

COURSE STRUCTURE (R23) AND DETAILED SYLLABUS (III YEAR)

COMPUTER SCIENCE AND ENGINEERING

**For
B.Tech., Four Year Degree Course
(Applicable for the batches admitted from 2023-24)**



LENDI INSTITUTE OF ENGINEERING AND TECHNOLOGY

An Autonomous Institution

Approved by AICTE & Permanently Affiliated to JNTUGV, Vizianagaram

Accredited by NAAC with “A” Grade and NBA (CSE,ECE, EEE & ME)

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Computer Science and Engineering (R23)

R23_B.Tech III year - Course Structures and Detailed Syllabus

III Year I Semester						
S. No	Course Code	Course Name	L	T	P	Credits
1	R23CSE-PC3101	Operating Systems	3	0	0	3
2	R23CSE-PC3102	Computer Networks	3	0	0	3
3	R23CSE-PC3103	Compiler Design	3	0	0	3
4		Professional Elective-I	3	0	0	3
4	R23CSE-PE3101.1	1. Advanced Data Structures	3	0	0	3
4	R23CSE-PE3101.2	2. Advanced Computer Architecture	3	0	0	3
4	R23CSE-PE3101.3	3. Principles of Programming Languages	3	0	0	3
4	R23CSE-PE3101.4	4. Advanced Python Programming	3	0	0	3
5	R23CSE-OE3101	Open Elective- I	3	0	0	3
6	R23CSE-PC3104	Operating Systems & Compiler Design Lab	0	0	3	1.5
7	R23CSE-PC3105	Computer Networks Lab	0	0	3	1.5
8	R23CSE-SC3101	Java Full Stack Development(Skill Oriented Course)	0	1	2	2
9	R23CSE-ES3101	Tinkering LAB	0	0	2	1
10	R23BSH-MC3101	English and Soft Skills for Job Seekers (Mandatory Course)	0	1	2	0
11	R23CSE-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	R23CSE-PC3201	Design and Analysis of Algorithms	3	0	0	3
2	R23CSE-PC3202	Data warehousing & Data Mining	3	0	0	3
3	R23CSE-PC3203	Machine Learning	3	0	0	3
4		Professional Elective-II	3	0	0	3
4	R23CSE-PE3201.1	1. DevOps	3	0	0	3
4	R23CSE-PE3201.2	2. Mobile Computing	3	0	0	3
4	R23CSE-PE3201.3	3. Software Testing Methodologies	3	0	0	3
4	R23CSE-PE3201.4	4. Human Computer Interface	3	0	0	3
5		Professional Elective-III	3	0	0	3
5	R23CSE-PE3202.1	1. 1.Distributed Systems	3	0	0	3
5	R23CSE-PE3202.2	2. Advanced Computer Networks	3	0	0	3
5	R23CSE-PE3202.3	3. Introduction to Cloud Computing	3	0	0	3
5	R23CSE-PE3202.4	4. Natural Language Processing	3	0	0	3
6	R23CSE-OE3201	Open Elective - II	3	0	0	3
7	R23CSE-PC3204	Machine Learning Lab	0	0	3	1.5
8	R23CSE-PC3205	Data warehousing & Data Mining Lab	0	0	3	1.5
9	R23CSE-SC3201	Retail Management (Skill Oriented Course)	0	1	2	2
10	R23CSE-MC3201	Technical Paper Writing & IPR (Mandatory Course)	2	0	0	0
Total			20	1	8	23

Track- I (Web Framework)

