Sensor Networks - C.S.Raghavendra, Krishna M.Sivalingam, 2004, Springer.
 5. Wireless Sensor Networks - S Anandamurugan, Lakshmi Publications
-

Course code	Course Title	L	T	P	Credits
R23ECE-OE0007	Satellite Communication (Open Elective)	3	0	0	3

Course Objectives:

- Introduce the basic concepts and architecture of satellite communication systems.
- Understand satellite orbits, launch methods, and positioning techniques.
- Study satellite subsystems including transponders and antennas.
- Learn about satellite link design and signal propagation.
- Explore multiple access techniques and satellite applications.

Course Outcomes:

1. Understand satellite system architecture and functions. (L2)
2. Analyze orbital mechanics and satellite positioning. (L4)
3. Understand the design and working of satellite subsystems. (L2)
4. Analyze satellite link budgets and signal propagation. (L4)
5. Understand access techniques and applications in communication systems. (L2)

UNIT – I

Overview of Satellite Communications: Introduction to satellite communication, advantages and limitations, types of satellites, satellite applications in communication, broadcasting, navigation, and remote sensing.

UNIT – II

Orbital Mechanics and Launchin: Kepler's laws, orbital elements, types of satellite orbits (LEO, MEO, GEO), look angle determination, eclipse effects, and satellite launching methods.

UNIT – III

Satellite Subsystems: Space segment and ground segment, transponders, antenna systems, telemetry, tracking and command (TT&C), and power systems.

UNIT – IV

Satellite Link Design and Propagation: Link power budget, system noise temperature, C/N ratio, G/T ratio, propagation effects such as rain attenuation, free-space loss, and ionospheric effects.

UNIT – V

Access Techniques and Applications: FDMA, TDMA, CDMA in satellite communication, VSAT systems, satellite mobile communication, GPS, and DTH systems.

Textbooks:

1. Dennis Roddy, Satellite Communications, McGraw-Hill.
2. Timothy Pratt et al., Satellite Communications, Wiley India.
3. T. K. Bandopadhyay, Satellite Communication, PHI Learning. (Indian Author)

Course code	Course Title	L	T	P	Credits
R23ECE-OE0008	Fundamentals of Embedded Systems (Open Elective)	3	0	0	3

Course Objectives

- Basic fundamentals and components of a typical embedded system.
- Embedded system development as a hardware design and firmware design methodologies, tools and integration.
- Understand the need and development of hardware software codesign.
- Aware of the interrupt service mechanism and device driver programming.
- Understand the working of real time operating systems.

Course Outcomes

1. Illustrate the working of various components of a typical embedded system. (L2)
2. Develop hardware and firmware design methodologies, tools and integration for a embedded system. (L3)
3. Discuss the importance and development using hardware software codesign. (L2)
4. Summarize the interrupt service mechanism and device driver programming. (L2)
5. Outline the real time operating system functions and study of a deployed RTOS. (L2)

UNIT-I

Introduction to Embedded System: Embedded System, Embedded System Vs General Computing System, History of Embedded Systems, Classification of Embedded System, major Application Areas, Purpose of Embedded system, Core of Embedded System, Memory, Sensors and Actuators, Communication Interface, other System components, PCB and passive components, Characteristics of Embedded System, Quality Attributes of Embedded System, application and domain specific embedded systems.

UNIT-II

Embedded system Development: Analog and Digital Electronic components, VLSI and IC Design, EDA tools, PCB Fabrication, Embedded Firmware Design approaches, embedded firmware development languages, Integration of Hardware and Firmware, Board Bring up, Embedded System Development Environment – IDE, Types of File Generated on Cross Compilation- Disassembler/ Decompiler, Simulator, Emulator and Debugging, Target hardware Debugging, Boundary Scan,

UNIT-III

Hardware Software Co-design and program modelling: Fundamental Issues in Hardware and Software Co-Design, Computational Models in Embedded Design, Introduction to Unified Modelling Language (UML), hardware Software Trade-offs, embedded product development life cycle- objectives, different phases, approaches of EDLC.

UNIT-IV

Device Drivers and Interrupt service mechanism: Programmed I/o, busy-wait approach without interrupt service mechanism, ISR concepts, interrupt sources, interrupt service handling mechanism, multiple interrupts, context and periods for context switching, interrupt latency and deadline. Classification of processors interrupt service mechanism from context saving, direct memory access, device driver programming.

UNIT-V

Real time operating system: operating system basics, types of operating systems, tasks, process and threads, multiprocessing and multitasking, task scheduling, threads, processes and scheduling, task communication, task synchronization, how to choose an RTOS, case study of ucos-II and vxworks.

Textbooks:

1. Introduction to Embedded System, Shibu K.V, Tata McGraw-Hill, 2014.

References:

1. Embedded Systems- Architecture, programming and Design, 2e, Raj kamal, McGraw Hill Education (India) Private Limited.
2. Embedded System Design- Frank vahid, Tony Givargis, Wiley publications, 2002.

Course code	Course Title	L	T	P	Credits
R23EEE-OE0001	Renewable Energy Sources (Open Elective)	3	0	0	3

Course Objectives:

- To study the solar radiation data, extraterrestrial radiation, radiation on earth's surface.
- To study solar thermal collectors.
- To study maximum power point techniques in solar Photovoltaic Systems
- To study wind energy conversion systems, Betz coefficient, tip speed ratio and geothermal systems.
- To study basic principle and working of tidal, biomass and fuel cell

Course Outcomes: After completion of the course, the student will be able to:

1. Understand the basic concepts of solar radiation, its data on earth's surface(L2)
2. Explain the different types of solar thermal energy collectors(L2)
3. Develop the maximum power point techniques in solar Photovoltaic Systems(L3)
4. Understand the Wind energy conversion systems and the various geothermal resources(L2)
5. Explain the methods of generation of electricity from tidal and chemical resources(L2)

UNIT-I

Fundamentals of Energy Systems and Solar energy: Energy conservation principle – Energy scenario (world and India) – various forms of renewable energy - Solar radiation: Outside earth's atmosphere – Earth surface – Analysis of solar radiation data – Geometry – Radiation on flat and tilted surfaces – Numerical problems.

UNIT-II

Solar Thermal Systems: Liquid flat plate collectors: Performance analysis –Transmissivity– Absorptivity product collector efficiency factor – Collector heat removal factor – Numerical problems. Introduction to solar air heaters – Concentrating collectors, solar pond and solar still – solar thermal plants.

UNIT-III

Solar Photovoltaic Systems: Solar photovoltaic cell, module, array – construction – Efficiency of solar cells – Developing technologies – Equivalent circuit of solar cell – Series resistance – Shunt resistance – Cell I-V characteristics and P-V characteristics. Applications and systems – Balance of system components – System design: storage sizing – PV system sizing – Maximum power point techniques: Perturb and observe (P&O) technique – Hill climbing technique.

UNIT-IV

Wind Energy and Geothermal Energy: Sources of wind energy - Wind patterns – Types of turbines –Horizontal axis and vertical axis machines - Kinetic energy of wind – Betz coefficient – Tip-speed ratio – Efficiency – Power output of wind turbine – Selection of generator (synchronous, induction) – Maximum power point tracking – wind farms. Geothermal: Classification – Dry rock and hot aquifer – Energy analysis – Geothermal based electric power generation

UNIT-V

Tidal Power, Biomass and Fuel Cells: Tidal power – Basics – Kinetic energy equation – Turbines for tidal power – Numerical problems – Wave power – Basics – Kinetic energy equation – Wave power devices.

Biomass Energy: Fuel classification – Pyrolysis – Direct combustion of heat – Different digesters and sizing.

Fuel cell: Classification of fuel for fuel cells – Fuel cell voltage– Efficiency – V-I characteristics

Text Books:

1. Solar Energy: Principles of Thermal Collection and Storage, S. P. Sukhatme and J. K. Nayak, TMH, New Delhi, 3rd Edition.
2. Renewable Energy Resources, John Twidell and Tony Weir, Taylor and Francis - second edition, 2013.

Reference Books:

1. Energy Science: Principles, Technologies and Impacts, John Andrews and Nick Jelly, Oxford University Press.
2. Renewable Energy- Edited by Godfrey Boyle-oxford university.press,3rd edition,2013.
3. Handbook of renewable technology Ahmed and Zobaa, Ramesh C Bansal, World scientific, Singapore.
4. Renewable Energy Technologies /Ramesh & Kumar /Narosa.
5. Renewable energy technologies – A practical guide for beginners – Chetong Singh Solanki, PHI.
6. Non-conventional energy source –B.H.khan- TMH-2nd edition.

Weblinks:

1. <https://nptel.ac.in/courses/103103206>
-

Course code	Course Title	L	T	P	Credits
R23EEE-OE0002	Energy Conservation and Management (Open Elective)	3	0	0	3

Course objectives:

- To make the students aware of global energy scenario
- To apply good engineering practices in energy conservation activities
- To summarize the salient features of energy conservation Act 2001.
- To study about energy management and methods of improving energy efficiency in different electrical systems.
- To calculate life cycle costing analysis and return on investment on energy efficient technologies.

Course Outcomes: At the end of the Course the student shall be able to

1. Understand the classification of Energy and global energy scenario(L3)
2. Understand the importance of Energy Conservation. (L2)
3. Understand the schemes of energy conservation act 2001 (L3)
4. Analyze the performance of electrical utilities and their efficient improvement approaches (L3)
5. Analyze the life cycle costing and return on investment of energy efficient technologies(L2)

UNIT – I

ENERGY SCENARIO: Classification of Energy – Primary and Secondary Energy, Commercial Energy and Non-commercial Energy and Renewable & Non-renewable energy; commercial energy production, final energy consumption, energy needs of growing economy, energy intensity on purchasing power parity (PPP), energy consumption in various sectors, long term energy scenario, Indian energy scenario, energy pricing.

UNIT - II

ENERGY CONSERVATION: Energy conservation and its importance – need of energy conservation, energy strategy for the future, energy efficiency and its benefits. Energy security – definition, purpose of implementing national energy security policy. Energy conservation systems- short, medium, long term energy conservation. Energy conservation equipments - Automatic power factor controller (APFC) - Intelligent power factor controller(IPFC).

UNIT - III

ENERGY CONSERVATION ACT – 2001: Energy conservation act – 2001 and its features, power and function of bureau, responsibilities and duties of state designated agencies, schemes of BEE under energy conservation act 2001 – Energy conservation building codes – standards and labelling – demand side management – Bachat lamp yojana(BLY) – promoting energy efficiency in small and medium enterprises – designated consumers – certification of energy auditors and managers (introduction only).

UNIT - IV

ENERGY MANAGEMENT: Energy management – energy management program, function of energy manager, principles of energy management and quality of energy manger, Energy management techniques in transformers and motors - Transformer losses& Energy efficient transformers. - Distribution losses in industrial systems. Assessment of transmission and distribution losses in power systems. - Economics of energy efficient motors and systems. Material and Energy balance: Facility as an energy system, methods for preparing process flow, material and energy balance diagrams.

UNIT - V

ECONOMIC ASPECTS AND ANALYSIS: Electricity billing, electrical load management and maximum demand control, Benefits of demand side management- Harmonics-causes-effects-overcoming - Economics Analysis – Depreciation Methods – Time value of money – Rate of return – Present worth method – Replacement analysis – Life cycle costing analysis.

Text books:

1. Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-1, General Aspects (available online)
2. Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-3, Electrical Utilities (available online)
3. Energy efficient electric motors by John.C.Andreas, Marcel Dekker Inc Ltd–2nd edition, 1995.
4. Amlan Chakrabarti, “Energy Engineering and management”, PHI Publication.

Reference books:

1. Energy management by W.R.Murphy & G.Mckay Butterworth, Elsevier publications. 2012
2. S.C.Tripathy, “Utilization of Electrical Energy and Conservation”, McGraw Hill, 1991.
3. Doty, Steven; Turner, Wayne C, Energy Management Hand book (8th Edition), Fairmont Press, Inc., 978-0-88173-707-3

Web Links:

1. www.energy.gov/energy_saver/blower-door-tests.
2. https://beeindia.gov.in/content/energy_auditor.
3. www.pcra.org/pages/display180-energy-audit
4. <https://www.myscheme.gov.in/schemes/peacedea>

Course code	Course Title	L	T	P	Credits
R23EEE-OE0003	Electrical Safety & Standards (Open Elective)	3	0	0	3

Course Objectives:

- To Explain the importance of electrical safety and security measures.
- To Demonstrate the principles of safe electrical wiring and fitting practices.
- To Demonstrate the importance of issuing safety clearance notices before energizing equipment.
- To Classify hazardous zones and the associated risks in electrical environments.
- To Explain regulations regarding physical clearances in electrical installations.

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

1. Explain the principles and scope of electrical safety, including its relevance across residential, commercial, and industrial sector. (L2)
2. Understand the Indian power sector organization and Electricity rules, electrical safety in residential, commercial, agriculture, hazardous areas. (L2)
3. Outline the electrical safety during installation, testing and commissioning procedure. (L2)
4. Make use of specification of electrical plants and classification of safety equipment for various hazardous locations. (L2)
5. Understand Safety Management & Standards in Electrical Systems. (L2)

UNIT-I

Introduction to Electrical Safety, Shocks and its Prevention: Terms and definitions, objectives of safety and security measures, Hazards associated with electric current and voltage, who is exposed, principles of electrical safety, Approaches to prevent Accidents, scope of subject electrical safety. Primary and secondary electrical shocks, possibilities of getting electrical shock and its severity, medical analysis of electric shocks and its effects, shocks due to flash/ Spark over's, prevention of shocks, safety precautions against contact shocks, flash shocks, burns, residential buildings and shop.

UNIT-II

Electrical Safety in Residential, Commercial and Agricultural Installations: Wiring and fitting –Domestic appliances –water tap giving shock –shock from wet wall –fan firing shock – multi-storied building –Temporary installations – Agricultural pump installation –Do's and Don'ts for safety in the use of domestic appliances.

UNIT-III

Electrical Safety during Installation, Testing and Commissioning: Preliminary preparations –safe sequence –risk of plant and equipment –safety documentation –field quality and safety –personal protective equipment –safety clearance notice –safety precautions –safeguards for operators –safety.

UNIT-IV

Electrical Safety in Hazardous Areas: Hazardous zones –class 0,1 and 2 – spark, flashovers and corona discharge and functional requirements – Specifications of electrical plants, equipment's for hazardous locations – Classification of equipment enclosure for various hazardous gases and vapours – classification of equipment/enclosure for hazardous locations.

UNIT-V

Safety Management of Electrical Systems and Standards: Principles of Safety Management, Management Safety Policy, Safety organization, safety auditing, Motivation to managers, supervisors, employees. Review of IE Rules and Acts, their Significance: Objective and scope – ground clearances and section clearances – standards on electrical safety - safe limits of current, voltage –Rules regarding first aid and firefighting facility. The Electricity Act, 2003,

Textbooks

1. Rao, S. and Saluja, H.L., "Electrical Safety, Fire Safety Engineering and Safety Management", Khanna Publishers, 1988.
2. Pradeep Chaturvedi, "Energy management policy, planning and utilization", Concept

Publishing company, New Delhi, 1997

Reference Books

1. Cooper.W.F, “Electrical safety Engineering”, Newnes-Butterworth Company, 1978.
2. John Codick, “Electrical safety hand book”, McGraw Hill Inc., New Delhi, 2000.
3. Nagrath, I.J. and Kothari, D.P., “Power System Engineering”, Tata McGraw Hill, 1998.
4. Wadhwa, C.L., “Electric Power Systems”, New Age International, 2004.

Web Links:

1. https://onlinecourses.nptel.ac.in/noc20_mg43
 2. https://onlinecourses.swayam2.ac.in/nou20_cs08/preview
 3. <https://www.udemy.com/course/electrical-safety>
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Course code	Course Title	L	T	P	Credits
R23EEE-OE0004	Utilization of Electrical Energy (Open Elective)	3	0	0	3

Course Objectives:

- To study the laws of illumination and their applications for various lighting schemes.
- To explain the various methods of Electric heating.
- To explain the various electric traction systems and its equipment
- To identify the speed-time curves of different services and energy consumption levels at various modes of operation.
- To analyze the economic aspects of utilization of electrical energy.

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

1. Apply the concepts of illumination to Calculate the illumination levels required for various lighting schemes (L3).
2. Explain the appropriate heating techniques for different applications (L2).
3. Apply the concepts of D.C and A.C traction systems (L3).
4. Apply speed-time curves and the energy consumption of different services under various operating conditions (L3).
5. Analyze the economic aspects of utilization of electrical energy (L4).

UNIT-I

Illumination: Basic definitions of Illumination, Laws of Illumination, Polar Curves, Calculation of MHCP and MSCP, Lamps: Incandescent Lamp, Sodium Vapour Lamp, Fluorescent Lamp, CFL and LED. Requirement of Good Lighting Scheme, Types, Design and Calculation of Illumination, Numerical Problems.

UNIT-II

Electric Heating: Electrical Heating: Advantages, Modes of heat transfer, Design of heating Element, Methods of Electric Heating – Resistance, Arc heating, Induction and Dielectric Heating, Applications of electric heating, Numerical Problems.

UNIT-III

Electric Traction – I: Introduction, Systems of Electric Traction, Comparison Between A. C. and D. C Traction, Special Features of Traction Motors, The Locomotive, Wheel arrangement and Riding Qualities, Transmission of Drive, and Motor Coaches for Track Electrification, DC Equipment, AC Equipment, Overhead Equipment, Numerical Problems.

UNIT-IV

Electric Traction – II: Introduction to Speed-Time Curves of Different Services, Calculations of Tractive Effort Mechanics of Train Movement, Adhesive Weight and Dead Weight, and Coefficient of Adhesion, Numerical Problems.

UNIT-V

Economic Aspects of Utilizing Electrical Energy: Power Factor Improvement, Load Factor improvement, Off Peak Loads, Use of Exhaust Steam, Waste Heat recovery, Pit Head Generation, Diesel Plant, General Comparison of Private Generating Plant and Public Supply- Initial Cost and Efficiency, Capitalization of Losses.

Textbooks:

1. E. Openshaw Taylor, Utilisation of Electric Energy, Universities Press, Penram International Publishers, 2010
2. N.V. Suryanarayana, Utilisation of Electrical power including Electric drives and Electric Traction, New Age Publishers, 2017.

Reference Books:

1. H. Partab, Art & Science of Utilization of Electric Energy, Dhanpat Rai & Sons, 1998.
2. J. B Gupta, Utilization of Electric Power & Electric Traction S.K. Kataria & Sons, Reprint 2020, 10th Edition.
3. Generation, distribution and utilization of electrical energy, C.L Wadhwa, Wiley Eastern Limited.
4. Electrical Power Systems, S. L. Uppal, Khanna publishers.

Web Links:

1. https://onlinecourses.nptel.ac.in/noc22_ee94/preview
 2. <https://archive.nptel.ac.in/courses/108/105/108105060/>
 3. <https://archive.nptel.ac.in/courses/112/103/112103263/>
 4. <https://archive.nptel.ac.in/courses/112/107/112107090/>
 5. https://onlinecourses.nptel.ac.in/noc23_ag06/preview
-

Course code	Course Title	L	T	P	Credits
R23MEC-OE0001	Operations Research (Open Elective)	3	0	0	3

Course Objectives:

The objectives of the course are to

- Explore advanced methodologies in Operations Research to model and optimize decision-making processes in complex systems.
- Comprehend the theoretical foundations and practical applications of Linear Programming to address challenges in industrial and operational domains.
- Develop effective solutions for Transportation and Assignment Problems by applying optimization techniques to enhance productivity in manufacturing and efficiency in logistics.
- Impart knowledge of strategic tools in Game Theory and Network Analysis to evaluate and improve competitive scenarios and project management systems.
- Evaluate Queuing models and Simulation models to address uncertainty and improve the system performance.

Course Outcomes

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

1. **construct** mathematical models for allocation problems to find the optimal solutions. (L3)
2. **determine** optimal solutions for transportation and assignment problems and **test** for optimality to obtain the optimal solutions. (L4)
3. **design** simulation models for discrete systems under uncertainties to obtain the solutions for decision making. (L4)
4. **apply** the concepts of PERT and CPM for scheduling the projects. (L3)
5. **determine** strategic solutions for competitive scenarios in two-person zero-sum games (L4)

UNIT I

Introduction to Operations Research (OR): OR definition - Classification of Models, **Linear Programming (LP):** Problem Formulation, Graphical Method, Special Cases of LP- Degeneracy, Infeasibility and Multiple Optimal Solutions; Simplex Method, Big- M simplex Method, application of L.P.P. in manufacturing firms. Software solutions

Applications: Determination of Production quantities of different products in manufacturing industries

UNIT II

Transportation and Assignment Problems: Transportation Problem – Formulation; Different Methods of Obtaining Initial Basic Feasible Solution –North West Corner Rule, Least Cost Method, Vogel's Approximation Method; Optimality Method – Modified Distribution (MODI) Method; Special Cases – Unbalanced Transportation Problem, Degenerate Problem. Assignment Problem – Formulation, Hungarian Method for Solving Assignment Problems, Traveling Salesman problem. application of Transportation and Assignment Problems in manufacturing firms. Software solutions.

Applications: Optimizing transportation costs in distribution of goods

UNIT III

Queuing Theory: Introduction – Basic queuing process, basic structure of queuing models terminology: arrival Pattern, service channel, population, departure pattern, queue discipline, Kendall's notation.

Single Channel model with poisson arrivals, exponential service times with infinite queue length

Simulation: Basic concept of simulation, discrete event simulation, applications of simulation, merits and demerits of simulation, Monte Carlo simulation, simulation of Inventory system, simulation of Queuing system. Simulation languages

Applications: Decision making in uncertainty situations

UNIT IV

Network Analysis: Network Representation, rules for drawing network, Fulkerson's Rule, Determination of Earlier Starting Time and Earliest Finishing Time in the Forward Pass – Latest Starting Time and Latest Finishing Time in Backward Pass, determination of critical path, total float calculation, Time estimates in PERT, Probability of completing the project, project cost, project crashing, Optimum project duration, Project management.

Applications: Project planning control in manufacturing and maintenance

UNIT V

Game Theory: Optimal solution of two-person zero sum games, the max min and min max principle. Games without saddle points, mixed strategies. algebraic method, Reduction by principles of dominance, graphical method for $[2 \times n]$ and $[m \times 2]$ game problems, Linear programming model

Applications: Determination of optimal strategies in competition between industries

Text books:

1. Sharma S.D., Operations Research: Theory, Methods and Applications, Kedar Nath Ram Nath.
2. Prem kumar Gupta and Hira, Operations Research, S Chand Company Ltd., New Delhi.

Reference books:

1. Hiller F.S., and Liberman G.J., Introduction to Operations Research, Tata McGraw Hill.
2. Sharma J.K., Operations Research: Theory and Applications, Laxmi Publications.
3. Taha H.A., Operations Research, Prentice Hall of India, New Delhi.
4. Pannerselvam R., Operations Research, Pentice Hall of India, New Delhi.
5. Sundaresan.V, and Ganapathy Subramanian.K.S, Resource Management Techniques: Operations Research, A.R Publications.

Web Source References:

1. https://onlinecourses.nptel.ac.in/noc22_mg15
 2. https://onlinecourses.nptel.ac.in/noc22_ma48
 3. https://onlinecourses.nptel.ac.in/noc24_mg30
 4. <https://www.britannica.com/topic/operations-research>
 5. <https://www.theorsociety.com/about-or>
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Course code	Course Title	L	T	P	Credits
R23MEC-OE0002	3D Printing Technology (Open Elective)	3	0	0	3

Course Objectives:

The objectives of the course are

- To exploit technology used in 3D printing.
- To understand importance of 3D printing in advance manufacturing process.
- To acquire knowledge, techniques and skills to select relevant 3D Printing process.
- To explore the potential of 3D Printing in different industrial sectors.

Course Outcomes

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

1. **Know** the importance of 3D printing in Manufacturing (L1)
2. **Understand** the liquid-based 3D printing system(L2)
3. **Illustrate** the solid-based 3D printing system (L2)
4. **Explain** the powder-based 3D printing system (L2)
5. **Elucidate** the application 3D printing in medical field (L2)

UNIT-I

Introduction: 3D Printing, Generic 3D Printing Process, Benefits of 3D Printing, Distinction Between 3D Printing and CNC Machining, Classification of 3D Printing Processes, Metal Systems, Hybrid Systems, Milestones in 3D Printing Development, 3D Printing around the World.

UNIT-II

LIQUID-BASED 3D PRINTING SYSTEM: Stereo lithography Apparatus (SLA): models and specifications, process, working principle, photopolymers, photo polymerization, layering technology, laser and laser scanning, applications, advantages and disadvantages.

UNIT-III

SOLID-BASED 3D PRINTING SYSTEMS: Models and specifications, process, working principle, applications, advantages and disadvantages, case studies. Fused deposition modelling (FDM) - models and specifications, process, working principle, applications, advantages and disadvantages, case studies.

UNIT-IV

POWDER BASED 3D PRINTING SYSTEMS: Selective laser sintering (SLS): models and specifications, process, working principle, applications, advantages, disadvantages and case studies.

UNIT-V

MEDICAL APPLICATIONS & FUTURE DIRECTION FOR 3D PRINTING - Use of 3D Printing to Support Medical Applications, Limitations of 3D Printing for Medical Applications, Further Development of Medical 3D Printing Applications. Use of Multiple Materials in 3D Printing - Discrete Multiple Material Processes, Blended Multiple Material Processes, Commercial Applications Using Multiple Materials, Business Opportunities and Future Directions

Text Books

1. Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing, Ian Gibson, David W Rosen, Brent Stucker, Springer.
2. 3D Printing and Additive Manufacturing: Principles & Applications, Chua Chee Kai, LeongKah Fai, World Scientific.

References

1. Rapid Prototyping: Laser-based and Other Technologies, Patri K. Venuvinod and Weiyin Ma, Springer.
 2. Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping and Rapid Tooling, D.T. Pham, S.S. Dimov, Springer.
 3. Rapid Prototyping: Principles and Applications in Manufacturing, Rafiq Noorani, John Wiley & Sons.
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4. Additive Manufacturing, Second Edition, Amit Bandyopadhyay Susmita Bose, CRC PressTaylor & Francis Group.
5. Additive Manufacturing: Principles, Technologies and Applications, C.P Paul, A.N Junoop, McGraw Hill.

Web resources

1. <https://www.nist.gov/additive-manufacturing>
 2. <https://www.metal-am.com/>
 3. <http://additivemanufacturing.com/basics/>
 4. <https://www.3dprintingindustry.com/>
 5. <https://www.thingiverse.com/>
 6. <https://reprap.org/wiki/RepRap>
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Course code	Course Title	L	T	P	Credits
R23MEC-OE0003	Statistical quality control (Open Elective)	3	0	0	3

Course Objectives:

The Objectives of this course are to

- Explore the techniques for identifying customer needs, gathering customer feedback, and using that information to drive quality improvements.
- develop skills in analyzing quality control data and making data-driven decisions to maintain or improve product quality
- Design and apply TQM tools and techniques such as control charts, process capability analysis, and Kaizen for continuous process improvement.
- Comprehend Six Sigma methodologies and acceptance sampling plans for quality excellence and reduce operational costs.
- foster a culture of quality and support quality management initiatives to ensure compliance, sustainability, and competitive advantage.

Course outcomes:

Upon completion of this course students will be able to

1. **apply** the concept of Quality function deployment to meet the customer quality requirements in product development (**L3**)
2. **apply** tools and techniques of Quality Management to identify the assignable causes for process variations to control the manufacturing process (**L3**)
3. **construct** control charts for variables and attributes for controlling manufacturing process (**L3**)
4. **develop** acceptance sampling plan to minimize producer risk and consumer risk. (**L4**)
5. **comprehend** Six Sigma methodologies and ISO quality systems to achieve quality excellence (**L2**)

UNIT –I

Introduction: Introduction to quality – Definition of Quality, Dimensions of Quality, Quality Planning, Total quality management – history – stages of evolution– objectives –Inspection and quality control, Quality Management versus TQM, Reliability engineering –reliability as a parameter of quality for sustainability -bathtub curve, MTBF, System reliability calculations, Quality Loss Function, Quality function deployment (QFD). applications, real life examples

Application:

Quality control concepts used to meet customer requirements in manufacturing industries

UNIT II

Tools and Techniques of TQM: Process capability, Natural Tolerance limits, Process capability index. Check Sheets, Histograms, Scatter Diagrams, Cause and Effect Diagrams, Pareto Chart, control charts, TPM, Kaizen, JIT, Quality Circles, Seven wastes elimination in manufacturing industries for sustainable development, Five S principle

Application: Perform Process capability studies in machine tool industries

UNIT III

Statistical Process Control: Control charts: Statistical basis of the Control Charts-principles, Control limits for X and R-Charts, analysis of pattern on control charts, Type I and Type II errors, p chart, c chart construction. Simple Numerical Problems, revised control limits

Application:

Identify the assignable causes Quality control in manufacturing to control the processes

UNIT- IV

ACCEPTANCE SAMPLING: Fundamental concept in acceptance sampling, Need of acceptance sampling, operating characteristics curve. Producer risk and consumer risk in sampling plans. Acceptance plans, single sampling plan, double sampling plan –exercises.

Application: Selection of sampling plan to minimize risk in purchasing parts, components from the suppliers

UNIT- V

Quality Systems: The Concept of Six Sigma, Objectives of Six Sigma, The Frame-Work of Six Sigma Programme, Six Sigma Problem Solving Approach, The DMAIC Model: Cost of Poor Quality, Benefits and Costs of Six Sigma.

Need for ISO 9000 and Other Quality Systems, ISO 9000: 2000 Quality System – Elements, Implementation of Quality System, Documentation, Quality Auditing, QS 9000, ISO 14000 – Concept, Requirements and Benefits.

Case Studies of TQM projects and Six Sigma projects.

Application: Systems followed in manufacturing units for quality excellence

Text books:

1. Subburaj Ramaswamy, Total Quality Management, Tata Mcgraw Hill Publishing Company Ltd.
2. Statistical Quality Control, M.Mahajan, Dhanpat Rai Publishing Co Pvt Ltd

Reference Books:

1. Introduction to statistical quality control: By D.C. Montgomery, John Wiley & Sons Inc.
2. Forrest W. Breyfogle, Implementing Six Sigma, John Wiley & Sons, Inc.
3. Statistical Quality Control – R.C. Gupta– Khanna Publishers, Delhi
4. Grant, E.L. and LavenWorth, R.S.: Statistical Quality Control, McGraw Hill.
5. Evans, J R and W M Lindsay, An Introduction to Six Sigma and Process Improvement, Cengage Learning.

Web Source References:

1. [https://nptel.ac.in/courses/112/107/112107259/-](https://nptel.ac.in/courses/112/107/112107259/) Inspection and Quality control manufacturing.
 2. <https://nptel.ac.in/courses/110105039>
 3. <https://www.youtube.com/watch?v=qb3mvJ1gb9g>
 4. <https://nptel.ac.in/courses/110104085>
 5. https://onlinecourses.nptel.ac.in/noc20_mg19
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Course code	Course Title	L	T	P	Credits
R23MEC-OE0004	Hybrid Vehicle Technologies (Open Elective)	3	0	0	3

Course Objectives:

The course is intended to

- Familiarize the fundamentals of conventional and hybrid electric vehicle components.
- Understand the configurations and working of hybrid and electric drive-trains.
- Understand the architecture, operation and energy management of PHEVs
- Study and understand different power converters used in hybrid and electrical vehicles.
- Familiarize with different batteries and other energy storage systems.

Course outcomes:

After completion of the course, the student will be able to:

1. *Understand* the fundamentals of conventional and hybrid electric vehicle components.
2. *Describe* hybridization of power sources in hybrid electric vehicles.
3. *Apply* the principles of power management and fuel economy to optimize the PHEV performance
4. *Explain* the working principle of power electronics in hybrid vehicles.
5. *Describe* the different battery technologies and other energy storage systems.

UNIT-I:

Introduction: Fundamentals of vehicle, components of conventional vehicle and propulsion load, drive cycles and drive terrain; concept of electric vehicle and hybrid electric vehicle; history of hybrid vehicles, advantages and applications of electric and hybrid electric vehicles, different motors suitable for electric and hybrid electric vehicles.

UNIT-II:

Architectures of Hybrid, Plug-in Hybrid, Fuel Cell and Electric Vehicles

Hybrid Electric Drive-trains: Architectures of HEVs, Series and parallel HEVs complex HEVs. Plug-in hybrid vehicle, constituents of PHEV, comparison of HEV and PHEV- Fuel Cell vehicles and its constituents.

Electric Drive-trains: Basic concept of electric traction, introduction to various electric drive-train topologies, power flow control in electric drive-train topologies.

UNIT-III:

Plug-in Hybrid Electric Vehicle: PHEVs and EREVs blended PHEVs, PHEV Architectures, equivalent electric range of blended PHEVs; Fuel economy of PHEVs, power management of PHEVs, end-of-life battery for electric power grid support, vehicle to grid technology(V2G), PHEV battery charging.

Applications:

- Optimizing fuel economy by managing the switch between electric and combustion power in PHEVs.
- Using PHEV batteries to support the grid during peak demand through Vehicle-to-Grid (V2G) technology.

UNIT-IV:

Power Electronics in HEVs: Rectifiers used in HEVs, voltage ripples, Buck converter used in HEVs, non- isolated bidirectional DC-DC converter, voltage source inverter, current source inverter, isolated bidirectional DC-DC converter, PWM rectifier in HEVs, EV and PHEV battery chargers.

UNIT-V:

Battery and Storage Systems: Energy storage parameters; lead acid, li-ion and Ni-MH batteries, ultracapacitors, flywheels- superconducting magnetic storage system; pumped hydroelectric energy storage; compressed Air energy storage-storage heat; energy storage as an economic resource.

Applications:

- Battery selection in EVs: Selecting Li-ion or Ni-MH batteries for EVs based on battery cost and performance.

- Supporting the power grid with pumped hydro or compressed air energy storage systems.

Text Books:

1. Ali Emadi, Advanced Electric Drive Vehicles, 1st Edition, CRC Press.
2. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, 2nd Edition, CRC Press, 2010.

Reference Books:

1. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2009.
2. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003.
3. H.Partab: Modern Electric Traction-DhanpatRai &Co,2007.

Web link:

1. <https://archive.nptel.ac.in/courses/108/103/108103009/>
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Course code	Course Title	L	T	P	Credits
R23MEC-OE0005	Industrial Robotics (Open Elective)	3	0	0	3

Course Objectives:

The objectives of the course are

- To understand the Geometrical Configuration and Components of Industrial Robots (Anatomy)
- To analyze the factors influencing gripper selection and design.
- To grasp the concept of rotation matrices and their significance in robotics.
- To understand forward and inverse kinematics of robot manipulator
- To familiarize the students with the fundamentals of sensors and various drive systems.
- To develop Program Robot for applications in various fields.

Course Outcomes:

At the end of the course, the student will be able to

1. Understand the anatomy of robots including the components and structure. (L2)
2. Design the grippers considering grasping force, Engelberger-g-factors, and actuation mechanisms (L2)
3. Apply basic transformation and rotation matrices in robot kinematics (L3)
4. Explain the function of feedback components such as position sensors (potentiometers, resolvers, encoders) and velocity sensors. (L2)
5. Understand the use of robots in manufacturing, inspection and quality control applications. (L2)

Unit- I

Robotics: Introduction, classification with respect to geometrical configuration (Anatomy), Controlled system & chain type, Serial manipulator & Parallel Manipulator. Components of Industrial robotics, precession of movement, resolution, accuracy & repeatability,

Dynamic characteristics: speed of motion, load carrying capacity & speed of response, Sensors, Internal sensors: Position sensors, & Velocity sensors, External sensors: Proximity sensors, Tactile Sensors, & Force and Torque sensors.

Unit-II

Grippers & End effectors: Mechanical Gripper, Grasping force, Engelberger-g-factors, mechanisms for actuation, Magnetic gripper, vacuum cup gripper, considerations in gripper selection & design, specifications. Selection of gripper based on Application.

Applications:

1. Wall climbing robot
2. Vacuum cups

Unit- III

Motion Analysis:

Basic Rotation Matrices, Equivalent Axis and Angle, Euler Angles, Composite Rotation Matrices. Homogeneous transformations as applicable to rotation and translation.

Manipulator Kinematics- Assignment of frames, D-H Transformation Matrix, joint coordinates and world Coordinates, Forward and inverse kinematics.

Applications:

1. Robot trajectory generation by forward kinematics.
2. Welding robots by inverse kinematics by root multiplicity.

Unit-IV

Robot actuators and Feedback components: Actuators: Pneumatic, Hydraulic actuators, electric & stepper motors, comparison of Actuators, Feedback components: position sensors, potentiometers, resolvers, encoders, Velocity sensors, Tactile and Range sensors, Force and Torque sensors, End Effectors and Tools.

Applications:

1. Automated Assembly Lines in Automotive Manufacturing
2. Surgical Robotics (e.g., Da Vinci System)

Unit-V

Robot Programming & Applications: Material Transfer - Material handling, loading and unloading- Processing spot and continuous arc welding & spray-painting Assembly and Inspection. Robotic Programming Methods - Languages: Lead Through Programming, Textual Robotic Languages such as APT, MCL.

Applications:

1. Automated Car Body Assembly
2. Electronics Manufacturing (e.g., PCB Assembly)

Text Books

1. Industrial Robotics / Groover M P /Mc Graw Hill
2. Introduction to Robotics / John j.Craig / Pearson

References

1. Introduction to Industrial Robotics / Ramachandran Nagarajan / Pearson
2. Robot Dynamics and controls / Spony and Vidyasagar / John Wiley

Web Resources:

1. https://onlinecourses.nptel.ac.in/noc23_me143/preview
 2. https://www.youtube.com/results?search_query=1.%09Robotics+Programming+in+Just+30+Days!+%7C+Industrial+Robotics+Programming+in+Bangalore+%7C+RVM+CAD
 3. <https://www.youtube.com/watch?v=QiFbrmJTib4&t=11s>
 4. https://www.youtube.com/watch?v=hL_GKapQd1k
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Course code	Course Title	L	T	P	Credits
R23MEC-OE0006	Nano Materials (Open Elective)	3	0	0	3

Course objectives:

The objectives of the course are

- To understand the nano-structured materials and their applications.
- To learn about the nano-crystalline materials, their properties and defects.
- To understand various techniques of nanofabrication.
- To identify the tools to characterize nano materials.
- To analyze the applications of nano materials.

Course Outcomes:

At the end of the course, the student will be able to

1. **Explain** nano-structured materials and their applications (L2)
2. **Apply** knowledge about the nano-crystalline materials, their properties and defects (L3)
3. **Demonstrate** various techniques of nanofabrication (L2)
4. **Apply** the tools to characterize nano materials (L3)
5. **Analyze** the applications of nano materials (L4)

UNIT-I

Introduction to Nanomaterials: History and Scope, Classification of Nano structured Materials, Distinction between nanomaterials and bulk materials, Classification of nanomaterials: 0D, 1D, 2D, 3D, Fascinating Nanostructures, and applications of nanomaterials, challenges and future prospects.

Learning outcomes:

At the end of this unit students will be able to:

1. **Understand** the fundamental concepts of nanomaterials and how they differ from bulk materials (L2)
2. **Identify** and describe various nanostructures (0D, 1D, 2D, 3D) and their unique properties at the nanoscale (L2)

Application:

Semiconductors , Nano sensors, Memory storage devices, Hydrogen fuel cells.

UNIT-II

Properties Of Nano Materials: Microstructure and Defects in Nano crystalline Materials: Dislocations, Twins, stacking faults and voids, Grain Boundaries, triple and declinations. Effect of Nano-dimensions on Materials Behaviour: Elastic properties, Melting Point, Diffusivity, Grain growth characteristics, enhanced solid solubility. Magnetic Properties: Soft magnetic nanocrystalline alloy, Permanent magnetic nanocrystalline materials, Giant Magnetic Resonance, Electrical Properties, Optical Properties, Thermal Properties and Mechanical Properties.

Application: high-density data storage and magnetic sensors

UNIT-III

Manufacturing Methods: Bottom-up approaches: Physical Vapour Deposition, Inert Gas Condensation, Laser Ablation, Chemical Vapour Deposition, Molecular Beam Epitaxy, Sol-gel method, Self-assembly. Top-down approaches: Mechanical alloying, Nano-lithography. Consolidation of Nano powders: Shock wave consolidation, Hot isostatic pressing, Cold isostatic pressing, Spark plasma sintering.

Application:

Bulk nanostructured alloys for aerospace and automotive applications

UNIT-IV

Characterization of Nanomaterials: X-Ray Diffraction (XRD), Small Angle X-ray scattering, Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), Atomic Force Microscopy (AFM), Scanning Tunneling Microscope (STM), Field Ion Microscope (FIM), Three-dimensional Atom Probe, Nano indentation.

Application:

Measures the hardness and elastic modulus of individual nanoparticles

UNIT-V

Applications of Nano Materials: Nano-electronics, Micro- and Nano electromechanical systems (MEMS/NEMS), Nano sensors, Nano catalysts, Food and Agricultural Industry, Cosmetic and Consumer Goods, Structure and Engineering, Automotive Industry, Water Treatment and the environment, Nano-medical applications, Textiles, Paints, Energy, Defense and Space Applications, Concerns and challenges of Nanotechnology.

Application:

Solar cells, Batteries and water purification systems

Textbooks

1. Charles. P. Poole Jr & Frank J. Owens, Introduction to Nanotechnology, Wiley-Inter science.
2. A.K. Bandyopadhyay, Nano Materials, New Age International Pvt Ltd Publishers.
3. T. Pradeep, Nano: The Essentials, McGraw Hill Education.

References

1. S.O. Pillai, Solid State Physics, New Age International Private Limited.
2. Charles Kittel, Introduction to solid state physics, Wiley & Sons (Asia) Pvt Ltd.

Web Sources References:

1. <https://www.youtube.com/watch?v=oN1I09LpygE&list=PLMlC7Vx5awsenMs5y02xcW6i5NmdEIRGx&index=2>
 2. <https://www.youtube.com/watch?v=jryDvx7VNxw&list=PLyqSpQzTE6M8682dGkNTN8936vSY4CbqZ&index=15>
 3. https://www.youtube.com/watch?v=mva_njonj2Y&list=PLbMVogVj5nJTdeiLvuGSB_AE8hloTAHWJ&index=3
 4. <https://www.youtube.com/watch?v=JffF6AqWCHE>
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Course code	Course Title	L	T	P	Credits
R23MEC-OE0007	AI and ML In Manufacturing (Open Elective)	3	0	0	3

Course Objectives:

The main objectives of this course are to:

- Introduce the fundamentals of Artificial Intelligence (AI) and its relevance to modern manufacturing systems.
- Enable students to understand and apply AI techniques like Machine Learning, Expert Systems, and Fuzzy Logic in industrial scenarios.
- Familiarize students with AI applications in predictive maintenance, quality control, process optimization, and robotics.
- Develop the ability to analyze manufacturing data using AI-based decision-making tools.
- Encourage innovation in smart manufacturing by integrating AI with Industry 4.0 technologies.