Track- I (Web Framework)							
S.No	Year & Semester	Course Code	Subject title	L	T	P	C
1	II-II	R23CSE-HN2201	Angular JS Framework	3	0	0	3
2	III-I	R23CSE-HN3101	Design Patterns	3	0	0	3
3	III-II	R23CSE-HN3201	UX and UI Design Framework	3	0	0	3
4	IV-I	R23CSE-HN4101	Scalable Angular and Architecture Patterns	3	0	0	3
5	II Year to IV Year	R23CSE-HM0001.1	Honors MOOCS-1	0	0	0	3
6	II Year to IV Year	R23CSE-HM0001.2	Honors MOOCS-2	0	0	0	3
Total							18
Track-II (Artificial Intelligence)							
S.No	Year & Semester	Course Code	Subject title	L	T	P	C
1	II-II	R23CSE-HN2202	AI for Problem Solving.	3	0	0	3
2	III-I	R23CSE-HN3102	Social Network Analysis	3	0	0	3
3	III-II	R23CSE-HN3202	Deep Learning for Computer Vision	3	0	0	3
4	IV-I	R23CSE-HN4102	AI in Health Care	3	0	0	3
5	II Year to IV Year	R23CSE-HM0001.1	Honors MOOCS-1	0	0	0	3
6	II Year to IV Year	R23CSE-HM0001.2	Honors MOOCS-2	0	0	0	3
Total							18
Track III (Networks)							
S.No	Year & Semester	Course Code	Subject title	L	T	P	C
1	II-II	R23CSE-HN2203	Introduction to Networks	3	0	0	3
2	III-I	R23CSE-HN3103	Switching, Routing, and Wireless Essentials	3	0	0	3
3	III-II	R23CSE-HN3203	Enterprise Networking, Security, and Automation	3	0	0	3
4	IV-I	R23CSE-HN4103	Wireless Sensor Networks	3	0	0	3
5	II Year to IV Year	R23CSE-HM0001.1	Honors MOOCS-1	0	0	0	3
6	II Year to IV Year	R23CSE-HM0001.2	Honors MOOCS-2	0	0	0	3
Total							18
Track IV (Security)							
S.No	Year & Semester	Course Code	Subject title	L	T	P	C
1	II-II	R23CSE-HN2204	Cyber Security	3	0	0	3
2	III-I	R23CSE-HN3104	Secure Coding	3	0	0	3
3	III-II	R23CSE-HN3204	Vulnerability Assessment & Penetration Testing	3	0	0	3
4	IV-I	R23CSE-HN4104	Malware Analysis	3	0	0	3
5	II Year to IV Year	R23CSE-HM0001.1	Honors MOOCS-1	0	0	0	3
6	II Year to IV Year	R23CSE-HM0001.2	Honors MOOCS-2	0	0	0	3
Total							18

R23 CSE (MINORS)

Track-I (DATA SCIENCE)							
S. No	Year & Semester	Course Code	Subject title	L	T	P	C
1	II-II	R23CSE-MT2201	Database Management System	3	0	0	3
2	III-I	R23CSE-MT3101	Data Mining	3	0	0	3
3	III-I	R23CSE-ML3101	Database Management System Lab	0	0	3	1.5
4	III-II		Elective-1	3	0	0	3
		R23CSE-MT3201.1	1.Machine Learning				
		R23CSE-MT3201.2	2.Artificial Intelligence & Neural Networks				
5	III-II		Elective-2	0	0	3	1.5
		R23CSE-ML3201.1	1.Machine Learning Lab				
		R23CSE-ML3201.2	2.Artificial Intelligence & Neural Networks Lab				
6	IV-I		Elective-3	3	0	0	3
		R23CSE-MT4101.1	1.Deep Learning				
		R23CSE-MT4101.2	2.Image Processing				
7	II Year to IV Year	R23CSE-MM0001	Minors MOOCS-1	0	0	0	3
Total							18

Track-II (ARTIFICIAL INTELLIGENCE)							
S. No	Year & Semester	Course Code	Subject title	L	T	P	C
1	II-II	R23CSE-MT2202	Mathematics for Machine Learning	3	0	0	3
2	III-I	R23CSE-MT3102	AI Tools & Techniques	3	0	0	3
3	III-I	R23CSE-ML3102	AI Tools Lab	0	0	3	1.5
4	III-II	R23CSE-MT3202	Machine Learning Using Python	3	0	0	3
5	III-II	R23CSE-ML3202	Machine Learning Using Python Lab	0	0	3	1.5
6	IV-I	R23CSE-MT4102	AI for Data Science	3	0	0	3
7	II Year to IV Year	R23CSE-MM0001	Minors MOOCS-1	0	0	0	3
Total							18