Course Outcomes:

After completing this course, the students will be able to:

1. Explain the role and benefits of Artificial Intelligence in modern manufacturing and Industry 4.0. (L2)
2. Apply machine learning algorithms to real-world problems like fault detection and predictive maintenance in manufacturing. (L3)
3. Develop expert systems to support manufacturing decision-making and diagnostics. (L6)
4. Analyze and implement fuzzy logic and neural network models for manufacturing process control. (L4)
5. Evaluate advanced AI applications in smart robotics, digital twins, and AI-driven production systems. (L5)

UNIT I:

Introduction to AI in Manufacturing: Definition and scope of AI in engineering, Evolution of AI and its relationship with automation, Traditional automation vs. AI-based decision-making, Role of AI in Industry 4.0 and Smart Factories, Cyber-Physical Systems (CPS) and AI, Benefits and limitations of AI in manufacturing, Case studies: AI in production lines, real-time process control

UNIT II:

Machine Learning for Manufacturing Systems: Overview of ML algorithms and relevance to manufacturing, Supervised, unsupervised, and reinforcement learning, Classification (SVM, Decision Trees, k-NN) and Regression models, Clustering techniques (K-means, Hierarchical) for pattern detection, Feature engineering and preprocessing of sensor data, Predictive maintenance using historical data, Intro to deep learning: CNN and RNN applications in fault detection, Tools: Python, Scikit-learn, TensorFlow, MATLAB

UNIT III:

Expert Systems and Knowledge Representation: Components of an expert system: knowledge base, inference engine, user interface, Rule-based reasoning and IF-THEN rule chaining, Certainty factors and decision trees, Knowledge acquisition methods: interviews, machine learning, simulations, Semantic networks, ontologies, and frames, AI-based troubleshooting and fault diagnostic systems, Case study: Expert systems in CNC, PLCs, and maintenance management

UNIT IV:

Fuzzy Logic and Neural Networks in Manufacturing : Fundamentals of fuzzy logic and fuzzy inference systems, Designing fuzzy rule-based controllers, Integration of fuzzy logic with PLCs and SCADA, Neural networks: architecture, activation functions, training algorithms, Backpropagation and real-time adaptation, Process optimization using neural networks and fuzzy hybrid models, Applications: welding control, casting defect prediction, tool wear monitoring

UNIT V:

AI Applications in Smart Manufacturing: Intelligent robotics and AI-based path planning, Machine vision systems and defect detection, Digital twins and virtual commissioning, AI in production planning and real-time scheduling, Role of AI in quality assurance and adaptive control, AI in smart inventory management and logistics, Ethical implications and challenges in AI implementation, Case studies: AI in aerospace, automotive, and healthcare manufacturing

Textbooks:

1. **Russell, Stuart J., and Peter Norvig**, *Artificial Intelligence: A Modern Approach*, Pearson Education, 3rd Edition, 2019.
2. **Dan W. Patterson**, *Introduction to Artificial Intelligence and Expert Systems*, PHI Learning, 2009.
3. **M. Gopal**, *Applied Machine Learning*, McGraw-Hill Education, 2018.
4. **Ramesh Babu**, *Artificial Intelligence in Mechanical and Industrial Engineering*, SciTech Publications, 2022 (Indian Author)

Reference Books:

1. **V.S. Janakiraman, K. Sarukesi, P. Gopalakrishnan**, *Foundations of AI and Expert Systems*, Macmillan India, 2019 (Indian Author)
2. **David Forsyth**, *Applied Machine Learning*, Springer, 2019.
3. **Donald A. Waterman**, *A Guide to Expert Systems*, Pearson, 2018.
4. **S. N. Sivanandam**, *Principles of Soft Computing*, Wiley India, 2nd Edition, 2011 (covers fuzzy logic and neural networks)

Online Resources:

Coursera – AI for Everyone (by Andrew Ng)

<https://www.coursera.org/learn/ai-for-everyone>

edX – Artificial Intelligence in Manufacturing (by RWTH Aachen University)

<https://www.edx.org>

MIT OpenCourseWare – Artificial Intelligence

<https://ocw.mit.edu>

Google AI – Research and Tools

<https://ai.google>

YouTube – AI in Industry by Analytics Vidhya / Siemens

<https://www.youtube.com>

Course code	Course Title	L	T	P	Credits
R23MEC-OE0008	Automation in Manufacturing (Open Elective)	3	0	0	3

Course Objectives:

The main objectives of this course are to:

- Understand the concept of automation and process control systems.
- Classify the automated flow lines and analyze automated flow lines
- Able to balance the operations on assembly line.
- Design automated material handling systems.
- Understand the level of automation in continuous and discrete manufacturing systems.

Course Outcomes:

1. **Understand** the characteristics of Automated Systems. (L2)
2. **Illustrate** operational aspects of flow lines.(L2)
3. **apply** the methods to balance the assembly line(L3)
4. **Compare** conventional and automated material transport, storage system.(L2)
5. **Explain** the level of automation in continuous and discrete manufacturing industries.(L2)

Unit-I

Introduction To Automation: Automated Manufacturing Systems, Computerized Manufacturing Support Systems, Reasons for Automation, Automation Principles and Strategies, levels of automation, Basic elements of an automated system, Types of production, pneumatic and hydraulic components, circuits, automation in foundry industries, automation in machine tools, mechanical feeding and tool changing and machine tool control. Economical and technological factors for automation. Barriers of automation in manufacturing industries.

Applications:

- Automated Material Handling System in Manufacturing
- Automation in Machine Tools for Precision Manufacturing

Unit-II

Automated Flow Lines: Methods of part transport, transfer mechanism, buffer storage, control function, design and fabrication considerations. Analysis of automated flow lines - General terminology and analysis of transfer lines without and with buffer storage, partial automation, implementation of automated flow lines.

Applications:

- Automated Conveyor Systems in Assembly Lines
- Buffer Storage in Automotive Manufacturing

Unit-III

Assembly Line Balancing: Assembly process and systems, assembly line, line balancing methods, ways of improving line balance, flexible assembly lines.

FMS: Types of FMS, components of FMS, Types of flexibility, types of FMS layouts, applications, scope for FMS in manufacturing today, group technology, hierarchy of computer control in FMS, economic justification of FMS planning, scheduling and control of FMS

Applications:

- Optimized Assembly Line Balancing in Electronics Manufacturing
- Flexible Manufacturing Systems (FMS) in Automotive Production

Unit-IV

Material Handling Systems: Introduction to Material Handling, Basic Principles, Material Transport equipment, analysis of material transport systems, Automated Guided Vehicle Systems, Generalized Theories Governing the Mechanical Design Parameters of Handling Systems storage systems–storage system performance and location strategies, Conventional storage methods and equipment, Automated Storage and Retrieval System (ASRS) and Its Types, Applications of ASRS,Engineering analysis of storage systems. ASRS and Industry 4.0

Automatic Identification Methods: Overview of Identification Methods, Barcode technology, Radio frequency identification, other AIDC technologies, benefits of AIDC.

Applications:

- Automated Storage and Retrieval System (ASRS) in Warehousing
- Radio Frequency Identification (RFID) in Supply Chain Management

Unit-V

Industrial Control Systems: Process industries Vs Discrete manufacturing industries, levels of automation in the two industries, variables and parameters in the two industries. Continuous Vs Discrete control –continuous control system, discrete control system.

Automated Inspection And Assembly: Fundamentals, inspection principles, types of inspection methods and equipment, Quality function deployment, Coordinate Measuring Machines, Machine Vision, Automated Assembly Systems, Design for Automated Assembly, and Quantitative Analysis of Assembly Systems, Multi- Station Assembly Machines, Single Station Assembly Machines.

Applications:

- Industrial Control Systems in Chemical Processing Plants
- Machine Vision-Based Automated Inspection in Automotive Manufacturing

Text Books:

1. M.P. Groover, Automation, Production systems and Computer Integrated Manufacturing, 3/e, PHI
2. Learning.
3. Geoffrey Boothroyd, Assembly Automation and Product design, Taylor and Francis Publishers.

Reference Books:

1. Krishna Kant, Computer based industrial control, Prentice Hall of India.
 2. Tiess Chiu chang and A. W. Richard, An introduction to automated process planning systems, Tata Mc Graw Hill.
 3. Mikell P. Groover and Mitchell Weiss, Roger N. Nagel, Nicholas, G. Odrey, IndustrialRobotics, McGraw Hill.
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Course Code	Subject Name	L	T	P	C
R23CSE-OE0001	PYTHON PROGRAMMING	3	0	0	3

Course Objectives:

- Understand the structure and data types of Python script.
- Implement iterations and functions in Python.
- Implement modules and understand packages.
- Implement data structures using mutable & immutable objects.
- Understand object-oriented concepts and Exception handling.

Course Outcomes:

- Implement Basic Python programming Fundamentals for Computation of Expression [L3]
- Apply Iterators and functions in data processing.[L3]
- Understand modules and packages to leverage powerful libraries for data science tasks.[L2]
- Implement sequences and data structures for data organization.[L3]
- Implement object-oriented principles in Python, handling run-time errors.[L3]

Unit I:

Hours:10

Introduction: History of Python, Features of Python, Applications, Python Using the REPL (Shell), Running Python Scripts, Variables, Assignment forms, Keywords, Input-Output, Indentation.

Operators and Type Conversion: Data Types: Numeric, Booleans, Sequence, Strings, Type Conversions, Operators, Operator Precedence, Evaluation of Expressions.

Learning Outcomes: After completing this chapter, students will be able to

- Understand the environment of Python. (L2)
- Write and run simple scripts in Python. (L3)
- Implement Type conversion techniques. (L3)

Unit II:

Hours:10

Control Flow: Conditional statements (if, else, elif), Looping structures (for, while, for-else, while-else) Transfer Control Statements: break, continue, pass.

Functions: Defining Functions, Calling Functions, Types of Arguments: Keyword Arguments, Default Arguments, Variable-length arguments, Fruitful Functions (Function Returning Values), Scope of the Variables in a Function - Global and Local Variables, Anonymous Functions, Lambda, map, reduce and filter.

Learning Outcomes: After completing this chapter, students will be able to

- Understand the iterations using looping structures.(L2)
- Implement Python functions.(L3)

Unit III:**Hours:9**

Modules: Creating modules, import statement, from import statement, namespace, built-in modules- OS, random, Math, JSON, request, date, RegEx, itertools

Packages: Introduction to PIP, Installing packages using PIP.

Exploring Data Science Libraries: NumPy, Pandas, Data visualization: Matplotlib

Learning Outcomes: After completing this chapter, student will be able to

- Understand modules (L2)
- Understand data science libraries.(L2)

Unit IV:**Hours:10**

Strings & Data Structures: String, String Formatting, List, String and List Slicing, Tuple, Sets, Frozen Sets, Dictionaries, Comprehensions, Built-in methods of all sequences, File Handling: Reading and writing files, File modes and file objects

Learning Outcomes: After completing this chapter, student will be able to

- Implement different data structures in Python.(L3)
- Understand different file handling Operations.(L2)

Unit V:**Hours:09**

Object Oriented Programming OOP in Python: Classes, 'self- variable', Methods, Constructor, Inheritance, Polymorphism, and Data Abstraction.

Errors and Exceptions: Syntax Errors, Exceptions, Exception Handlers, Raising Exceptions, User-defined Exceptions.

Learning Outcomes: After completing this chapter, student will be able to

- Understand Object oriented concepts with real world scenarios.(L2)
- Implement exceptions in Python.(L3)

TEXT BOOKS:

1. Let Us Python by Yashavant Kanetkar ,Aditya Kanetkar ,6th edition, BPB Publication
2. Python Programming: Using Problem Solving Approach by Reema Theraja, 2nd edition, Oxford publications.

REFERENCE BOOKS:

1. Python Programming: A Modern Approach, Vamsi Kurama, Pearson.
2. Learning Python, Mark Lutz, Orielly.
3. Python Programming, S Sridhar, J Indumathi, V M Hariharan, 2nd Edition, Pearson, 2024

COURSE OUTCOMES VS POs MAPPING (DETAILED; HIGH:3; MEDIUM:2; LOW:1):

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
	3	2	2	2	3				3			1	2	3	3
	3	3	2	2	3				3			1	2	3	3
	3	3	2	2	3				3			1	2	3	3
	3	3	3	2	3				3			1	2	3	3
	3	3	3	3	3				3			1	2	2	3
	3	3	3	2	3				3			1	2	3	3

* For Entire Course, PO & PSO Mapping

Course Code	Subject Name	L	T	P	C
R23CSE-OE0002	DATA STRUCTURES USING C	3	0	0	3

Course Objectives:

1. To teach efficient storage mechanisms of data for an easy access.
2. To develop application using data structures.
3. To improve the logical ability

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

1. Compare the performances of various Searching and Sorting techniques in terms of time and space complexities.
2. Illustrate the applications of Stacks.
3. Implement various types of Queues and their efficient operations.
4. Demonstrate the advantages of dynamic memory allocation via linked lists.
5. Implement the basic operations, search and traversals on Trees.

UNIT-I

Time and space complexity, Data Structures – Introduction to Data Structures, abstract data types, Searching and Sorting – Sorting- selection sort, bubble sort, insertion sort, quick sort, merge sort, shell sort, radix sort, Searching-linear and binary search methods, comparison of sorting and searching methods.

UNIT –II

Linear list – singly linked list implementation, insertion, deletion and searching operations on linear list, circular linked list implementation, Double linked list implementation, insertion, deletion and searching operations. Applications of linked lists.

UNIT-III

Stacks-Operations, array and linked representations of stacks, stack applications -infix to postfix conversion, postfix expression evaluation, recursion implementation.

UNIT-IV

Queues-operations, array, and linked representations. Circular Queue operations, Dequeues, applications of queues.

UNIT-V

Trees – Definitions, tree representation, properties of trees, Binary tree, Binary tree representation, binary tree properties, binary tree traversals, binary tree implementation, applications of trees.

Text Books:

1. Fundamentals of Data structures in C, 2nd Edition, E.Horowitz, S.Sahniand Susan Anderson-Freed, Universities Press, 2008.
2. Data structures A Programming Approach with C, 2nd Edition D.S.Kushwaha and A.K.Misra, PHI, 2007.

References:

1. Data structures: A Pseudocode Approach with C, 2nd edition, R.F.GilbergAndB.A.Forouzan, CengageLearning.
2. Data structures and Algorithm Analysis in C, 2nd edition, M.A.Weiss, Pearson.
3. Data Structures using C& C ++,2nd Edition A.M.Tanenbaum,Y. Langsam, M.J.Augenstein, Pearson.
4. Data structures and Program Design in C, 2nd edition, R.Kruse, C.L.TondoandB.Leung,Pearson

Course Code	Subject Name	L	T	P	C
R23CSE-OE0003	OPERATING SYSTEM CONCEPTS	3	0	0	3

Course Objectives

1. Provide knowledge about the services rendered by operating systems.
2. Present detail discussion on processes, threads and scheduling algorithms.
3. Discuss various file-system implementation issues and memory management techniques.

Course Outcomes:

1. Understand the importance of operating systems and different types of system calls.
2. Analyze the communication between processes and various process scheduling algorithms.
3. Understand the process synchronization, different ways for deadlocks handling.
4. Analyze various memory mapping techniques and different page replacement methods.
5. Evaluate various file allocation and disk scheduling algorithms.

UNIT-I: Operating Systems Overview:

Introduction: what is an operating system, Types of operating systems, operating systems concepts, operating systems services, Introduction to System call, System call types, Operating System Generation.

UNIT-II: Process Management:

Process concept: Process Concept, Process Scheduling, Operations on Processes, Inter process Communication.

Multithreaded Programming: Overview, Multithreading models, Threading Issues.

Process scheduling: Basic Concepts, Scheduling Criteria, Scheduling Algorithms.

UNIT-III: Synchronization:

Process Synchronization: The Critical-Section Problem, Synchronization Hardware, Semaphores, Classic Problems of Synchronization, Monitors, Synchronization examples.

Principles of deadlock – System Model, Deadlock Characterization, Deadlock Prevention, Detection and Avoidance, Recovery from Deadlock.

UNIT-IV: Memory Management:

Memory Management strategies: Swapping, Contiguous Memory Allocation, Segmentation, Paging, Structure of the Page Table.

Virtual Memory Management: Virtual Memory, Demand Paging, Page-Replacement Algorithms, Thrashing.

UNIT-V: File system Interface- The concept of a file, Access Methods, Directory and Disk structure, File system mounting.

File System implementation: File system structure, allocation methods, free-space management.

Mass-storage structure: Overview of Mass-storage structure, Disk scheduling, Device drivers.

Text Books:

1. Silberschatz A, Galvin P B, and Gagne G, Operating System Concepts, 10th edition, Wiley, 2013.
2. Tanenbaum A S, Modern Operating Systems, 4th edition, Pearson Education, 2008.
(for Interprocess Communication and File systems).

References:

- i. Tanenbaum A S, Woodhull A S, Operating Systems Design and Implementation, 3rd edition, PHI, 2006.
- ii. Dhamdhare D M, Operating Systems A Concept Based Approach, 3rd edition, Tata McGraw-Hill, 2012.
- iii. Stallings W, Operating Systems -Internals and Design Principles, 6th edition, Pearson Education, 2009.
- iv. Nutt G, Operating Systems, 3rd edition, Pearson Education, 2004.

Course Code	Subject Name	L	T	P	C
R23CSE-OE0004	INTRODUCTION TO JAVA PROGRAMMING	3	0	0	3

Course Objectives

1. Understand the structure and environment of Java.
2. Implement the relationship between objects.
3. Understand the Strings and Organize data using different data
4. Implement text processes and error handling.
5. Understand to create multi threading applications and GUI applications.

Course Outcomes:

1. Understand the environment of JRE and Control Statements. (L2)
2. Implement real world objects using class Hierarchy (L3)
3. Implement generic data structures for iterating distinct objects (L3)
4. Implement error handling through exceptions and file handling through streams. (L3)
5. Design thread-safe GUI applications for data communication between objects (L4)

Unit I: Java Environment and Program Structure (10 Hours)

History of Java, Features, Applications, Java Installation - JDK and JRE, JVM Architecture, OOPS Principles, Class and Object, Naming Convention, Data Types, Type Casting, Type Conversion, Wrapper classes, Operators, instance of operator, Command Line Arguments, Decision making, Arrays, and Looping statements.

Learning Outcomes: Student will be able to

1. Understand architecture of Java Virtual Machine. (L2)
2. Understand the structure of java program and its environment. (L2)

Unit II: Class Hierarchy & Data Hiding (10 Hours)

Property, Method, Constructor, Inheritance (IS-A) , Aggregation and Composition (HAS-A), this and super, static and initialize blocks, Method overloading and overriding, static and final keywords, Types of Inheritance, Compile time and Runtime Polymorphism, Access Specifiers and scope, packages and access modifiers, Abstract class, Interface, Interface Inheritance, Achieving Multiple Inheritance, Class casting, Object Cloning, Inner Classes.

Learning Outcomes: Student will be able to

1. Understand the class hierarchy and their scope. (L2)
2. Implement relationship between objects. (L3)
3. Understand data hiding and nested classes. (L2)
4. Implement data type casting and cloning of objects. (L3)

Unit III: Strings and Collections (10 Hours)

String: Methods, StringBuffer and StringBuilder, StringTokenizer

Collections: Exploring java.util.*, Scanner, Iterable, Collection Hierarchy, Set, List, Queue and Map, Comparable and Comparator, Iterators: foreach, Enumeration, Iterator and ListIterator.

Learning Outcomes: Student will be able to

1. Understand the usage of String and its properties and methods.(L2)
2. Understand data structures and Iterators. (L2)
3. Create the data structures and implement different utility classes. (L3)

Unit IV: IO and Error Handling (10 Hours)

IO Streams: Exploring java.io.*, Character and Byte Streams, Reading and Writing, Serialization and De-serialization, Error Handling: Error vs Exception, Exception hierarchy, Types of Exception, Exception handlers, User defined exception, Exception propagation.

Learning Outcomes: Student will be able to

1. Understand character and byte streams. (L2)
2. Understand the hierarchy of errors and exceptions. (L2)
3. Implement data streams and exception handlers. (L3)

Unit V: Threads and GUI (8 Hours)

Multi-Threading: Process vs Thread, Thread Life Cycle, Thread class and Runnable Interface, Thread synchronization and communication.

GUI: Component, Container, Applet, Applet Life Cycle, Event delegation model, Layouts, Menu, MenuBar, MenuItem.

Learning Outcomes: Student will be able to

1. Understand the Thread Life Cycle and its scheduling.(L2)
2. Implement the synchronization of threads. (L2)

TEXT BOOKS:

1. The complete Reference Java, 8th edition, Herbert Schildt, TMH.
2. Programming in JAVA, Sachin Malhotra, SaurabhChoudary, Oxford.
3. Introduction to java programming, 7th edition by Y Daniel Liang, Pearson.
4. Java: How to Program, 9th Edition (Deitel) 9th Edition.
5. Core Java: An Integrated Approach, Java 8 by R. Nageswara Rao.

REFERENCE BOOKS:

1. Swing: Introduction, JFrame, JApplet, JPanel, Componets in Swings, Layout Managers
2. Swings, JList and JScrollPane, Split Pane, JTabbedPane, JTree, JTable, Dialog Box.

Weblinks:

1. <https://www.javapoint.com/>
2. <https://www.sitesbay.com/java/index>
3. <https://www.tutorialspoint.com/java/index.htm>
4. <https://www.w3schools.com/java/>
5. <https://www.programiz.com/java-programming>

COURSE OUTCOMES VS POs MAPPING (DETAILED; HIGH: 3; MEDIUM: 2; LOW: 1):

SNO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	3	3	2	1	2				1			1	3	1	2
CO2	3	3	2	2	2				2			1	3	1	2
CO3	3	3	2	1	2				2			1	3	1	2
CO4	3	3	2	1	2				2			1	3	1	2
CO5	3	3	2	1	2				2			1	3	1	2

Subject Code	Subject Name	L	T	P	C
R23CSE-OE0005	DATA BASE MANAGEMENT SYSTEMS CONCEPTS	3	0	0	3

Course Objectives:

1. Train in the fundamental concepts of database management systems, database modeling and design, SQL, PL/SQL, and System implementation techniques.
2. Enable students to model ER diagram for any customized applications.
3. To learn the principles of systematically designing and using large scale Database Management Systems for various applications.

Course Outcomes:

1. Understand the usage of Key Constraints on Database.
2. Describe ER model and normalization for database design.
3. Create, maintain, and manipulate a relational database using SQL.
4. Understand efficient data storage and retrieval mechanism, recovery techniques.
5. Design and build database system for a given real world problem.

UNIT-I:

An Overview of Database Management: Introduction- Importance of Database System, Data Independence- Relation Systems and Others- Summary, Database system architecture, Introduction- The Three Levels of Architecture-The External Level- the Conceptual Level- the Internal Level- Mapping- the Database Administrator-The Database Management Systems- Client/Server Architecture.

UNIT-II:

The E/R Models: The Relational Model, Relational Calculus, Introduction to Database Design, Database Design and ER Diagrams-Entities Attributes, Entity Sets-Relationship and Relationship Sets-Conceptual Design with the ER Models.

The Relational Model: Integrity Constraints Over Relations- Key Constraints –Foreign Key Constraints-General Constraints, Relational Algebra and Calculus, Relational Algebra- Selection and Projection- Set Operation, Renaming – Joins- Division- More Examples of Queries, Relational Calculus - Tuple Relational Calculus, Domain Relational Calculus.

UNIT-III:

Queries, Constraints, Triggers: The Form of Basic SQL Query, Union, Intersect, and Except, Nested Queries, Aggregate Operators, Null Values, Complex Integrity Constraints in SQL, Triggers and ActiveDatabase.

Schema Refinement (Normalization) : Purpose of Normalization or Schema Refinement, Concept of Functional Dependency, Normal Forms Based on Functional Dependency(1NF, 2NF and 3 NF), Concept of Surrogate Key, Boyce-Codd Normal Form(BCNF), Lossless Join and Dependency Preserving Decomposition, Fourth Normal Form(4NF).

UNIT-IV:

Transaction Management and Concurrency Control:

Transaction, Properties of Transactions, Transaction Log, Transaction Management with SQL using Commit Rollback and Save Point, Concurrency Control for Lost Updates, Uncommitted Data, Inconsistent Retrievals, and the Scheduler.

Concurrency Control with Locking Methods: Lock Granularity, Lock Types, Two Phase Locking For Ensuring Serializability, Deadlocks, Concurrency Control with Time Stamp Ordering: Wait/Die and Wound/Wait Schemes, Database Recovery Management : Transaction Recovery.

UNIT-V:

Overview of Storages and Indexing: Data on External Storage- File Organization and Indexing – Clustered Indexing – Primary and Secondary Indexes, Index Data Structures, Hash-Based Indexing – Tree- Based Indexing, Comparison of File Organization.

Text Books:

1. Introduction to Database Systems, 8th Edition CJ Date, Pearson, 2004.
2. Data base Management Systems, Raghurama Krishnan, Johannes Gehrke, TATA McGraw Hill 3rd Edition.

References Books:

1. Data base Systems design, Implementation, and Management, Peter Rob & Carlos Coronel 13th Edition.
2. Fundamentals of Database Systems, 7th Edition Elmasri Navrate Pearson Education.
3. Database Systems - The Complete Book, 2nd edition H G Molina, J D Ullman, J Widom Pearson.
4. Data base System Concepts, 7th edition, Silberschatz, Korth, McGraw Hill (TMH).

Subject Code	Subject Name	L	T	P	C
R23CSE-OE0006	UNIX and Shell Programming	3	0	0	3

Course Objectives:

- To provide an overview of the history, development, and significance of UNIX/Linux in computing.
- To provide skills in diagnosing common problems, log analysis, and troubleshooting techniques in a UNIX/Linux environment.
- To provide an overview of system administration tasks such as user management, backup and restore, system monitoring, and software installation.
- To explain file systems, mounting, disk usage, file permissions (chmod), and file attributes (chown).

Course Outcomes:

- Understand the architecture and features of UNIX. (L2)
- Apply the commands for implementation of the File System. (L3)
- Understand the Streams, Pipes and Filters. (L2)
- Apply the pattern reorganization commands and scripting concepts. (L3)
- Implementation of system calls for file system. (L3)

Unit 1 (10 Hours)

Introduction to Unix:

Introduction to Unix-Brief History-What is Unix-Unix Components-Using Unix-Commands in Unix-Some Basic Commands-Command Substitution-Giving Multiple Commands.

Learning Outcomes: Student will be able to

- Understand the origins and development of Unix. (L2)
- Learn the key milestones in the evolution of Unix (L3)
- Learn how to use command substitution to streamline tasks. (L3)

Unit 2 (8 Hours)

Unix Utilities:

Introduction to Unix file system, vi editor, file handling utilities, security by file permissions, process utilities, disk utilities, networking commands, unlink, du, df, mount, unmount, find, unmask, ulimit, ps, w, finger, Arp, ftp, telnet, rlogin. Text processing utilities and backup utilities , detailed commands to be covered are tail, head , sort, nl, uniq, grep, egrep, fgrep, cut, paste, join, tee, pg, comm, cmp, diff, tr, awk, cpio

Learning Outcomes: Student will be able to

1. Learn the organization and layout of the Unix directory hierarchy. (L2)

2. File Attributes and Permissions: Understand the various file attributes and how permissions work. (L2)

Unit 3 (10 Hours)

Introduction to Shells:

Using the Shell-Command Line Structure-Met characters- Creating New Commands-Command Arguments and Parameters-Program Output as Arguments-Shell Variables- -More on I/O Redirection- Looping in Shell Programs.

Filters:

Filters and Pipes, Concatenating files, Display Beginning and End of files, Cut and Paste, Sorting, Translating Characters, Files with Duplicate Lines, Count characters, Words or Lines, Comparing Files.

Learning Outcomes: Student will be able to

1. Understand the role and management of variables in the Unix shell. (L2)
2. Gain advanced knowledge of input/output redirection in Unix. (L3)
3. Learn how to implement loops in shell scripts. (L3)

Unit 4 (12 Hours)

Grep: Operation, grep Family, Searching for File Content.

Sed:Scripts, Operation, Addresses, commands, Applications, grep and sed.

Shell Programming:

Basic Script concepts, Expressions, Decisions: Making Selections, Repetition, special Parameters and Variables, changing Positional Parameters, Argument Validation, Debugging Scripts, Script Examples.

Learning Outcomes: Student will be able to

1. Understand the basics of awk for pattern scanning and text processing (L2)
2. Learn best practices for creating and using effective filters and well-structured files in Unix. (L3)

Unit 5 (8 Hours)

File Management:

File Structures, System Calls for File Management – create, open, close, read, write, lseek, link, symlink, unlink, stat, fstat, lstat, chmod, chown, Directory API – opendir, readdir, closedir, mkdir, rmdir, umask.

Learning Outcomes: Student will be able to

1. Learn how to change file ownership using the chown command.(L2)
2. Understand how to change the group ownership of a file using the chgrp command.(L2)

TEXT BOOKS:

1. Unix and shell Programming Behrouz A. Forouzan, Richard F. Gilberg.Thomson
2. Your Unix the ultimate guide, Sumitabha Das, TMH. 2nd Edition.

REFERENCE BOOKS:

- Unix for programmers and users, 3rd edition, Graham Glass, King Ables, Pearson Education.
- Unix programming environment, Kernighan and Pike, PHI. / Pearson Education.
- The CompleteReference Unix, Rosen, Host, Klee, Farber, Rosinski, Second Edition, TMH.

COURSE OUTCOMES VS POs MAPPING (DETAILED; HIGH: 3; MEDIUM: 2; LOW: 1):

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	3				1		1	1	2	3	3
CO2	3	2	2	1	3				1		1	1	2	3	3
CO3	3	3	3	2	3				1		1	2	3	3	3
CO4	3	3	3	2	3				2		1	2	3	3	3
CO5	2	2	2	2	2				2		1	1	2	2	2

Subject Code	Subject Name	L	T	P	C
R23CSE-OE0007	SOFTWARE ENGINEERING	3	0	0	3

Course Objectives:

1. Explain the phases of Software Development.
2. Teach the customer requirement gathering techniques.
3. Teach Software Design techniques
4. Demonstrate coding standards
5. Apply the testing techniques on software

Course Outcomes:

Students will be able to:

1. Understand the need of Software Life Cycle Models (L1)
2. Demonstrate the Requirements of the Software Systems process (L2)
3. Summarize the system models of software engineering (L2)
4. Choose appropriate software architecture style for real-time software projects (L3)
5. Analyze various testing techniques, Risk management and Software quality of the software products(L4)

UNIT-1

Introduction: Introduction to Software Engineering, Evolving role of Software, Software Crisis, Changing Nature of Software, Software myths, Process Models for Software Development, Waterfall, prototyping Evolutionary models: Incremental model, Spiral model, Agile developmental process.

Learning Outcomes:

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

1. List the steps involved in software development. (L1)
2. Explain myths of software. (L2)
3. Apply various software process models (L3)

UNIT-2

Software Requirements Engineering: Functional & Non-functional requirements, Feasibility studies, Requirements Elicitation and Analysis, requirements validation, Software Requirements Specification, Process and System Models, context models, behavioural model, Data model.

Learning Outcomes:

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

1. Explain software development model (L2)
2. Define functional and non-functional requirements for software development (L1)
3. Analyse user requirements for a software(L4)

UNIT-3

Design Engineering: Design concepts, data design, software architecture, Architectural styles and patterns, User interface design - Golden rules, User interface analysis and design, Effective Modular Design.

Learning Outcomes:

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

1. List the software architecture style for the given problem. (L1)
2. Build Golden rules for the given problem (L3)
3. User Interface Analysis and Design (L5)

UNIT-4

Coding&Testing: Coding standards, code review and verification, Testing levels: Unit testing, integration testing, system testing . alpha and beta testing, black box and white box testing, debugging.

Learning Outcomes:

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

1. Implementation of coding standards(L6)
2. Apply different Testing concepts (L3)

UNIT-5

Risk Management: Risk types, strategies, Estimation and Planning. Software Quality .McCall Quality factors, Six Sigma for Software Quality, Quality Assurance and its techniques.

Applications: analyze the risks in any software project

Learning Outcomes:

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

1. Evaluate different Risk management techniques. (L5)

Text books:

1. Roger S. Pressman, Software Engineering, A practitioner.s Approach, 7thEdition, McGraw-Hill International Edition, 2009
2. Rajib Mal, Fundamentals of software Engineering, 3rdEdition, Eastern Economy Edition, 2009

Reference books:

1. Sommerville, Software Engineering, 7thEdition, Pearson education, 2004
2. K KAggarwal and Yogeshsingh, Software engineering,3rd Edition,New age International publication,2008

Subject Code	Subject Name	L	T	P	C
R23CSE-OE0008	Introduction to Data Mining	3	0	0	3

COURSE OBJECTIVES:

- Students will be enabled to understand and implement classical models and algorithms in data warehousing and data mining.
- They will learn how to analyze the data, identify the problems, and choose the relevant models and algorithms to apply.
- They will further be able to assess the strengths and weaknesses of various methods and algorithms and to analyze their behavior.

COURSE OUTCOMES:

- Understand the process of knowledge discovery from data.
- Analyze the Data Pre-processing techniques.
- Apply classification techniques to various data sets.
- Apply the association rule mining to real time applications
- Apply the clustering algorithms to various data sets.

UNIT –I:

Introduction: Why Data Mining? What Is Data Mining? What Kinds of Data Can Be Mined? What Kinds of Patterns Can Be Mined? Which Technologies Are Used? Which Kinds of Applications Are Targeted? Major Issues in Data Mining. Data Objects and Attribute Types, Basic Statistical Descriptions of Data, Data Visualization, Measuring Data Similarity and Dissimilarity

Learning Outcomes: Student should be able to

1. Summarize the process of Data mining.(L2)
2. Classify various kinds of Data Mining techniques.(L2)
3. Memorize different visualization techniques.(L1)
4. Differentiate a data warehouse with data mining(L4)

UNIT –II:

Data Pre-processing: Data Preprocessing: An Overview, Data Cleaning, Data Integration, Data Reduction, Data Transformation and Data Discretization

Learning Outcomes: Student should be able to

1. Recognize various steps in Data Preprocessing.(L1)
2. Identify the process of handling noisy data.(L1)

UNIT –III:

Classification: Basic Concepts, General Approach to solving a classification problem, Decision Tree Induction: Working of Decision Tree, building a decision tree, methods for expressing an attribute test conditions, measures for selecting the best split, Algorithm for decision tree induction.

Classification: Alternative Techniques, Bayesian Classifier: Bayes theorem, using bayes theorem for classification, Native Bayes Classifier: Bayes error rate, Bayesian Belief Networks: Model representation, model building (Tan)

Learning Outcomes: Student should be able to

1. Summarize the process of classification.(L2)
2. Apply the process of classification on sample data.(L3)
3. Construct a decision tree for any sample data.(L3)
4. Calculate Bayes probability for any given data(L3)
5. Calculate Naïve Bayes probability.(L3)

UNIT –IV:

Association Analysis: Basic Concepts and Algorithms: Problem definition, Frequent Item Set generation, Rule generation, compact representation of frequent item sets, FP-Growth Algorithm. **(Tan & Vipin)**

Learning Outcomes: Student should be able to

1. Apply the Apriori algorithm on any sample data.(L3)
2. Construct an FP tree for any sample data. (L3)

UNIT –V

Cluster Analysis: Basic Concepts and Algorithms: Overview: What Is Cluster Analysis? Different Types of Clustering, Different Types of Clusters; K-means: The Basic K-means Algorithm, K-means Additional Issues, Bisecting K-means, Strengths and Weaknesses; Agglomerative Hierarchical Clustering: Basic Agglomerative Hierarchical Clustering Algorithm DBSCAN: Traditional Density Center-Based Approach, DBSCAN Algorithm, Strengths and Weaknesses. **(Tan & Vipin)**

Learning Outcomes: Student should be able to

1. Identify the data objects and partition them into different clusters.(L2)
2. Apply the different clustering techniques on sample data.(L3)
3. Acquire the knowledge of The strength and weakness of clustering algorithms.(L2)

TEXT BOOKS:

1. Introduction to Data Mining: Pang-Ning Tan & Michael Steinbach, Vipin Kumar, Pearson.
2. Data Mining concepts and Techniques, 3/e, Jiawei Han, Michel Kamber, Elsevier.

REFERENCE BOOKS:

1. Data Mining Techniques and Applications: An Introduction, Hongbo Du, Cengage Learning.
2. Data Mining : VikramPudi and P. Radha Krishna, Oxford.
3. Data Mining and Analysis - Fundamental Concepts and Algorithms; Mohammed J. Zaki, Wagner Meira, Jr, Oxford
4. Data Warehousing Data Mining & OLAP, Alex Berson, Stephen Smith, TMH.

MAPPING (DETAILED; HIGH: 3; MEDIUM: 2; LOW: 1):

COs	P O 1	P O2	P O3	P O4	P O5	P O6	P O7	P O8	P O9	P O1 0	P O1 1	P O1 2	PSO 1	PSO 2	PSO 3
CO1	3	2	2	2	2				1			2	2	1	2
CO2	2	3	2	1	2				1			2	2	1	1
CO3	3	2	2	1	2				1			2	2	1	1
CO4	3	3	2	2	2				1			2	2	1	3
CO5	3	2	3	1	2				1			2	2	1	2

Subject Code	Subject Name	L	T	P	C
R23CSE-OE0009	FUNDAMENTALS OF WEB TECHNOLOGIES	3	0	0	3

COURSE OBJECTIVES:

1. Creating Web User Interfaces
2. Creating dynamic Web pages
3. Implementing the usage of Scripts in Web Pages
4. Analyzing real world objects into Web Pages as Scripts Handlers
5. Analyzing look and feel kind of applications which are useful for real world
6. Web framework implementation using Model View Controller
7. Writing background scripts to run the virtual machines and servers

COURSE OUTCOMES:

1. Demonstrate knowledge on web page design elements.
2. Design web pages with dynamic content
3. Create Responsive layout with customized forms
4. Implement simple client-side scripts using AJAX
5. Build web applications using PHP

UNIT-I:

HTML: Introduction: Fundamentals of HTML, Working with text, Organizing text in HTML, Working with links and URLs, Creating tables, Working with images, Canvas, Forms, Frames and Multimedia.

HTML5: Introduction, HTML5 document structure, Creating editable content, Checking spelling mistakes.

Learning Outcomes:

After completion of this unit, student will be able to

- Identify basic steps that are followed to develop web applications [L2]
- Understand the functions of different HTML5 tags and how to use them [L2]
- Design and develop basic web pages using HTML5[L3]

UNIT-II:

CSS AND JAVASCRIPT: CSS: Introduction, CSS selectors, Inserting CSS in an HTML document, Backgrounds, Fonts and Text styles, Creating boxes, Displaying, Positioning and floating elements, Features of CSS3,Media queries. JavaScript: Overview of JavaScript, JavaScript functions, Events, Image maps and animations, JavaScript objects, working with browser and document objects.

Learning Outcomes:

After completion of this unit, student will be able to

- Learn the basic syntax of the CSS Style rule[L2]
- Get an idea about different CSS Selectors[L2]
- Use style rules to apply styles to different elements[L3]
- Understand HTML5 DOM object hierarchy[L2]
- Understand java script event handling mechanism[L2]

UNIT -III:

JQUERY and BOOTSTRAP: JQuery: Introduction, JQuery selectors, Events, Methods to access HTML elements and attribute. Bootstrap: Getting started with Bootstrap, Creating responsive layouts using Bootstrap CSS - Basic HTML structure for Bootstrap, Responsive classes, Rendering images, the grid system, Constructing data entry forms.

Learning Outcomes:

After completion of this unit, student will be able to

- Understanding the Bootstrap file structure[L2]
- Learning the basics of responsive design[L2]
- Understanding the all-important grid system in Bootstrap[L2]
- Introduce Bootstrap as a responsive design framework[L2]

UNIT –IV:

XML: Document type Definition, XML schemas, Document object model, XSLT, DOM and SAX Approaches, AJAX A New Approach: Introduction to AJAX, Integrating PHP and AJAX.

Learning Outcomes:

After completion of this unit, student will be able to

- Learn the basic building blocks of XML Documents [L1]
- Understand how name clashes are avoided using namespaces [L2]
- Learn how to create forms dynamically [L2]
- Learn how to generate dynamic tables[L2]
- Write interactive web applications using AJAX [L3]

UNIT-V:

INTRODUCTION TO PHP: Introduction, Data types, Variables, Constants, Expressions, String interpolation, Control structures, Functions, Arrays, Embedding PHP code in web pages, Object Oriented PHP.PHP Web forms: PHP and web forms, Sending form data to a server, Working with cookies and session handlers PHP with MySQL: Interacting with the database, Prepared statement, Database transactions.

Learning Outcomes:

After completion of this unit, student will be able to

- Examine the relationship between PHP and MySQL L2]
- Plan a PHP Web application [L4]
- Create and use a Logon Window [L6]
- Manage User sessions using cookies and sessions [L3]

Text Books:

1. Kogent Learning Solutions Inc, HTML 5 Black Book: Covers CSS3, JavaScript, XML, XHTML, AJAX, PHP and JQuery, Dreamtech Press, Second Edition, 2016.
2. W. Jason Gilmore, Beginning PHP and MySQL, APress, Fourth Edition, 2011.

Reference Books:

1. Snig Bahumik, Bootstrap Essentials, PACKT Publishing, 2015 (e-book).
2. Thomas A. Powell, The Complete Reference: HTML and CSS, Tata McGraw Hill, Fifth Edition, 2010
3. Andrea Tarr, PHP and MySQL, Willy India, 2012.
4. Ruby on Rails Up and Running, Lightning fast Web development, Bruce Tate, Curt Hibbs, Oreilly (2006)

COURSE OUTCOMES VS POs MAPPING (DETAILED; HIGH: 3; MEDIUM: 2; LOW: 1):

COs	P O 1	P O 2	P O 3	P O 4	P O 5	P O 6	P O 7	P O 8	P O 9	P O 10	P O 11	P O 12	PSO 1	PSO 2	PSO 3
CO1	3	2	2	2	2				1			2	2	1	2
CO2	2	3	2	1	2				1			2	2	1	1
CO3	3	2	2	1	2				1			2	2	1	1
CO4	3	3	2	2	2				1			2	2	1	3
CO5	3	2	3	1	2				1			2	2	1	2

Subject Code	Subject Name	L	T	P	C
R23CSE-OE0010	FUNDAMENTALS OF COMPUTER NETWORKS	3	0	0	3

Course Objectives:

1. To introduce the fundamental various types of computer networks.
2. To understand state-of-the-art in network protocols, architectures, and applications.
3. To explore the various layers of OSI Model.

Course Outcomes:

The students can

1. Understand OSI and TCP/IP reference models with an emphasis to Physical Layer, Data Link Layer and Network Layer.
2. Analyze the issues related to data link, medium access and transport layers by using channel allocation and connection management schemes. Analyze MAC layer protocols and LAN technologies.
3. Solve problems related to Flow control, Error control, Congestion control and Network Routing.
4. Design and compute subnet masks and addresses for networking requirements.
5. Understand how internet works

UNIT-I:

Introduction: Network Hardware and software Reference models- The OSI Reference Model- the TCP/IP Reference Model - A Comparison of the OSI and TCP/IP Reference Models, Examples of Networks: Novell Networks, Arpanet, Internet, Network Topologies WAN, LAN, MAN.