Track-III (APPLICATION PROGRAMMING)							
S. No	Year & Semester	Course Code	Subject title	L	T	P	C
1	II-II		Elective-1	3	0	0	3
		R23CSE-MT2203.1	1.Python Programming				
		R23CSE-MT2203.2	2.Object Oriented Programming through C++				
2	III-I	R23CSE-MT3103	Java Programming	3	0	0	3
3	III-I	R23CSE-ML3103	Java Programming Lab	0	0	3	1.5
4	III-II	R23CSE-MT3203	Advanced Java Programming	3	0	0	3
5	III-II		Elective-2	0	0	3	1.5
		R23CSE-ML3203.1	1. Advanced Java Programming Lab				
		R23CSE-ML3203.2	2. Advanced Python Programming Lab				
			3. Object Oriented Programming through C++ Lab				
6	IV-I		Elective-3	3	0	0	3
		R23CSE-MT4103.1	1. Dot Net Programming				
		R23CSE-MT4103.2	2. Java Enterprise Framework				
7	II Year to IV Year	R23CSE-MM0001	Minors MOOCS-1	0	0	0	3
Total							18

Track-IV (WEB PROGRAMMING)							
S. No	Year & Semester	Course Code	Subject title	L	T	P	C
1	II-II	R23CSE-MT2204	Web UI Framework	3	0	0	3
2	III-I	R23CSE-MT3104	Angular Framework	3	0	0	3
3	III-I	R23CSE-ML3104	Angular Framework Lab	0	0	3	1.5
4	III-II		Elective-1	3	0	0	3
		R23CSE-MT3204.1	1.Mobile App Development				
		R23CSE-MT3204.2	2.DJango Framework				
5	III-II		Elective-2	0	0	3	1.5
		R23CSE-ML3204.1	1.MobileApp Development Lab				
		R23CSE-ML3204.2	2.DJango Framework Lab				
6	IV-I		Elective-3	3	0	0	3
		R23CSE-MT4104.1	1.React Framework				
		R23CSE-MT4104.2	2.Node Framework				
7	II Year to IV Year	R23CSE-MM0001	Minors MOOCS-1	0	0	0	3
Total							18

R23_Open Electives Courses for CSE

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	R23CSS-OE0001	Operating Systems	3	0	0	3
2	R23CSS-OE0002	Redhat Linux	3	0	0	3
3	R23CSS-OE0003	Cloud Computing	3	0	0	3
4	R23CSS-OE0004	Distributed Operating System	3	0	0	3
5	R23CIT-OE0001	Basics of Computer Networks	3	0	0	3
6	R23CIT-OE0002	Cryptography and Network Security	3	0	0	3
7	R23CIT-OE0003	Mobile Computing	3	0	0	3
8	R23CIT-OE0004	Wireless sensor networks	3	0	0	3
9	R23CSM-OE0001	An Introduction to Artificial Intelligence	3	0	0	3
10	R23CSM-OE0002	Introduction to Machine Learning with Python	3	0	0	3
11	R23CSM-OE0003	Foundation of Deep Learning for Engineering Applications	3	0	0	3
12	R23CSM-OE0004	Natural Language Processing- Frontiers Approach	3	0	0	3

Computer Science and Engineering (R23)
R23_B.Tech III year - Course Structures and Detailed Syllabus