Physical Layer: Guided Transmission Media, Digital Modulation and Multiplexing: frequency division multiplexing, wavelength division multiplexing, synchronous time division multiplexing, statistical time division multiplexing.

UNIT-II:

The Data Link Layer - Design Issues, Services Provided to the Network Layer – Framing – Error Control – Flow Control, Error Detection and Correction – Error-Correcting Codes – Error Detecting Codes, Elementary Data Link Protocols, Sliding Window Protocols.

Channel allocation methods: TDM, FDM, ALOHA, Carrier sense Multiple access protocols, Collision Free protocols – IEEE standard 802 for LANS – Ethernet, Token Bus, Token ring, Bridges and IEEE 802.11 and 802.16. Data link layer switching, virtual LANs.

UNIT-III:

Network layer Routing Algorithms: Design Issues, Routing Algorithms-Shortest path, Flooding,

Flow based Distance vector, Link state, Hierarchical, Broadcast routing, Congestion Control algorithms-General principles of congestion control, Congestion prevention policies, Choke packets, Load shedding, and Jitter Control.

Internet Working: Tunnelling, internetworking, Fragmentation, Network layer in the internet– IP protocols, IP address, Subnets, Internet control protocols, OSPF, BGP, Internet multicasting, Mobile IP, IPV6.

UNIT IV:

The Transport Layer: Elements of transport protocols – addressing, establishing a connection, releasing connection, flow control and buffering and crash recovery, End to end protocols: UDP, Real Time Transport Protocol.

The Internet Transport Protocol: TCP- reliable Byte Stream (TCP) end to end format, segment format, connection establishment and termination, sliding window revisited, adaptive retransmission, TCP extension, Remote Procedure Call.

UNIT – V:

Application Layer: WWW and HTTP: Architecture- Client (Browser), Server, Uniform Resource Locator HTTP: HTTP Transaction, HTTP Operational Model and Client/Server Communication, HTTP Generic Message Format, HTTP Request Message Format, HTTP Response Message Format.

The Domain Name System: The DNS Name Space, Resource Records, Name Servers, Electronic Mail: Architecture and Services, The User Agent, Message Formats, Message Transfer, Final Delivery.

Text Books:

1. Data Communications and Networks – Behrouz A. Forouzan, Third Edition ,TMH.
2. Computer Networks, 5ed, David Patterson,Elsevier
3. Computer Networks: Andrew S Tanenbaum, 5th Edition. PearsonEducation/PHI
4. Computer Networks, Mayank Dave, CENGAGE

References:

1. Tanenbaum and David J Wetherall, Computer Networks, 5th Edition, Pearson Edu, 2010
2. Computer Networks: A Top Down Approach, Behrouz A. Forouzan, FirouzMosharraf, McGraw Hill Education
3. An Engineering Approach to Computer Networks-S.Keshav, 2nd Edition, PearsonEducation.
4. Understanding communications and Networks, 3rd Edition, W.A. Shay, ThomsonThe TCP/IP Guide, by Charles M. Kozierok, Free online Resource,<http://www.tcpipguide.com/free/index.htm>.

Subject Code	Subject Name	L	T	P	C
R23CSE-OE0011	BASICS OF CLOUD COMPUTING	3	0	0	3

Course Objective :

1. To provide students with the fundamentals and essentials of Cloud Computing.
2. To provide students a sound foundation of the Cloud Computing so that they are able to start using and adopting Cloud Computing services and tools in their real life scenarios.
3. To enable students exploring some important cloud computing driven commercial systems and applications.

Course Outcomes :

Upon completion of the course, it is expected that student will be able to:

1. Understand and analyze different computing paradigms
2. Understand the basics of cloud computing and different cloud deployment models.
3. Understand different cloud implementation and management strategies.
4. Understand and evaluate different cloud service models.
5. Identify, analyze and use different cloud services /applications/tools available from key cloud providers.

UNIT-I:

Computing Paradigms: High-Performance Computing, Parallel Computing, Distributed Computing, Cluster Computing, Grid Computing, Cloud Computing, Bio computing, Mobile Computing, Quantum Computing, Optical Computing, Nano computing..

UNIT-II:

Cloud Computing Fundamentals: Motivation for Cloud Computing, The Need for Cloud Computing, Defining Cloud Computing, Definition of Cloud Computing, Cloud Computing is a Service, Cloud Computing is a Platform, Principles of Cloud computing, Five Essential Characteristics, Four Cloud Deployment Models

UNIT-III:

Cloud Computing Architecture and Management: Cloud architecture, Layer, Anatomy of the Cloud, Network Connectivity in Cloud Computing, Applications on the Cloud, Managing the Cloud, Managing the Cloud Infrastructure, Managing the Cloud Application, Migrating Application to Cloud, Phases of Cloud Migration Approaches for Cloud Migration.

UNIT-IV:

Cloud Service Models: Infrastructure as a Service, Characteristics of IaaS. Suitability of IaaS, Pros and Cons of IaaS, Summary of IaaS Providers, Platform as a Service, Characteristics of PaaS, Suitability of PaaS, Pros and Cons of PaaS, Summary of PaaS Providers, Software as a Service, Characteristics of SaaS, Suitability of SaaS, Pros and Cons of SaaS, Summary of SaaS Providers, Other Cloud Service Models.

UNIT-V:

Cloud Providers and Applications : EMC, EMC IT, Captiva Cloud Toolkit, Google Cloud Platform, Cloud Storage, Google Cloud Connect, Google Cloud Print, Google App Engine, Amazon Web Services, Amazon Elastic Compute Cloud, Amazon Simple Storage Service, Amazon Simple Queue service, Microsoft, Windows Azure, Microsoft Assessment and Planning Toolkit, SharePoint, IBM, Cloud Models, IBM Smart Cloud, SAP Labs, SAP HANA Cloud Platform, Virtualization Services Provided by SAP, Sales force, Sales Cloud, Service Cloud: Knowledge as a Service, Rack space, VMware, Manjra soft, Aneka Platform.

Text Book:

- i. Essentials of Cloud Computing, K. Chandra sekhran, CRC press.

Reference Books:

- i. Cloud Computing: Principles and Paradigms, Rajkumar Buyya, James Broberg and Andrzej M. Goscinski, Wiley.
- ii. Distributed and Cloud Computing, Kai Hwang, Geoffery C. Fox, Jack J. Dongarra, Elsevier.
- iii. Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance, Tim Mather, Subra Kumara swamy, Shahed Latif, O'Reilly.

Subject Code	Subject Name	L	T	P	C
R23CSE-OE0012	INTRODUCTION TO MACHINE LEARNING	3	0	0	3

Course Objectives:

- To familiarize with a set of well-known Machine Learning (ML) algorithms.
- The ability to implement machine learning algorithms.
- To understand how machine learning algorithms are evaluated.
- To formulate machine learning problems corresponding to different applications.
- To understand a range of machine learning algorithms with their pros and cons.

Course Outcomes:

- Illustrate the characteristics of machine learning algorithms.
- Summarize the process of classification using decision tree approach.
- Apply Bayesian classifier to label data points an ML approach.
- Understand computational and instance-based learning.
- Understand advanced computational and types of learning.

UNIT I: (10 Hours)

Introduction: Well- posed learning problems, designing a learning system, perspectives, and issues in machine learning. Applications of machine learning. **Concept Learning:** Concept learning and the general to specific ordering. Concept learning task, Concept learning as search, Find-s: finding a maximally specific hypothesis, version spaces and the candidate elimination algorithm, Remarks on version spaces and candidate elimination, Inductive bias.

Learning Outcomes: Student will be able to

- Summarize the process of machine learning.
- Recognize various machine learning Applications.
- Understand various candidate elimination algorithms

UNIT II: (09 Hours)

Decision Tree Learning: Decision tree representation, Appropriate problems for decision tree learning, the basic decision tree learning algorithm, Hypothesis space search in decision tree learning, Inductive bias in decision tree learning, Issues in decision tree learning

Learning Outcomes: Student will be able to

- Summarize the process of classification.
- Construct a decision tree for any sample data.

UNIT III: (11 Hours)

Bayesian learning: Bayes theorem, Bayes theorem and concept learning, Maximum likelihood and least squared error hypotheses, Maximum likelihood hypotheses for predicting probabilities, Bayes optimal classifier, An example learning to classify text, Bayesian belief networks

Learning Outcomes: Student will be able to

- Calculate Bayes probability for any given data.
- Calculate Naïve Bayes probability.
- Distinguish the process of Bayes and Naïve Bayes probability calculation.

UNIT IV: (09 Hours)

Computational learning theory – 1: Probability learning an approximately correct hypothesis, Sample complexity for infinite Hypothesis spaces, The mistake bound model of learning- Instance- Based learning- Introduction.

Learning Outcomes: Student will be able to

- Understand Probability learning and Instance- Based learning.

UNIT V: (09 Hours)

Computational learning theory – 2: K- Nearest Neighbour Learning, Locally Weighted Regression, Radial Basis Functions, Case-Based Reasoning, Remarks on Lazy and Eager Learning

Learning Outcomes: Student will be able to

- Understand the concept of classification.
- Distinguish lazy Lazy and Eager Learning.

Contemporary Problems:

Explore Modern Tools- Altair Rapid Miner Tools- Scalability Issues- Regularity Complex-Black Box Problem

Text Books

1. Tom M. Mitchell, —Machine Learning, McGraw-Hill Education (India) Private Limited, 2013.
2. Raschka, Sebastian and Mirjalili, Vahid, Python Machine Learning, 3rd Edition, Packt Publishing., 2019
3. Stephen Marsland- Machine Learning – An Algorithmic Perspective – Second Edition – Chapman & Hall CRC Press, 2015

References

1. Ethem Alpaydin, Introduction to machine learning, 2nd edition, PHI.
2. Kevin P. Murphy, "Machine Learning," A Probabilistic Perspective, MIT Press, 2012

COURSE OUTCOMES VS POs MAPPING (DETAILED; HIGH: 3; MEDIUM: 2; LOW: 1):

CO	PO1	PO2	P O3	P O4	P O5	P O6	P O7	P O8	P O9	PO 10	PO 11	PO 12	PS O1	PS O 2	PS O 3
CO1	3	3	1	2	2			1	2	1		2	1	2	1
CO2	3	3	1	2	2			1	2	1		2	1	2	1
CO3	3	3	3	3	3			1	2	1		2	1	2	1
CO4	3	3	1	2	2			1	2	1		2	1	2	1
CO5	3	3	1	2	2			1	2	1		2	1	2	1

Subject Code	Subject Name	L	T	P	C
R23CSE-OE0013	ESSENTIALS OF CYBER SECURITY	3	0	0	3

Course Objectives:

1. Understand the fundamental concepts and principles of cyber security.
2. Understand Security architecture, risk management, attacks, incidents, and emerging IT and IS technologies.
3. To Provide the importance of Cyber Security and the integral role of Cyber Security professionals.
4. Recognize the importance of cybersecurity in protecting digital assets and information.
5. Analyze real-world cyber-attack scenarios and case studies.

Course Outcomes:

1. Understand Cyber Security architecture principles
2. Analyze the System and application security threats and vulnerabilities
3. Estimate operational cyber security strategies and policies.
4. Apply security model to handle mobile, wireless devices and related security issues.
5. Analyze the functionality of Security Technologies and Controls in Cybersecurity

UNIT - I: (8 Hours)

Introduction to Cyber Security: Need for Cyber security - History of Cyber security - Defining Cyberspace and Cyber security, scope of Cyber security, Importance of Cyber security in the modern world, Evolution of cyber threats, Importance of Cybersecurity in the digital age.

Foundations of Cyber Security: Cyber Security principles, threat models, and cyber laws. Confidentiality, integrity, and availability (CIA) Triad– Cyber security Framework, Security principles and concepts, Risk management. to better understand the dynamics of Cyber Security.

Learning Outcomes: student will be able to

- Outline the Importance of Cyber security. (L2)
- Understand the Security architecture principles and concepts. (L2)
- Understand the Design of Cyber security Framework. (L2)

UNIT-II: (10 Hours)

Common Threats and Attack Vectors: Introduction, Proxy Servers and Anonymizers, Password Cracking, Key loggers and Spywares, Virus and Worms, Trojan Horses and Backdoors, Steganography, DoS and DDoS Attacks, SQL Injection, Buffer Overflow, Attacks on Wireless Networks, Social Engineering attacks: Introduction, Phishing, spear phishing, pretexting, Identity Theft (ID Theft).

Learning Outcomes: student will be able to

- Understand about the Cyber security Threats and Attacks. (L2)
- Summarize the various types of application security vulnerabilities (L2)
- Analyze the System and application security threats and vulnerabilities (L4)

UNIT-III: (12 Hours)

Introduction to Cyber Crime, law and Investigation: Introduction to Cybercrime, Definition and scope of cybercrime, Categories of cybercrimes, Impact of cybercrime, Cybercrime and Information Security, classifications of cybercrimes, Cybercrime: The Legal Perspectives, cybercrime and the Indian IT Act 2000, a Global perspective on Cybercrimes.

Cyber laws: Introduction to Cyber Laws, Need for Cyber laws The Indian Context, The Indian IT Act, Challenges to Indian Law and Cybercrime Scenario in India, Consequences of Not Addressing the Weakness in Information Technology Act, Digital Signatures and the Indian IT Act, Information Security Planning and Governance, Information Security Policy Standards.

Learning Outcomes: student will be able to

- Extend The Categories of cybercrimes and Impact of cybercrime(L2)
- Understand about the Need for Cyber laws and Cybercrime Scenario in India(L2)
- Estimate operational cyber security strategies and policies(L5)
- Develop an understanding of cybercrimes and various legal perspectives involved(L3)

UNIT-IV: (10 Hours)

Cybercrime-Mobile and Wireless Devices: Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit Card Frauds in Mobile and Wireless Computing Era, Authentication Service Security, Attacks on Mobile/Cell Phones.

Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile Devices-Related Security Issues, Organizational Security Policies and Measures in Mobile Computing Era, Laptops.

Learning Outcomes: student will be able to

- Understand Various devices and related security issues (L2)
- Develop a security model to handle Policies and Measures in Computing era(L3)
- Develop a security model to handle mobile, wireless devices and related security issues of an organization (L3)

UNIT-V: (8 Hours)

Security Technologies and Controls in Cyber security: Access control mechanisms, Encryption, Firewalls, intrusion detection systems (IDS), intrusion prevention systems (IPS), Network Security, Security Information and Event Management (SIEM), functionality of cyber security tools.

Legal and Ethical Aspects of Cyber Security: Laws and regulations governing cyber security, Ethical considerations in cyber security practices, Privacy issues.

Learning Outcomes: student will be able to

- Analyze the functionality of Security Technologies and Controls in Cyber security(L4)
- Outline the Ethical considerations in cyber security practices(L2)
- Understand the functionality of cyber security tools(L2)

Text Books:

1. Computer Security: Principles and Practice, Third Edition, William Stallings, Lawrie Brown, Pearson Education, 2014.
2. Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Nina Godbole, SunitBelapure, 1st Edition Publication Wiley, 2011.
3. William Stallings, Effective Cyber security: A Guide to Using Best Practices and Standards, 1st edition, 2019.
4. Mark Rhodes, Ousley, Information Security, 1st Edition, MGH, 2013.

Reference Books:

1. Principles of Information Security, Michael E. Whitman and Herbert J. Mattord, Cengage Learning.
2. Charles J. Brooks, Christopher Grow, Philip A. Craig, Donald Short, Cybersecurity Essentials, Wiley Publisher, 2018.
3. Yuri Diogenes, Erdal Ozkaya, Cyber security - Attack and Defense Strategies, Packt Publishers,

COURSE OUTCOMES VS POs MAPPING (DETAILED; HIGH:3; MEDIUM:2; LOW:1):

CNO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO2	PSO3
	3	2	1	-	-	-	-	-	-	-	-	1	-	-	1
	3	3	2	2	-	-	-	-	-	-	-	1	2	-	1
	3	2	2	-	-	-	-	-	-	-	-	2	2	-	-
	3	2	1	1	2	-	-	-	-	1	-	1	-	-	1
	3	2	2	2	2	-	-	-	-	1	-	1	1	2	-
	3	2	2	2	2	-	-	-	-	1	-	1	2	2	1

** For Entire Course, PO & PSO Mapping*

Subject Code	Subject Name	L	T	P	C
R23CSE-OE0014	INTRODUCTION TO REACT JS	3	0	0	3

Course Objectives:

- To learn essential React JS skills for front-end development.
- To explore client-side JavaScript application development and the React library.
- To implement React components, hooks, and state management for building interactive UIs.
- To gain experience with React.js, JSX, HTML, CSS, and JavaScript.
- To create a functional front-end web application using React.

Course Outcomes:

1. Understand the anatomy of React Java Script. (L2)
2. Understand the life cycle methods of React JS. (L2)
3. Implement React components for building applications. (L3)
4. Apply React hooks for component reusability and monitoring. (L3)
5. Implement React rendering for interactive applications. (L3)

Unit 1 (10 Hours)

React JS: Introduction to React JS, React vs Angular, React Version History, Architecture of the React Application, Installation, Creating and Running React App, Anatomy of React Project.

Templating using JSX: Expressions, Operators, Attributes, Fragments.

Learning Outcomes: Student will be able to

- Understand react framework for building applications. (L2)
- Understand the installations of react packages. (L2)
- Implement templates in react applications. (L3)

Unit 2 (8 Hours)

React Core: Props, State, Event Handling, Lists and Keys, Styling, Pagination, React Life Cycle, Life Cycle Methods, State Management, Mounting Life Cycle.

Learning Outcomes: Student will be able to

- Understand event handling in React. (L2).
- Implement life cycle methods in react. (L3).
- Implement props and states in building react apps. (L3)

Unit 3 (10 Hours)

React Components: Pure Components, memo, Refs, Portals, Higher Order Components (HOC), Context, HTTP requests (POST & GET).

Learning Outcomes: Student will be able to

- Understand http request methods in handling end points. (L2)
- Implement components to handle react requests. (L3)
- Implement higher order components and refs in react. (L3)

Unit 4 (12 Hours)

React Hooks: Introduction to Hooks, useState, useEffect, Run Effects, Fetching Data, useContext, useReducer, useCallback, useMemo, useRef, Custom Hooks

Learning Outcomes: Student will be able to

- Understand react hooks. (L2)
- Apply hooks and custom methods for handling components. (L3)
- Implement context and callback methods in hooks. (L3)

Unit 5 (8 Hours)

React Render: Introduction to Rendering, useState, useReducer, State Immutability, Parent & Child, Memo, Context, useCallback.

Learning Outcomes: Student will be able to

- Understand the working react rendering. (L2)
- Implement userReducer and context for rendering react apps. (L3)

TEXT BOOKS:

1. React.js Book: Learning React JavaScript Library From Scratch by Greg Sidelnikov, Learning Curve.
2. React: Quickstart Step-By-Step Guide To Learning React Javascript Library (React.js, Reactjs, Learning React JS, React Javascript, React Programming) by Lionel Lopez

REFERENCE BOOKS:

- Full-Stack React Projects: Learn MERN stack development by building modern web apps using MongoDB, Express, React, and Node.js, 2nd Edition by Shama Hoque, Packt

Course Code	Subject Name	L	T	P	C
R23CSE-OE0015	Deep Learning	3	0	0	3

Course Objectives

1. Understand the fundamentals of machine learning algorithms and their challenges.
2. Learn the architecture and training of deep feedforward networks.
3. Master regularization techniques to improve deep learning model performance.
4. Explore optimization methods for training deep neural networks.
5. Gain comprehensive knowledge of convolutional neural networks and their applications.

Course Outcomes: Upon successful completion of course , students will be able to

1. Apply machine learning algorithms to solve practical problems, demonstrating understanding of overfitting and underfitting (Application).
2. Analyse and design deep feedforward networks using gradient-based learning techniques (Analysis).
3. Evaluate the effectiveness of various regularization techniques to enhance model performance and robustness (Evaluation).
4. Analyse advanced optimization strategies to efficiently train deep neural networks (Synthesis).
5. Understand the convolutional neural networks, explaining their significance in the context of deep learning history and neuroscientific principles.

Unit-I – Machine Learning Basics (8 Hours)

Learning Algorithms-Capacity,OverfittingandUnderfitting-HyperparametersandValidationSets-
Estimators,BiasandVariance -SupervisedLearningAlgorithms -UnsupervisedLearningAlgorithms -
ChallengesMotivatingDeepLearning.

Learning Outcomes: Student will be able to understand the fundamentals of machine learning.

Application:ML Algorithms can use in health care, NLP and computer vision applications.

Unit – II: DeepNetworks (8 Hours)

Deep Feed forward Networks: Example: Learning XOR - Gradient-Based Learning - Hidden Units - Architecture Design – BackPropagation and Other Differentiation Algorithms.

Learning Outcomes:Student will be able to analyse the fundamentals of deep learning.

Application:Deep Networks can use in NLP and finance applications for solving complex problems.

Unit – III: Regularization for Deep Learning (8 Hours)

Parameter Norm Penalties – Norm Penaltiesas Constrained Optimization- Regularization and Under Constrained Problems – DatasetAugmentation-NoiseRobustness- SemiSupervisedLearning- MultiTaskLearning- EarlyStopping - ParameterTyingandParameterSharing – SparseRepresentations -BaggingandOtherEnsembleMethods -Dropout.

Learning Outcomes: Student will be able to evaluate the regularization importance in deep neural networks.

Application: Regularization is used for improve the performance of network in various applications like computer vision and NLP etc.

Unit – IV: Optimization for Training Deep Models (8 Hours)

How Learning Differs from Pure Optimization- Challenges in Neural Network Optimization- Basic Algorithms – Parameter Initialization Strategies – Algorithms with Adaptive Learning Rates- Approximate Second Order Methods- Optimization Strategies and Meta-Algorithms.

Learning Outcomes: Student will be able to analyse the fundamentals of optimization techniques in deep learning.

Application: Optimization techniques are using in many applications like NLP, computer vision and finance sector.

Unit – V: Convolutional Networks (8 Hours)

The Convolution Operation- Motivation- Pooling – Convolution and Pooling as an Infinitely Strong Prior – Variants of the Basic Convolution Function- The Neuro scientific Basis for Convolutional Networks – Convolutional Networks and the History of Deep Learning.

Learning Outcomes: Student will be able to understand the purpose of CNN and its importance in deep learning.

Application: CNN used in the area of computer vision applications and many more like NLP, finance and manufacturing sectors.

Text Books: Ian Goodfellow and Yoshua Bengio and Aaron Courville,” Deep Learning” MIT Press, 2017.

References Books:

1. Shai Shalev-Shwartz, Shai Ben-David “Understanding Machine Learning: From Theory to Algorithms” , Cambridge Press
2. Peter Harington “ Machine Learning in Action”, , 2012, Cengage.

COURSE OUTCOMES VS POs MAPPING (DETAILED; HIGH: 3; MEDIUM: 2; LOW: 1):

CO	PO1	PO2	P O3	P O4	P O5	P O6	P O7	P O8	P O9	PO 10	PO 11	PO 12	PS O1	PS O2	PSO 3
C01	3	2	1	1	1							1			1
C02	3	2	1	1	1							1			1
C03	3	2	1	1	1							1			1
C04	3	2	1	1	1							1			1
C05	3	2	1	1	1							1			1

Subject Code	Subject Name	L	T	P	C
R23CSE-OE0016	DevOps	3	0	0	3

Course Objectives:

DevOps improves collaboration and productivity by automating infrastructure and workflows and continuously measuring applications performance.

(Need to write at least 5 objects for this course)

Course Outcomes:

At the end of the course, student will be able to

1. Enumerate the principles of continuous development and deployment, automation of configuration management, inter-team collaboration, and IT service agility
2. Understand different actions performed through Version control tools like Git.
3. Illustrate the types of version control systems, continuous integration tools, continuous monitoring tools, and cloud models
4. Ability to Perform Automated Continuous Deployment
5. Understand to leverage Cloud-based DevOps tools using Azure DevOps

Need to write what is the skill gained by student at the end of each unit and mention the blooms taxonomy levels in parenthesis for each course outcome

UNIT –I:

Introduction to Software Engineering: Phases of Software Development life cycle. Models ,Values and principles of agile software development.

Learning outcomes:

- Identify and describe the phases of the Software Development Life Cycle (SDLC) (Knowledge, Understanding). (L1 & L2)
- Compare and contrast different software development models (e.g., Waterfall, Agile) and their applications (L3)
- Apply the values and principles of agile software development in real-world scenarios (L3)

UNIT -II: Introduction To DevOps -Devops Essentials – Introduction To AWS, GCP, Azure – Version control systems: Git and Github.

Learning outcomes:

- Understand the essentials of DevOps and its importance in modern software development (L2)
- Demonstrate the use of version control systems(L3)
- Compare cloud platforms and their relevance to DevOps practices (L3)

UNIT –III:

DevOps adoption in projects: Technology aspects, Agiling capabilities, Tool stack implementation, People aspect, processes.

Learning outcomes:

- Analyze the technology aspects required for successful DevOps adoption (L4)
- Analyze the agile capabilities and tool stack implementation for DevOps in various projects (L4)
- Analyze the people and process aspects necessary for DevOps adoption and their impact on project success (L4)

UNIT -IV:

CONTINUOUS INTEGRATION USING JENKINS: Install & Configure Jenkins, Jenkins Architecture Overview, Creating a Jenkins Job, Configuring a Jenkins job, Introduction to Plugins, Adding Plugins to Jenkins, Commonly used plugins (Git Plugin, Parameter Plugin, HTML Publisher, Copy Artifact and Extended choice parameters). Configuring Jenkins to work with java, Git and Maven, Creating a Jenkins Build and Jenkins workspace.

Learning outcomes:

- Install and configure Jenkins for continuous integration (L3)
- implement Jenkins jobs and pipelines, including configuring jobs and adding plugins (L3)
- Understand Jenkins in continuous integration by creating and managing builds (L2)

UNIT-V: BUILDING DEVOPS PIPELINES USING AZURE :
Create Github Account, Create Repository, Create Azure Organization, Create a new pipeline, Build a sample code, Modify azure-pipelines.yaml file

Learning outcomes:

- Create and manage repositories on GitHub and integrate them with Azure DevOps (Application). (L3)
- Implement new pipeline in Azure DevOps and build sample code using azure-pipelines.yaml file(L3)
- Analyze the Modification and optimization Azure DevOps pipelines for continuous deployment (L4)

Text Books:

- Roberto Vormittag, “A Practical Guide to Git and GitHub for Windows Users: From Beginner to Expert in Easy Step-By-Step Exercises”, Second Edition, Kindle Edition, 2016.
- Jason Cannon, “Linux for Beginners: An Introduction to the Linux Operating System and Command Line”, Kindle Edition, 2014

Reference Books:

- Hands-On Azure Devops: Cidc Implementation For Mobile, Hybrid, And Web Applications Using Azure Devops And Microsoft Azure: CICD Implementation for ... DevOps and Microsoft Azure (English Edition) Paperback – 1 January 2020 by Mitesh Soni
- Jeff Geerling, “Ansible for DevOps: Server and configuration management for humans”, First Edition, 2015.
- David Johnson, “Ansible for DevOps: Everything You Need to Know to Use Ansible for DevOps”, Second Edition, 2016.
- MariotTsitoara, “Ansible 6. Beginning Git and GitHub: A Comprehensive Guide to Version Control, Project Management, and Teamwork for the New Developer”, Second Edition, 2019.

Web References :

- <https://www.jenkins.io/user-handbook.pdf>
- <https://maven.apache.org/guides/getting-started/>

COURSE OUTCOMES VS POs MAPPING (DETAILED: HIGH: 3, MEDIUM: 2, LOW: 1)

Cours e	CNO	PO 1	P O2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	P O 9	P O 10	P O 11	PO 12	PS O1	PS O2	PS O3
DevO ps		3	3	2	2					2			1	3	1	2
		3	3	2	2					2			1	3	1	2
		3	3	2		2				2			1	3	1	2
		3	3	2		2				2			1	3	1	2
		3	3	2		2				2			1	3	1	2
		3	3	2	2	2				2			1	3	1	2

Subject Code	Subject Name	L	T	P	C
R23CSE-OE0017	Mobile Computing	3	0	0	3

Course Objective:

1. Understand the fundamental concepts, architecture, and paradigms of mobile computing and GSM.
2. Comprehend the motivation for specialized MAC techniques in wireless communications, addressing issues such as hidden and exposed terminals, near and far terminals and IEEE 802.11.
3. Analyze the IP and Mobile IP network layers, focusing on packet delivery, handover management, location management, registration, tunneling, encapsulation and DHCP.
4. Understand conventional TCP/IP protocols and specialized protocols like Indirect TCP, Snooping TCP, and Mobile TCP for mobile networks and database issues in mobile computing.
5. Introduce the concept, applications, and challenges of Mobile Ad hoc Networks (MANETs), and to explore various routing algorithms such as DSR, AODV, and DSDV.

Course Outcomes: Upon Successful completion of Course, the students will be able to

1. Understand the fundamental concepts, architecture, and paradigms of mobile computing and GSM.
2. Understand the need for specialized MAC techniques in wireless communications, addressing challenges like hidden and exposed terminals, near and far terminals and IEEE 802.11.
3. Understand the concept of the IP and Mobile IP network layers, focusing on packet delivery, handover management, location management, registration, tunnelling, encapsulation, route optimization, and DHCP.
4. Understand proficient in conventional TCP/IP protocols as well as specialized protocols like Indirect TCP, Snooping TCP, and Mobile TCP.
5. Understand the concept, applications, and challenges of Mobile Ad hoc Networks (MANETs).

UNIT I

Introduction: Mobile Communications, Mobile Computing – Paradigm, Promises/Novel Applications and Impediments and Architecture; Mobile and Handheld Devices, Limitations of Mobile and Handheld Devices.

GSM – Services, System Architecture, Radio Interfaces, Protocols, Localization and Calling, Handover, Security, New Data Services, GPRS.

Learning Outcome:

- 1) Student able to understand the basic concepts of mobile communications and GSM.

UNIT –II

(Wireless) Medium Access Control (MAC): Motivation for a specialized MAC (Hidden and exposed Terminals, Near and far terminals), SDMA, FDMA, TDMA, CDMA.

Learning Outcome:

- 1) Student able to differentiate the SDMA, FDMA, TDMA and CDMA.

UNIT –III

Mobile Network Layer: IP and Mobile IP Network Layers, Packet Delivery and Handover Management, Location Management, Registration, Tunnelling and Encapsulation, Route Optimization, DHCP.

Learning Outcome:

- 1) Student able to explain the Mobile IP in mobile networks.

UNIT –IV

Mobile Transport Layer: Conventional TCP/IP Protocols, Indirect TCP, Snooping TCP, Mobile TCP, Other Transport Layer Protocols for Mobile Networks.

Learning Outcome:

- 1) Student able to understand the issues of databases and Mobile TCP/IP in mobile networks.

UNIT V

Mobile Ad hoc Networks (MANETs): Introduction, Applications & Challenges of a MANET, Routing, Classification of Routing Algorithms, Algorithms such as DSR, AODV, DSDV, etc., Mobile Agents, Service Discovery. **Protocols and Platforms for Mobile Computing:** WAP, Bluetooth, XML, J2ME, Java Card, PalmOS, Windows CE, SymbianOS, Linux for Mobile Devices, Android.

Learning Outcomes:

- 1) Student able to identify the best routing protocol for mobile networks for data transmission.

Text Books:

1. Jochen Schiller, “Mobile Communications”, Addison-Wesley, Second Edition, 2009.
2. Raj Kamal, “Mobile Computing”, Oxford University Press, 2007, ISBN: 0195686772

Reference Book:

1. ASOKE K TALUKDER, HASAN AHMED, ROOPA R YAVAGAL, “Mobile Computing, Technology Applications and Service Creation” Second Edition, Mc Graw Hill.
2. UWE Hansmann, Lothar Merk, Martin S. Nocklous, Thomas Stober, “Principles of Mobile Computing,” Second Edition, Springer.

Course Code	Subject Name	L	T	P	C
R23CSE-OE0018	Java Full-Stack Development (Open Elective)	0	1	2	2

Course Objectives:

1. Understand the basics of full-stack web development and the software development life cycle.
2. Design simple and responsive web pages using HTML, CSS, and JavaScript.
3. Develop basic backend applications using Java Servlets, JSP, and connect to databases.
4. Learn how to use SQL for database management.
5. Build and deploy a simple full-stack project using basic tools.

Course Outcomes: After completing this course, students will be able to:

1. Understand the structure of a full-stack web application.
2. Design interactive and responsive web pages.
3. Write basic backend logic and connect to a database.
4. Apply simple SQL queries to manage data effectively.
5. Build and deploy a simple full-stack project.

Unit 1: Frontend Development

Introduction to Full-Stack Development

- What is Full-Stack Development?
- Frontend, Backend, and Databases overview

HTML & CSS Basics

- HTML5: Elements, Forms, Tables
- CSS3: Selectors, Flexbox, Grid
- Responsive design with media queries

JavaScript Basics

- Variables, Loops, Functions
- Simple DOM Manipulation and Event Handling

Unit 2: Backend Development

Java Servlets & JSP

- Servlet lifecycle
- Handling HTTP requests and responses
- Basic JSP: Scripting and Expressions

Introduction to Hibernate

- What is Hibernate?
- Basic setup and configuration
- Mapping simple Java classes to database tables

Unit 3: Database Development

SQL Basics

- SELECT, INSERT, UPDATE, DELETE
- Simple JOINS
- Basic database normalization

Hibernate Basics

- Using annotations for mapping
- Simple one-to-many relationships
- Basic queries with HQL

Unit 4: Introduction to Frameworks

Spring & Spring Boot

- What is Spring? IoC and Dependency Injection
- Introduction to Spring Boot: Starter packs, auto-configuration
- Simple Spring Boot application connecting to a database

Unit 5: REST APIs & Deployment

RESTful APIs

- Basic REST concepts: GET, POST, PUT, DELETE
- Building a simple REST API with Spring Boot

Deployment Basics

- Using Git/GitHub for version control
- Testing APIs with Postman
- Simple project deployment (local server)

Project & Capstone

Mini Projects:

- Online Book Store
- Student Portal or basic E-Commerce App

Tools:

- Git/GitHub for version control
- Maven/Gradle for builds
- Postman for testing

Project & Deployment Tools

- Git & GitHub – Version Control
- Maven/Gradle – Build Tools
- Postman – API Testing

Full-Stack Capstone Project

- Online Book Store / Student Portal
- E-Commerce App with Payment Gateway.

CONTEMPORARY TOPICS:

1. Micro services Architecture using Spring Boot and Spring Cloud
2. JWT-Based Authentication and Authorization in Web Applications
3. Containerization and Deployment using Docker and Kubernetes
4. Integration of No SQL Databases like MongoDB with Java Applications

APPLICATIONS:

1. Online Book Store

- Features: User registration/login, book catalog, shopping cart, order management, admin panel
- Tech Stack: Java Spring Boot , React/HTML-CSS-JS , MySQL

2. Student Information Portal

- Features: Student profiles, course registration, grade tracking, admin dashboard
- Tech Stack: Java Servlets + Hibernate, Bootstrap + JavaScript , PostgreSQL

3. Job Placement Management System

- Features: Company registration, student applications, interview tracking, placement stats
- Tech Stack: Spring Boot + JSP , HTML/CSS + JavaScript , MySQL

TEXT BOOKS:

1. "Learning Web Design" by Jennifer Niederst Robbins, 5th Edition, O'Reilly Media
2. "Beginning Hibernate: For Hibernate 5" by Joseph B. Ottinger, Jeff Linwood, Dave Minter, 4th Edition, Apress

REFERENCE BOOKS:

1. "Web Programming and Internet Technologies" by Uttam K. Roy, Published 2010, Oxford University Press.
2. "Java: The Complete Reference" By Herbert Schildt, Published 2023, McGraw Hill Education

COURSE OUTCOMES VS POs MAPPING (DETAILED; HIGH: 3; MEDIUM: 2; LOW: 1)

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
117.1	3	2	2	1	3				1		1	1	2	3	3
117.2	3	2	2	1	3				1		1	1	2	3	3
117.3	3	3	3	2	3				1		1	2	3	3	3
117.4	3	3	3	2	3				1		1	2	3	3	3
117.5	2	2	2	2	2				1		1	1	2	2	2
117*	3	2	2	2	3				1		1	1	2	3	3

Subject Code	Subject Name	L	T	P	C
R23CSE-OE0019	Human Computer Interface	3	0	0	3

Course Objectives:

1. Demonstrate an understanding of guidelines, principles, and theories influencing human Computer interaction.
2. Recognize how a computer system may be modified to include human diversity.
3. Select an effective style for a specific application.
4. Design mock ups and carry out user and expert evaluation of interfaces.
5. Carry out the steps of experimental design, usability and experimental testing, and evaluation of human computer interaction systems.
6. Use the information sources available, and be aware of the methodologies and technologies supporting advances in HCI.

Course Outcomes:

UNIT-I:

The User Interface: Introduction, Importance of the User Interface, Importance and benefits of Good Design History of Human Computer Interface. Characteristics of Graphical and Web User Interface: Graphical User Interface, popularity of graphics, concepts of Direct Manipulation, Graphical System advantage and disadvantage, Characteristics of GUI. Web User Interface, popularity of web, Characteristics of Web Interface, Merging of Graphical Business systems& the Web, Principles of User Interface Design.

UNIT-II:

The User Interface Design Process: Obstacles and Pitfall in the development Process, Usability, The Design Team, Human Interaction with Computers, Important Human Characteristics in Design, Human Consideration in Design, Human Interaction Speeds, Performance versus Preference, Methods for Gaining and Understanding of Users

UNIT-III:

Understanding Business Functions: Business Definitions & Requirement analysis, Determining Business Functions, Design standards or Style Guides, System Training and Documentation

UNIT-IV:

Principles of Good Screen Design: Human considerations in screen Design, interface design goals, test for a good design, screen meaning and purpose, Technological considerations in Interface Design System Menus and Navigation Schemes: Structure, Functions, Context, Formatting, Phrasing and Selecting, Navigating of Menus, Kinds of Graphical Menus Windows Interface: Windows characteristic, Components of Window, Windows Presentation Styles, Types of Windows, Window Management, Web systems.

UNIT-V:

Device and Screen-Based Control: Device based controls, Operable Controls, Text entry/read-Only Controls, Section Controls, Combining Entry/Selection Controls, Other Operable Controls and Presentation Controls, Selecting proper controls

Text Books:

1. Wilbert O. Galitz, "The Essential Guide to User Interface Design", Wiley India Edition
2. Prece, Rogers, "Sharps Interaction Design", Wiley India.
3. Ben Shneidermann, "Designing the user interfaces". 3rd Edition, Pearson Education Asia.

References Books:

1. Soren Lauesen, "User Interface Design", Pearson Education
2. Alan Cooper, Robert Riemann, David Cronin, "Essentials of Interaction Design", Wiley
3. Alan Dix, Janet Fincay, GreGoryd, Abowd, Russell, Bealg, "HumanComputer Interaction", Pearson Education

Subject Code	Subject Name	L	T	P	C
R23CSE-OE0020	Cryptography and network security	3	0	0	3

Course Objectives:

- Understand the fundamentals of Information Security
- Acquire knowledge on Security Needs to provide confidentiality, integrity and authenticity.
- Understand the various key cryptography concepts
- Design security applications using security policies
- Understand the Security Issues in TCP/IP

Course Outcomes:

1. Analyze the vulnerabilities in any computing system and hence be able to design a security solution
2. Identify the security needs in the network
3. Explain the basic objectives of symmetric & Asymmetric key cryptography technique to secure the communication over the internet
4. Identify the security policies to provide strong authentication
5. Understand basic ecommerce security protocols.

Unit 1: Introduction.

The History of Information Security, Balancing Information Security and Access, Introduction and Security Trends, General Security Concepts and introduction to what is an “info sphere”, Operational Security and People’s Role in Information Security.

Learning outcomes: Student should be able to

1. Understand various types of Information Security concepts (L2)
2. Analyze the role of information security.(L4)

Unit 2: Security Needs.

The Need for Security, Business Needs, Needs to protect against Threats and Attacks, Security in Emails. Secure Software Development.

Learning outcomes: Student should be able to

1. Understand the need of security to deal with the threats and attacks.(L2)

Unit 3: Cryptography Concepts.

Concepts of Data encryption, Introduction, Plaintext & Cipher text, Substitution Techniques, Transposition Techniques, Encryption & Decryption, Symmetric& Asymmetric key Cryptography. Public Key Infrastructure (PKI), Different attacks on Cryptosystems

Network Security & Web Security.

Security Issues in TCP/IP – TCP, DNS, Routing (Topics such as basic problems of security in TCP/IP, IPsec, BGP Security, DNS Cache poisoning etc), Network Defense tools – Firewalls, Intrusion Detection, Filtering, DNSSec, NSec3, Distributed Firewalls

Learning outcomes: Student should be able to

1. Understand various Cryptography Concepts (L2)
2. Analyze the impact of Symmetric& Asymmetric key Cryptography in real time applications (L4)
3. Understand Security Issues in TCP/IP. (L2)
4. Identify the tools to provide the web and network security. (L2)

What is security policy, high and low level policy, user issues? Protocol problems, assumptions, Shared secret protocols, public key protocols, mutual authentication, reflection attacks, use of timestamps, nonce and sequence numbers, session keys, one-and two-way public key based authentication.

1. Understand various Security Policies for authentication (L2)
2. Identity various Security Handshake (L2)

1. Apply the concepts of the cryptography and security in case studies. (L4)

1. Michael E Whitman and Herbert J Mattord, “Principles of Information Security”, Vikas Publishing House, New Delhi.
- 2 Micki Krause, Harold F. Tipton, “ Handbook of Information Security Management”, CRC Press LLC
3. AtulKahate, Cryptography and Network Security, McGraw Hill
- 4 Kaufman, c., Perlman, R., and Speciner, M., Network Security, Private Communication in a public world, 2nd ed., Prentice Hall PTR., 2002
5. Stallings, W.,Cryptography and Network Security: Principles and Practice, 3rd ed., Prentice Hall PTR.,2003
6. Stallings, W. Network security Essentials: Applications and standards, Prentice Hall, 2000

[illegible]

Subject Code	Subject Name	L	T	P	C
R23CSE-OE0021	QUANTUM COMPUTING	3	0	0	3

Course Objectives:

1. To understand the components of computing in a Quantum world
2. To gain knowledge on mathematical representation of quantum physics and operations.
3. To write computations in the real world (standard) in a Quantum computer and simulator.

Course Outcomes:

By the end of this course, the student is able to

1. Analyze the behavior of basic quantum algorithms
2. Implement simple quantum algorithms and information channels in the quantum circuit model
3. Simulate a simple quantum error-correcting code
4. Prove basic facts about quantum information channels
5. Know about Quantum Computing Models

UNIT –I:

Introduction: Quantum Measurements Density Matrices, Positive-Operator Valued Measure, Fragility of quantum information: Decoherence, Quantum Superposition and Entanglement, Quantum Gates and Circuits.

UNIT –II:

Quantum Basics and Principles: No cloning theorem & Quantum Teleportation, Bell's inequality and its implications, Quantum Algorithms & Circuits.

UNIT -III:

Algorithms: Deutsch and Deutsch–Jozsa algorithms, Grover's Search Algorithm, Quantum Fourier Transform, Shore's Factorization Algorithm.

UNIT –IV:

Performance, Security and Scalability: Quantum Error Correction: Fault tolerance; Quantum Cryptography, Implementing Quantum Computing: issues of fidelity; Scalability in quantum computing.

UNIT -V:

Quantum Computing Models: NMR Quantum Computing, Spintronics and QED MODEL, Linear Optical MODEL, Nonlinear Optical Approaches; Limits of all the discussed approaches, Future of Quantum computing.

Text Books:

1. Eric R. Johnston, Nic Harrigan, Mercedes and Gimeno-Segovia “Programming Quantum Computers: Essential Algorithms And Code Samples, SHROFF/O’Reilly.
2. Dr. Christine Corbett Moran, Mastering Quantum Computing with IBM QX: Explore the world of quantum computing using the Quantum Composer and Qiskit, Kindle Edition Packt

Subject Code	Subject Name	L	T	P	C
R23CSE-OE0022	BIG DATA ANALYTICS	3	0	0	3

Course Objectives:

- Optimize business decisions and create a competitive advantage with Big Data analytics
- Introducing Hadoop concepts for developing solutions.
- Derive business benefits from unstructured data
- Imparting the architectural concepts of Hadoop and introducing map- reduce paradigm
- To introduce programming tools PIG & HIVE in the Hadoop ecosystem.

Course Outcomes:

1. Understands the basic concepts and challenges of handling Big Data.
2. Applying data modelling techniques of Big Data.
3. Analyze Hadoop components & its applications.
4. Analyze spark for optimized query execution and memory caching.
5. Understand the Big data frame work and its applications.

UNIT-I

Introduction: Introduction to Big data, Characteristics & Classification of Data, Challenges of conventional systems(storage), Intelligent data analysis, The Life cycle of Big Data Analytics, Types of Big Data Analytics, Analytic processes, and tools, Big Data Industry Applications, Analysis vs. Reporting.

Learning Outcomes: Students will be able to

- Understands the Basic concept of Big Data.
- Understands their challenges in the industry

UNIT-II

Working with Big Data: Google File System, Hadoop Distributed File System (HDFS) –Building blocks of Hadoop (Name node, Datanode, Secondary Name node, Job Tracker, Task Tracker), What is NoSQL, Why NoSQL, Use of No SQL in Industry, Comparison of SQL, No SQL, and New SQL, No SQL Business Drivers, No SQL Case Studies,

Learning Outcomes: Students will be able to

- Understand HDFS and its basic building blocks
- Understand No SQL for working with Data sets.

UNIT-III

Introduction to Hadoop: why Hadoop, RDBMS versus Hadoop, History of Hadoop, Components of Hadoop, Hadoop Distributed File System (HDFS), Processing Data with Hadoop, How Map Reduce Works, Anatomy of a Map Reduce Job run, Map Reduce Features Hadoop environment. Interacting with Hadoop Ecosystem.

Learning Outcomes: Students will be able to

- Understand and implement Hadoop Components.
- Understand the Concept of Interacting with the Hadoop Ecosystem.

UNIT-IV

SPARK: SPARK BASICS, Using the Spark Shell, RDD Data Types and RDD Creation, RDDs (Resilient Distributed Datasets) in Spark, General RDD Operations: Transformations & Actions, RDD Lineage, RDD Persistence, Overview, Distributed Persistence

Learning Outcomes: Student will be able to

- Understand Hadoop Architecture,
- Explain about Hadoop Ecosystem components.

UNIT-V

Frameworks and Applications: HIVE : Hive Shell, Hive Services, Hive Meta store, Comparison with Traditional Databases **Learning,** Frameworks: Applications on Big Data Using Pig and Hive, Data processing operators in Pig, Hive Architecture of Hive, Hive services, HiveQL, Querying Data in Hive, fundamentals of H Base and Zoo keeper.

Outcomes: Students will be able to

- Work with PIG and Hive Tech.
- Understand programming tools of HIVE in the Hadoop ecosystem.
- Applying a complete business data analytics solution.

Text Books :

1. Big Data Analytics 2nd Edition, Seema Acharya, Subhashini Chellappan, Wiley India Pvt. Ltd, Second Edition, 1 Jan 2019.
2. Min Chen, Shiwen Mao, Yin Zhang, Victor C.M. Leung, "Big Data: Related Technologies, Challenges and Future Prospects", Springer; 2014.
3. Big Java 4th Edition, Cay Horstman, Wiley John Wiley & Sons, INC, by Wiley India Pvt. Ltd, 2008.
4. Hadoop: The Definitive Guide by Tom White, 3rd Edition, O'Reilly, 12 June 2012.
5. Tom White, "Hadoop- The Definitive Guide", O'reilly, 4th Edition, April 2015.

Reference Books :

1. Hadoop in Practice by Alex Holmes, MANNING Publ, Second Edition, 5 Feb 2015.
2. Hadoop MapReduce Cookbook, Srinath Perera, Thilina Gunarathne, Ingram short title, 1 Jan 2013.
3. Hadoop for Dummies by Dirk deRoos, Paul C. Zikopoulos, Roman B. Melnyk, Bruce Brown, Rafael Coss, by For Dummies, First Edition, 7 May 2014.
4. Eric Sammer, "Hadoop Operations", O'Reilly, 2nd Edition., October 2012.

Software Links :

1. Hadoop: <http://hadoop.apache.org/>+
2. Hive: <https://cwiki.apache.org/confluence/display/Hive/Home>
3. Pig latin: <http://pig.apache.org/docs/r0.7.0/tutorial.html>
4. http://www.jbonneau.com/doc/2012-04-27-big_data_lecture_1.pdf
5. https://www.ibm.com/developerworks/community/blogs/SusanVisser/entry/flash_book_understanding_big_data_analytics_for_enterprise_class_hadoop_and_streaming_data?lang=en

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
x.1	1	2	2	3	1	2	1	1	1	-	2	1	1	2	1
x.2	2	1	3	3	3	-	-	-	1	-	-	1	2	3	1
x.3	1	2	1	3	3	3	-	-	1	-	1	1	3	3	1
x.4	2	2	3	3	3	1	1	-	-	-	1	1	3	3	3
x.5	2	2	3	3	3	1	1	-	-	-	1	1	3	3	3

Subject Code	Subject Name	L	T	P	C
R23CSE-OE0023	BLOCK CHAIN TECHNOLOGIES	3	0	0	3

Course Objective:

1. To provide conceptual understanding of the function of Blockchain as a method of securing distributed ledgers.
2. To understand the structure of a Blockchain and why/when it is better than a simple distributed database
3. To make students understand the technological underpinnings of Blockchain operations as distributed data structures and decision making systems.

Course Outcomes:

Upon completion of the course, it is expected that student will be able to:

1. Define and explain the fundamentals of Blockchain.
2. Understand decentralization and the role of Blockchain in it.
3. Understand and analyze Bitcoin in Cryptocurrency and underlying Blockchain network.
4. Understand Ethereum currency and platform, and develop applications using Solidity.
5. Understand Hyper ledger project and its components; critically analyze the challenges and future opportunities in Block chain technology.

UNIT-I:

Introduction: History and basics, Types of Blockchain, Consensus, CAP Theorem.

Cryptographic Hash Functions: Properties of hash functions, Secure Hash Algorithm, Merkle trees, Patricia trees.

UNIT-II:

Decentralization: Decentralization using Blockchain, Methods of decentralization, decentralization framework, Blockchain and full ecosystem decentralization, Smart contracts, Decentralized Organizations, Platforms for decentralization.

UNIT-III:

Bitcoin: Introduction to Bitcoin, Digital keys and addresses, Transactions, Blockchain, The Bitcoin network, Bitcoin payments, Bitcoin Clients and APIs, Alternatives to Proof of Work, Bitcoin limitations.

UNIT-IV:

Ethereum: Smart Contracts, Introduction to Ethereum, The Ethereum network, Components of the Ethereum ecosystem, Blocks and Blockchain, Fee schedule, Ethereum Development Environment, Solidity.

UNIT-V:

Hyperledger: Introduction, Hyperledger Projects, Protocol, Architecture, Hyperledger Fabric, Sawtooth Lake, Corda.

Challenges and Opportunities: Scalability, Privacy, Blockchain for IoT, Emerging trends

Text Book:

1. Mastering Block chain, Imran Bashir, Second Edition, PacktPublishing.

References:

1. Mastering Bitcoin: Unlocking Digital Cryptocurrencies, 3rd Edition Andreas Antonopoulos,O'Reilly.
2. Blockchain Blueprint for a New Economy, Melanie Swan,O'Reilly.
3. Mastering Bitcoin: Programming the Open Blockchain, Antonopoulos, Andreas M. O'Reilly.
4. Blockchain Technology: Cryptocurrency and Applications, S. Shukla, M. Dhawan, S. Sharma, S. Venkatesan, Oxford University Press

Subject Code	Subject Name	L	T	P	C
R23CSE-OE0024	MULTIMEDIA APPLICATION DEVELOPMENT	3	0	0	3

COURSE OBJECTIVES: To learn

1. To understand the definition of multimedia
2. To understand and differentiate text, image, video & audio.
3. To describe the ways in which multimedia information is captured, processed, and rendered
4. Introduce multimedia quality of service (QoS) and to compare subjective and objective methods of assessing user satisfaction and multicast protocols to provide QoS guarantees
5. Discuss privacy and copyright issues in the context of multimedia

COURSE OUTCOMES: Upon successful completion of the course, the student is able to

1. Describe different realizations of multimedia tools and the way in which they are used
2. Analyze the structure of the tools in the light of low-level constraints imposed by the adoption of various QoS schemes (i.e. bottom up approach)
3. Analyze the effects of scale and use on both presentation and lower-level requirements (i.e. top down approach)
4. State the properties of different media streams;
5. Compare and contrast different network protocols and to describe mechanisms for providing QoS guarantees in the network.

UNIT – I Classes: 12

Introduction: Definitions - Brief history of Multimedia; its market; content and copyright –public Domain, establishment of Copyright, fair use, multimedia copyright issues; resources for multimedia developers – Uses of multimedia - Making multimedia : Stages of a project

UNIT – II Classes: 14

Hardware Macintosh Versus Windows Platform – Connections – SCSI – IDE – EIDE – ULTRA – IDE – ATA – ULTRA - ATA - Memory and Storage Devices - Input Devices - Output Hardware – Communication Devices Basic Software Tools :Text Editing - Word Processing - OCR Software - Painting and Drawing Tools - 3D Modeling and Animation Tools - Image Editing - Sound Editing – Animation – Video - Digital Movie tools - Movie Editors - Compressing Movie Files MLR Institute of Technology B.Tech-IT Academic Regulations & Syllabi – MLR18

UNIT – III Classes: 14

Text : Fonts – Designing – Choosing -Menus for Navigation - Buttons for Interaction – Fields for Readings - HTML Documents - Symbols and Icons – Animating - Fonts Foundries – Managing Fonts - Character sets and Alphabets - Mapping Text – Fontographer - Hypermedia Structures – Hypertext tools Sound : Power of sound - Multimedia System Sound - MIDI Versus Digital Audio - Preparing Digital Audio Files - Making MIDI Audio - Audio File Formats - Sound for the World Wide Web – Adding Sound to Your Multimedia Project - Toward Professional Sound - The Red Book Standard – Space Considerations - Production Tips - Audio Recording -

Keeping Track of Your Sounds - Testing and Evaluation

UNIT – IV Classes: 12

Introduction: The Bandwidth Bottleneck - Internet Services - MIME-Types - World Wide Web and HTML – Dynamic Web Pages and XML - Multimedia on the Web. Tools for the World Wide Web: Web Servers - Web Browsers - Web Page Makers and Site Builders - Plug ins and Delivery Vehicles - Text – Images –Sound - Animation, Video and Presentation - Beyond HTML - 3D Worlds, designing for the World Wide Web..

UNIT – V Classes: 08

Multimedia File Handling: Compression & De compression - Data & file formats standards - Digital voice, Audio, video – Video image and Animation - Full motion video - storage and retrieval Technologies

Text Books:

1. Multimedia making it work Tay Vaughan Tata McGrawHill, Delhi
2. Multimedia – Technology and applications David Hillman Galgotia Publications, Delhi

Subject Code	Subject Name	L	T	P	C
R23CSE-OE0025	MOBILE AD-HOC NETWORKS	3	0	0	3

Course Objectives:

- To understand the concepts of Ad Hoc Wireless Networks
- To understand the Data Transmission in MANETS
- To understand the MAC protocols for ad-hoc networks
- To understand and analyze the various routing protocols and model link cost
- Understanding cross layer design in Adhoc Networks

Course Outcomes:

1. Evaluate the principles and characteristics of mobile ad hoc networks (MANETs) and what distinguishes them from infrastructure-based networks
2. Discuss the challenges in designing MAC, routing, and transport protocols for wireless ad-hoc sensor networks
- 3.. Understand the MAC Protocols for Ad Hoc Wireless Networks
4. Illustrate the various Routing Protocols And Transport Layer In Ad Hoc Wireless
5. Demonstrate the issues and challenges in security provisioning and also familiar with the mechanisms for implementing security and trust mechanisms in MANETs and WSNs

UNIT - 1

INTRODUCTION: Introduction to ad-hoc networks – definition, characteristics features, applications. Characteristics of wireless channel, ad-hoc mobility models: indoor and outdoor models.

UNIT - 2

MEDIUM ACCESS PROTOCOLS: MAC Protocols: Design issues, goals and classification. Contention based protocols – with reservation, scheduling algorithms, protocols using directional antennas. IEEE standards: 802.11a, 802.11b, 802.11g, 802.15. HIPERLAN.

UNIT - 3

NETWORK PROTOCOLS: Routing Protocols: Design issues, goals and classification. Proactive Vs reactive routing, unicast routing algorithms, Multicast routing algorithms, hybrid routing algorithm, energy aware routing algorithm, hierarchical routing, QoS aware routing.

UNIT - 4

END – END DELIVERY AND SECURITY: Transport Layer: Issues in designing – Transport layer classification, adhoc transport protocols.

Security issues in adhoc networks: issues and challenges, network security attacks, secure routing protocols.

UNIT – 5

CROSS LAYER DESIGN:

Cross layer Design: Need for cross layer design, cross layer optimization, parameter optimization techniques, cross layer cautionary perspective. Integration of adhoc with Mobile IP networks.

TEXT BOOKS:

1. C. Siva Ram Murthy and B. S. Manoj, Ad hoc Wireless Networks Architecture and Protocols, 2nd edition, Pearson Edition, 2007.
2. Charles E. Perkins, Ad hoc Networking, Addison – Wesley, 2000.

REFERENCES:

1. Stefano Basagni, Marco Conti, Silvia Giordano and Ivan stojmenovic, Mobile ad-hoc networking, Wiley-IEEE press, 2004.
2. Mohammad Ilyas, The handbook of ad-hoc wireless networks, CRC press, 2002.
3. T. Camp, J. Boleng, and V. Davies “ A Survey of Mobility Models for Ad-hoc Network”
4. Research, “Wireless Commun, and Mobile Comp.. Special Issue on Mobile Ad-hoc Networking Research, Trends and Applications, Vol. 2, no. 5, 2002, pp. 483 – 502.
5. A survey of integrating IP mobility protocols and Mobile Ad-hoc networks, Fekri M.bduljalil and Shrikant K. Bodhe, IEEE communication Survey and tutorials, no: 12007.

COURSE OUTCOMES VS POs MAPPING (DETAILED; HIGH: 3; MEDIUM: 2; LOW: 1):

[illegible]

Subject Code	Subject Name	L	T	P	C
R23CIT-OE0001	Basics of Computer Networks	3	0	0	3

Course Objectives:

1. understand the contemporary technologies in network protocols and network architecture
2. To acquire the knowledge on design principles of network infrastructure. the basics Physical layer and their functionality.
3. Understand the functionalities of the Data Link Layer and their protocols.
4. Understand the functionalities of the Network Link Layer and routing Algorithms.
5. Analyze different protocols in Application Layer

Course Outcomes:

1. Analyze different types of network topologies, various Reference models.[L2]
2. Analyze network performance metrics and data transmission Techniques.[L4]
3. Analyze different data link layer framing techniques and Link Layer Protocols.[L4]
4. Analyze the medium access techniques and different routing algorithms.[L4]
5. Understand various Application layer protocols.[L2]

Unit 1:

10-Hours

Introduction: Components of a Data Communication system, Dataflow , Network Topologies Categories of Networks: LAN, MAN,WAN. Reference models- The OSI Reference Model- the TCP/IP Reference Model, Networking and Internet working Devices.

Learning Outcomes: Student will be able to

- Understand the Basics of Computer Networks (L2).
- Understand the data flow in a Computer Network and the use of protocols.(L2)
- Analyze the importance of each layer in the reference models.(L4).

Applications:

Conceptual Framework of a Network, ATM, Online reservation systems, reservation systems.

Unit 2:

9-Hours

Physical Layer:

Transmission Media: Guided,Unguided.Bandwidth,throughput,Latency.

Multiplexing: frequency division multiplexing, wave length division multiplexing, synchronous time division multiplexing, statistical time division multiplexing, switching techniques.

Learning Outcomes: Studentwill be able to

- Understand the Basics of physical functionality .(L2).
- Analyze different types of Multiplexing Techniques. (L4).
- Analyze the Network performance Evaluation metrics . (L4).

Applications:

Identify the use of different devices in real time computer networks and data processing tasks.

Unit 3:**10- Hours**

Data Link Layer: Design issues, Framing, flow control, error control, error detection and correction, CRC.

Data Link Layer protocols: simplex protocol, Simplex stop and wait, Simplex protocol for Noisy Channel. Sliding window protocols. HDLC configuration and transfer modes, HDLC frame format, control field

Learning Outcomes: Student will be able to

- Understand DataLink Layer Services to the Network Layer. (L2)
- Understand Error Correction and Detection techniques. (L2)
- Apply Detecting Codes for sample data. (L3)

Applications: Error correction and detecting procedures on binary data.

Unit 4:**10- Hours**

Random Access: ALOHA protocols, Carrier sense multiple access (CSMA), CSMA with Collision Detection, CSMA with Collision Avoidance

Network Layer: Routing algorithm, shortest path routing, Flooding, distance vector routing, Link state routing Algorithms, IPv4 address, subnetting, Congestion Control Algorithms.

Learning Outcomes: Student will be able to

- Understand random access protocols in data link layer and their functions. (L2)
- Analyze the static and dynamic routing Algorithms. (L4)
- Analyze the IPv4 Addressing ,sub netting.(L4)

Applications: setting up the routes for data packets to take, checking to see if a server in another network is up and running, and addressing and receiving IP packets from other networks.

UNIT –5 :**09-Hours**

The Transport Layer: addressing, TCP establishing a connection, releasing connection, TCP Header format, End to end protocols: UDP,.

Application layer: File Transfer(FTP), WWW: architecture ,client / server ,uniform resource locator, cookies, web documents: static ,dynamic, active document, HTTP transaction: persistent, non-persistent, Proxy server, HTTP Generic Message Format, HTTP Request Message Format, HTTP Response Message Format, Domain Name System (DNS), SMTP (Simple Mail Transfer Protocol).

Learning Outcomes: Student will be able to

- Understand the functions of Transport Layer protocols.(L2)
- Analyze the various protocols in application layer .(L4)

Applications: Users can forward several emails and it also provides a storage facility, allows users to access, retrieve and manage files in a remote computer layer provides access to global information about various services.

Text Books:

1. Data Communications and Networking ,Behrouz A Forouzan,fifth Edition.
2. Tanenbaum and David J Wetherall, Computer Networks, 5th Edition, Pearson Edu, 2010

Reference Books:

1. Computer Networks, Mayank Dave, CENGAGE
2. Larry L. Peterson and Bruce S. Davie, “Computer Networks - A Systems Approach” (5th ed), Morgan Kaufmann/ Elsevier, 2011

COURSE OUTCOMES VS POs MAPPING (DETAILED; HIGH: 3; MEDIUM: 2; LOW: 1):

SNO	PO 1	PO 2	P O3	P O4	P O5	P O6	P O7	P O8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO3
Cxx.1	3	3	2	1	3				3			1		2	3
Cxx.2	3	3	2	1					3			1		2	3
Cxx.3	3	3	2	1					3					2	3
Cxx.4	3	3	2	1	3				3			1		2	3
Cxx.5	3	1	1	1	3				3			1		2	3
Cxx.*	3	3	2	1	3				3			1		2	3

** For Entire Course, PO & PSO Mapping*

Subject Code	Subject Name	L	T	P	C
R23CIT-OE0002	Cryptography & Network Security	3	0	0	3

Course Objectives:

- Classical systems, symmetric block ciphers (DES, AES, other contemporary symmetric ciphers) are Introduced.
- Introduction to Public- key cryptography (RSA, discrete logarithms) is provided.
- Algorithms for factoring and discrete logarithms, cryptographic protocols, hash functions, authentication, key management, key exchange, signature schemes are learnt.
- An overview of e-mail and web security is provided.
- An overview of viruses, firewalls and system security is provided.

Course Outcomes:

1. Understand the basics of Cryptography, the goals, services and mechanisms.
2. Analyze the Symmetric Encryption Algorithms.
3. Analyze the Asymmetric Cryptographic Algorithms.
4. Understand the Digital signature Schemes.
5. Understand the email security and system security.

UNIT- I

Basic Principles Security Goals, Cryptographic Attacks, Services and Mechanisms, Mathematics of Cryptography

Learning Outcomes: Student will be able to

- Understand what is meant by Cryptography.(L1)
- Understand the goals, mechanisms and services of Cryptography.(L1)

UNIT- II

Symmetric Encryption Mathematics of Symmetric Key Cryptography, Introduction to Modern Symmetric Key Ciphers, Data Encryption Standard, Advanced Encryption Standard.

Learning Outcomes: Student will be able to

- Understand symmetric key Cryptography (L2)
- Analyze the various algorithms of Symmetric key Cryptography (L3)

UNIT- III

Asymmetric Encryption Mathematics of Asymmetric Key Cryptography, Asymmetric Key Cryptography

Learning Outcomes: Student will be able to

- Understand symmetric key Cryptography (L1)
- Analyze the various algorithms of Asymmetric key Cryptography(L2)

UNIT- IV

Data Integrity, Digital Signature Schemes & Key Management Message Integrity and Message Authentication, Cryptographic Hash Functions, Digital Signature, KeyManagement.

Learning Outcomes: Student will be able to

- Understand about Digital Signature and the security schemes.(L1)
- Understand the Hash functions and its importance.(L2)

UNIT -V

Network Security: Security at application layer: PGP and S/MIME, Security at the Transport Layer: SSL and TLS, IPSec, System Security.

Learning Outcomes: Student will be able to

- Understand email-security.(L1)
- Understand the mechanisms of Transport Layer Security.(L1)
- Understand about system security.(L2)

Text Books:

1. Cryptography and Network Security, Behrouz A Forouzan, Debdeep Mukhopadhyay, (3e) McGraw Hill.
2. Cryptography and Network Security, William Stallings, (6e) Pearson.
3. Everyday Cryptography, Keith M. Martin, Oxford.

Reference Books:

4. Network Security and Cryptography, Bernard Meneges, Cengage Learning

COURSE OUTCOMES VS POs MAPPING (DETAILED: HIGH: 3, MEDIUM: 2, LOW: 1)

CO \ PO/PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	3	2	1	1	3	2	1	1	1	1	1	2	3	2	2
CO2	3	3	2	2	3	1	1	1	1	1	1	2	3	3	2
CO3	3	3	3	2	3	1	1	1	2	2	2	3	3	3	3
CO4	3	3	2	3	3	1	1	1	2	2	2	3	3	3	3
CO5	3	3	2	3	3	1	1	1	2	2	2	3	3	3	3
	3	3	3	3	3	1	1	1	2	2	2	3	3	3	3

**For Entire Course, PO & PSO Mapping*

Subject Code	Subject Name	L	T	P	C
R23CIT-OE0003	Mobile Computing	3	0	0	3

Course Objectives:

- To understand the fundamentals of mobile communication
- To understand the architecture of various Wireless Communication Networks
- To understand the significance of different layers in mobile system Course Contents
- To understand the mobility supported protocols
- To apply the mobility support in real time

Course Outcomes:

1. Understand the fundamentals of mobile Networks
2. Apply knowledge in MAC, Network, and Transport Layer protocols of Wireless Network
3. Comprehend, design, and develop a lightweight network stack
4. Analyze the Mobile Network Layer system working
5. Understand WAP Model

UNIT- I

Introduction to Wireless Networks: Applications, History, Simplified Reference Model, Wireless transmission, Frequencies, Signals, Antennas, Signal propagation, Multiplexing, Modulation, Spread spectrum, Cellular Systems: Frequency Management and Channel Assignment, types of hand-off and their characteristics.

Learning Outcomes: Student will be able to

1. Understand the basic concepts of wireless networks (L2)
2. Understand the fundamentals of cellular system(L2)

UNIT-II

MAC – Motivation, SDMA, FDMA, TDMA, CDMA, Telecommunication Systems, GSM: Architecture Location tracking and call setup, Mobility management, Handover, Security, GSM, SMS, International roaming for GSM, call recording functions, subscriber and service data management, DECT, TETRA, UMTS, IMT-2000.

Learning Outcomes: Student will be able to

1. Understand the MAC layer functionalities (L2)
2. apply the strategy of subscriber and service data management(L3)

UNIT-III

Wireless LAN: Infrared vs. Radio transmission, Infrastructure, Adhoc Network, IEEE 802.11 WLAN Standards, Architecture, Services, HIPERLAN, Bluetooth Architecture & protocols.

Learning Outcomes: Student will be able to

1. Understand the wireless LAN functionalities(L2)
2. Understand the the various protocols in WLAN(L2)

UNIT-IV

Mobile Network Layer: Mobile IP, Dynamic Host Configuration Protocol, Mobile Transport Layer, Traditional TCP, Indirect TCP, Snooping TCP, Mobile TCP, Fast retransmit/Fast recovery, Transmission/Time-out freezing, Selective retransmission, Transaction Oriented TCP.

Learning Outcomes: Student will be able to

1. Understand the working of mobile network layer (L2)
2. Understand the concepts of mobile transport layer(L2)

UNIT-V

Support for Mobility: Wireless Application Protocol: Architecture, Wireless Datagram Protocol, Wireless Transport Layer Security, Wireless Transaction Protocol, Wireless Session Protocol, Wireless Application Environment, Wireless Markup Language, WML Scripts, Wireless Telephone Application.

Learning Outcomes: Student will be able to

1. Understand the working functionality of wireless protocols(L2)
2. Apply the wireless markup language in real time (L3)

Text Books:

1. Jochen Schiller, "Mobile Communication", Second Edition, Pearson Education, 2008.
2. "Mobile Computing: Principles and Practices" by Asoke K. Talukder, Roopa R. Yavagal

Reference Books:

1. William Stallings, "Wireless Communications and Networks", Second Edition, Pearson Education, 2004.
2. C. Siva Ram Murthy, B. S. Manoj, "Adhoc Wireless Networks: Architectures and Protocols", Second Edition, Pearson Education, 2008.

COURSE OUTCOMES VS POs MAPPING (DETAILED: HIGH: 3, MEDIUM: 2, LOW: 1)

COs	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	3	3	2	2	2				1		1	2	3	1	2
CO2	3	3	2	2	2				1			2	3	1	2
CO3	3	3	2		2			1			1	2	3	1	2
CO4	3	3	2		2			1	1			2	3	1	2
CO5	3	3	2		2			1	1		1	2	3	1	2
CO*	3	3	2	2	2				1			2	3	1	2

**For Entire Course, PO & PSO Mapping*

Subject Code	Subject Name	L	T	P	C
R23CIT-OE0004	Wireless Sensor Networks	3	0	0	3

Course Objectives:

- Define WSN and Dynamic modulation scaling.
- Explore working of the MAC protocols
- Demonstrate Routing and Data gathering protocols
- Illustrate working of Embedded OS.
- Explore a wide range of WSN applications in different sectors

Course Outcomes:

1. Understand the basics, characteristics and challenges of Wireless Sensor Network
2. Apply the knowledge to identify appropriate physical and MAC layer protocol
3. Apply the knowledge to identify the suitable routing algorithm based on the network and user requirement
4. Analysis of OS used in Wireless Sensor Networks and build basic modules
5. Analyze specific WSN application using a case study approach

Unit-I – CHARACTERISTICS OF WSN (8 Hours)

Characteristic requirements for WSN – Challenges for WSNs – WSN vs Adhoc Networks – Sensor node architecture – Commercially available sensor nodes – Imote, IRIS, Mica Mote, EYES nodes, BTnodes, TelosB, Sunspot -Physical layer and transceiver design considerations in WSNs, Energy usage profile, Choice of modulation scheme, Dynamic modulation scaling, Antenna considerations.

Learning Outcomes:

- Identify and explain the key characteristics
- Differentiate between Wireless Sensor Networks (WSNs) and Ad-hoc Networks
- Understand the role and functionalities of each component within the sensor node.

Unit – II: MEDIUM ACCESS CONTROL PROTOCOLS (10 Hours)

Fundamentals of MAC protocols – Low duty cycle protocols and wakeup concepts – Contention based protocols – Schedule-based protocols – SMAC – BMAC – Traffic adaptive medium access protocol (TRAMA) – The IEEE 802.15.4 MAC protocol.

Learning Outcomes:

- Describe the main challenges of MAC protocols in wireless sensor networks (WSNs)
- Understand the concept of low duty cycle operation and its importance
- Evaluate the performance characteristics of contention-based protocols, including throughput, latency, and energy efficiency

Unit – III: ROUTING AND DATA GATHERING PROTOCOLS (10 Hours)

Routing Challenges and Design Issues in Wireless Sensor Networks, Flooding and gossiping – Data centric Routing – SPIN – Directed Diffusion – Energy aware routing – Gradient-based routing –Rumor Routing – COUGAR – ACQUIRE – Hierarchical Routing – LEACH, PEGASIS – Location Based Routing – GF, GAF, GEAR, GPSR – Real Time routing Protocols – TEEN, APTEEN, SPEED, RAP – Data aggregation - data aggregation operations – Aggregate Queries in Sensor Networks – Aggregation Techniques – TAG, Tiny DB.

Learning Outcomes:

- Identify the key routing challenges in WSNs compared to traditional wired networks
- Analyze popular hierarchical routing protocols
- Analyze location-based routing protocols, Real-Time Routing Protocols

Unit – IV: EMBEDDED OPERATING SYSTEMS (10 Hours)

Operating Systems for Wireless Sensor Networks – Introduction – Operating System Design Issues – Examples of Operating Systems – TinyOS – Mate – MagnetOS – MANTIS – OSPM – EYES OS – SenOS – EMERALDS – PicOS – Introduction to Tiny OS – NesC – Interfaces and Modules – Configurations and Wiring – Generic Components – Programming in Tiny OS using NesC, Emulator TOSSIM.

Learning Outcomes:

- Understand the role and importance of operating systems in managing the resources and functionalities of Wireless Sensor Networks.
- Compare and contrast prominent WSN operating systems like TinyOS, Mate, MagnetOS, MANTIS, OSPM, EYES OS, SenOS, EMERALDS, and PicOS.
- Understand the strengths and weaknesses of each operating system in terms of features, resource management, and suitability.

Unit – V: APPLICATIONS OF WSN (10 Hours)

WSN Applications – Home Control – Building Automation – Industrial Automation – Medical Applications – Reconfigurable Sensor Networks – Highway Monitoring – Military Applications – Civil and Environmental Engineering Applications – Wildfire Instrumentation – Habitat Monitoring – Nanoscopic Sensor Applications – Case Study: IEEE 802.15.4 LR-WPANs Standard – Target detection and tracking – Contour/edge detection – Field sampling

Learning Outcomes:

- Identify the key characteristics of Wireless Sensor Networks (WSNs) that make them suitable for various applications.
- Analyze a specific WSN application through a Case Study
- Develop a basic understanding of common data analysis techniques used with WSN data

Text Books:

1. Wireless Sensor Networks Technology, Protocols, and Applications, KazemSohraby, Daniel Minoli and TaiebZnati, John Wiley & Sons, 2007
2. Protocols and Architectures for Wireless Sensor Network, Holger Karl and Andreas Willig John Wiley & Sons, Ltd ,2005

References Books:

1. A survey of routing protocols in wireless sensor networks , K. Akkaya and M. Younis, Elsevier
2. Ad Hoc Network Journal, Vol. 3, no. 3, pp. 325--349
3. TinyOS Programming , Philip Levis
4. Wireless Sensor Network Designs , Anna Ha'c , John Wiley & Sons Ltd

COURSE OUTCOMES VS POs MAPPING (DETAILED; HIGH: 3; MEDIUM: 2; LOW: 1) :

[illegible]

Course Code	Subject Name	L	T	P	C
R23CSM-OE0001	An Introduction to Artificial Intelligence	3	0	0	3

Prerequisites:

- Basic knowledge of programming, linear algebra, and probability & statistics.

Course Objectives:

- To focus is made on definition, scope, foundations, historical development, applications of AI, and core concepts such as the Turing Test and intelligent agents.
- To work on uninformed and informed search techniques, including heuristic and game-based approaches, to solve AI problems effectively.
- To differentiate between various knowledge representation techniques such as logic-based, semantic networks, frames, scripts, and conceptual dependency
- To introduce students to fundamental reasoning and learning techniques in Artificial Intelligence
- To analyse the impact of AI technologies on society, identify ethical challenges, and discuss current trends in AI research, robotics, and perception.

Course Outcomes:

- Understand the Fundamentals and Scope of AI
- Develop Problem-Solving and Search Strategy Skills
- Acquire Knowledge Representation Techniques
- Apply reasoning techniques and learning methods to solve problems under uncertainty
- Explore Emerging AI Topics and Ethical Considerations

Unit-1:

Introduction to Artificial Intelligence- Definition and scope of AI- AI Applications- Foundations of AI- History and Philosophy of AI- Turing Test and Intelligent Agents.

Unit-2:

Problem Solving and Search- Problem formulation- Uninformed search: BFS, DFS- Heuristic search: Hill Climbing, Best-First, A*- Game playing: Minimax, Alpha-Beta pruning.

Unit-3:

Knowledge Representation- Declarative vs Procedural Knowledge- Logic-Based Representations- Semantic networks, Frames, Scripts- Conceptual Dependency.

Unit-4:

Reasoning and Learning- Rule-based systems and Expert Systems, Fuzzy Sets and Fuzzy Logic, Machine Learning -Types of learning – Learning by analogy- explanation based learning.

Unit-5:

Emerging Topics and AI Ethics- Robotics and Perception- AI in society: Ethics, Bias, Safety- Current trends in AI research.

Text Book:

1. *Elaine Rich, Kevin Knight, and Shivashankar B. Nair , Artificial Intelligence, Tata McGraw-Hill Education*
2. *Stuart Russell and Peter Norvig – Artificial Intelligence: A Modern Approach, 3rd Edition, Pearson*
3. George F. Luger - Artificial Intelligence Principles and Practice (2025) -Springer

Reference Text Books:

4. N.P. Padhy, Artificial Intelligence and Intelligent Systems, Oxford University Press
5. *Nick Bostrom, Superintelligence: Paths, Dangers, Strategies*
6. *Cathy O'Neil, Weapons of Math Destruction*

Course Code	Subject Name	L	T	P	C
R23CSM-OE0002	Introduction to Machine Learning Using Python	3	0	0	3

Prerequisites:

- Basic knowledge of mathematics (linear algebra, probability, and statistics) and fundamental programming concepts.

Course Objectives:

- To introduce the fundamental concepts, types, and real-world applications of machine learning, and to familiarize students with essential tools such as Python, Jupyter Notebooks, and scikit-learn.
- To enable students to understand and perform essential data pre processing techniques including data cleaning, transformation, and visualization for machine learning tasks.
- To provide a solid foundation in implementing and evaluating supervised learning algorithms such as linear regression, logistic regression, decision trees, and k-nearest neighbours.
- To familiarize students with unsupervised learning methods including clustering and dimensionality reduction techniques, and their application to engineering problems.
- To develop students' ability to validate and tune machine learning models using appropriate techniques and apply their knowledge through case studies relevant to engineering domains.

Course Outcomes:

- Describe the fundamental concepts of machine learning and its types.
- Pre process and represent data effectively using Python libraries
- Implement basic supervised learning algorithms and evaluate their performance.
- Apply unsupervised learning techniques for data grouping and dimensionality reduction
- Perform model validation, avoid over fitting, and analyze real-world ML case studies.

Unit-1:

Introduction to Machine Learning -What is Machine Learning? - Types of Machine Learning: Supervised, Unsupervised, Reinforcement- ML in real-world engineering applications, Introduction to Python, scikit-learn, and Jupyter Notebooks, ML pipeline overview.

Unit-2:

Data Representation and Pre-Processing - Data types: numerical, categorical, Feature extraction and representation, handling missing values, scaling, normalization, encoding categorical variables, splitting data: train-test split, validation set, Visualization using Matplotlib.

Unit-3:

Supervised Learning Algorithms - Linear Regression, Logistic Regression, Decision Trees, K-Nearest Neighbours, Model evaluation: accuracy, confusion matrix, Bias-variance trade-off.

Unit-4:

Unsupervised Learning Algorithm and Dimensionality Reduction- Clustering: K-Means, Hierarchical clustering, Evaluation of clustering, Principal Component Analysis (PCA).

Unit-5:

Model Validation and Applications - Cross-validation, Over fitting and under fitting. Case Studies - Predictive maintenance, Demand Forecasting, Simple Recommendation Systems.

Text Book:

1. Andreas C. Müller & Sarah Guido – Introduction to Machine Learning with Python (O'Reilly, 2016)
2. Tom M. Mitchell – Machine Learning (McGraw-Hill, 1997) – for foundational concepts
3. Zhen _Leo_ Liu - Artificial Intelligence for Engineers_ Basics and Implementations (AI) (2025)-Springer

Reference Text Books:

4. Aurélien Géron – Hands-On Machine Learning with Scikit-Learn, Keras, and Tensor Flow (O'Reilly) – for optional deeper reading/projects

Course Code	Subject Name	L	T	P	C
R23CSM-OE0003	Foundation of Deep Learning for Engineering Applications	3	0	0	3

Prerequisites:

- Basic knowledge on python programming and overview on AI and Machine Learning

Course Objectives:

- To introduce the fundamentals of artificial and deep neural networks.
- To familiarize students with the working of popular deep learning architectures.
- To train students to implement and apply deep learning models using Python-based tools.
- To expose students to practical applications of deep learning across various engineering domains.
- To highlight the ethical and responsible use of deep learning technologies.

Course Outcomes:

- Describe the basic concepts and architecture of neural networks and their relevance to engineering applications.
- Explain the training process of neural networks and optimization techniques.
- Implement and evaluate convolutional and recurrent neural networks for solving problems in image and time-series.
- Apply deep learning techniques to domain-specific case studies.
- Analyse the ethical implications, limitations, and emerging trends in deep learning.

Unit-1:

Introduction to Neural Networks- Introduction to Artificial Neural Networks (ANN)- Biological inspiration, Perceptron, Activation functions, Neural network architecture: Input, Hidden, Output layers, Applications of deep learning in various engineering fields

Unit-2:

Training Neural Networks- Forward and backward propagation, Loss functions and optimization, Gradient descent and learning rate, Overfitting and underfitting. Introduction to TensorFlow and Keras frameworks

Unit-3:

Deep Architectures – CNN and RNN- Convolutional Neural Networks (CNN): Basics, layers, and applications, CNN for image classification and object detection, Recurrent Neural Networks (RNN): Basics, vanishing gradients

Unit-4:

Applications and Case Studies- Image processing -Defect detection, Biomedical imaging- Predictive maintenance in mechanical systems- Speech and signal recognition- Forecasting in energy and climate models

Unit-5:

Ethics, Challenges & Future Trends- Interpretability and explainability in deep learning, Bias and fairness in deep learning systems, Deep fakes and misuse of AI, Green AI and energy-efficient training. Future trends: Generative AI, Edge AI, TinyML

Text Book:

1. François Chollet – *Deep Learning with Python* – Manning Publications
2. Ian Good fellow, Yoshua Bengio, Aaron Courville – *Deep Learning* – MIT Press
3. Michael Nielsen – *Neural Networks and Deep Learning* – Online book

Reference Text Books:

4. Melanie Mitchell – *Artificial Intelligence: A Guide for Thinking Humans*-Farrar, Straus and Giroux

Course Code	Subject Name	L	T	P	C
R23CSM-OE0004	Natural Language Processing– Frontiers Approach	3	0	0	3

Prerequisites:

- A foundational understanding of programming, basic linguistics, and probability/statistics is essential.

Course Objectives:

- To learn the fundamentals of natural language processing
- To understand the use of CFG and PCFG in NLP
- To understand the role of semantics of sentences and Pragmatics
- To gain knowledge in automated natural language generation and machine translation
- To understand language modeling

Course Outcomes:

- Understand the fundamentals of basic language features
- Analyse the words involved in NLP
- Analyse the syntactic analysis involved in NLP
- Apply semantic Analysis for NLP
- Compare different statistical approaches of NLP applications.

Unit-1:

Introduction: Origins and challenges of NLP, Language Modeling: Grammar-based LM, Statistical LM – Regular Expressions, Finite-State Automata – English Morphology, Transducers for lexicon and rules, Tokenization, Detecting and Correcting Spelling errors.

Unit-2:

Word level analysis: Unsmoothed N-grams, Evaluating N-grams, Smoothing, Interpolation and Backoff – Word Classes, Part-of-Speech Tagging, Rule-based, Stochastic and Transformation-based tagging, Issues in Po Tagging –Hidden Markov and Maximum Entropy models.

Unit-3:

Syntactic analysis: Context-Free Grammars, Grammar rules for English, Normal Forms for grammar – Dependency Grammar – Syntactic Parsing, Ambiguity, Dynamic Programming parsing – Probabilistic CFG, Probabilistic CYK, Probabilistic Lexicalized CFGs – Feature structures, Unification of feature structures.

Unit-4:

Semantics Analysis: Requirements for representation, First-Order Logic, Description Logics –Syntax- Driven Semantic analysis, Semantic attachments– Word Senses, Relations between Senses, Thematic Roles, selection restrictions – Word Sense Disambiguation

Unit-5:

Discourse Analysis and Lexical Resources: Discourse segmentation, Coherence–Reference Phenomena, Anaphora Resolution using Hobbs and Centering Algorithm–Coreference Resolution – Resources: Porter Stemmer, Lemmatizer, Penn Treebank, Brill's Tagger, Word Net, Prop Bank, Frame Net, Brown Corpus, British National Corpus (BNC).

Text Book:

1. Daniel Jurafsky, James H. Martin — Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech, Pearson Publication, 2014.
2. Steven Bird, Ewan Klein and Edward Loper, —Natural Language Processing with Python, First Edition, O'Reilly Media, 2009.

Reference Text Books:

3. Breck Baldwin, — Language Processing with Java and Ling Pipe Cook book, Atlantic Publisher, 2015.
4. Richard M Reese, —Natural Language Processing with Java, O'Reilly Media, 2015.
5. Nitin Indurkha and Fred J. Damerau, —Handbook of Natural Language Processing, Second Edition, Chapman and Hall/CRC Press, 2010.
6. Tanveer Siddiqui, U.S. Tiwary, Natural Language Processing and Information Retrieval, Oxford University Press, 2008.