III Year I Semester						
S. No	Course Code	Course Name	L	T	P	Credits
1	R23CSE-PC3101	Operating Systems	3	0	0	3
2	R23CSE-PC3102	Computer Networks	3	0	0	3
3	R23CSE-PC3103	Compiler Design	3	0	0	3
4		Professional Elective-I	3	0	0	3
4	R23CSE-PE3101.1	1. Advanced Data Structures	3	0	0	3
4	R23CSE-PE3101.2	2. Advanced Computer Architecture	3	0	0	3
4	R23CSE-PE3101.3	3. Principles of Programming Languages	3	0	0	3
4	R23CSE-PE3101.4	4. Advanced Python Programming	3	0	0	3
5	R23CSE-OE3101	Open Elective- I	3	0	0	3
6	R23CSE-PC3104	Operating Systems & Compiler Design Lab	0	0	3	1.5
7	R23CSE-PC3105	Computer Networks Lab	0	0	3	1.5
8	R23CSE-SC3101	Java Full Stack Development(Skill Oriented Course)	0	1	2	2
9	R23CSE-ES3101	Tinkering LAB	0	0	2	1
10	R23BSH-MC3101	English and Soft Skills for Job Seekers (Mandatory Course)	0	1	2	0
11	R23CSE-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	R23CSE-PC3201	Design and Analysis of Algorithms	3	0	0	3
2	R23CSE-PC3202	Data warehousing & Data Mining	3	0	0	3
3	R23CSE-PC3203	Machine Learning	3	0	0	3
4		Professional Elective-II	3	0	0	3
4	R23CSE-PE3201.1	1. DevOps	3	0	0	3
4	R23CSE-PE3201.2	2. Mobile Computing	3	0	0	3
4	R23CSE-PE3201.3	3. Software Testing Methodologies	3	0	0	3
4	R23CSE-PE3201.4	4. Human Computer Interface	3	0	0	3
5		Professional Elective-III	3	0	0	3
5	R23CSE-PE3202.1	1. 1.Distributed Systems	3	0	0	3
5	R23CSE-PE3202.2	2. Advanced Computer Networks	3	0	0	3
5	R23CSE-PE3202.3	3. Introduction to Cloud Computing	3	0	0	3
5	R23CSE-PE3202.4	4. Natural Language Processing	3	0	0	3
6	R23CSE-OE3201	Open Elective - II	3	0	0	3
7	R23CSE-PC3204	Machine Learning Lab	0	0	3	1.5
8	R23CSE-PC3205	Data warehousing & Data Mining Lab	0	0	3	1.5
9	R23CSE-SC3201	Retail Management (Skill Oriented Course)	0	1	2	2
10	R23CSE-MC3201	Technical Paper Writing & IPR (Mandatory Course)	2	0	0	0
Total			20	1	8	23

Course Code	Subject Name	L	T	P	C
R23CSE-PC3101	Operating Systems	3	0	0	3

Course Objectives:

- Provide knowledge about the services rendered by operating systems.
- Present detail discussion on processes, threads and scheduling algorithms.
- Expose the student with different techniques of handling deadlocks.
- Discuss various file-system implementation issues and memory management techniques.
- Learn the basics of Linux operating system.

Course Outcomes:

1. Understand the importance of operating systems and different types of system calls (L2).
2. Analyze process scheduling algorithms and various IPC mechanisms (L4).
3. Understand the process synchronization, different ways for deadlocks handling (L2).
4. Analyze different page replacement methods, various File management techniques (L4).
5. Understand Android environment and behavior (L2).

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.

Learning outcomes: Student should be able to

1. Understand operating system structure and functions. (L2).
2. Understand operating system services and system calls (L2).

UNIT-II:

Process Management: Process concept: Process Concept, Process Scheduling, Operations on Processes, Interprocess Communication.

Multithreaded Programming: Overview, Multithreading models, Threading Issues.

Process scheduling: Basic Concepts, Scheduling Criteria, Scheduling Algorithms.

Learning outcomes: Student should be able to

1. Identify various message sharing mechanisms used in IPC. (L2).
 2. Understand how to handling multiple threads. (L2).
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3. Differentiate between preemptive, non-preemptive and real time CPU scheduling(L2).

UNIT-III:

Synchronization: Process Synchronization, The Critical-Section Problem- Dekker's Solution, Petersons Solution, 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.

Learning outcomes: Student should be able to

1. Analyze various solutions for process synchronization. (L4).
2. Analyze the reasons for deadlocks and proposed solutions to detect, avoid, recover from deadlocks. (L4).

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.

Learning outcomes: Student should be able to

1. Demonstrate the ability to implement various memory management techniques (L2)
2. Illustrate various demand paging techniques. (L2).

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

Android Software Platform: Android Architecture, Operating System Services, Android Runtime Application Development, Application Structure, Application Process management

Learning outcomes: Student should be able to

1. Identify various file management and optimization techniques. (L2).
 2. Understand how data streams are exchanged between I/O subsystems.(L2).
 3. Analyze various storage structures to store the data in secondary memory. (L4).
 4. Analyze different disk scheduling algorithms. (L4).
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Text Books:

1. Silberschatz A, Galvin P B, and Gagne G, Operating System Concepts, 9th edition, Wiley, 2013.
2. Tanenbaum A S, Modern Operating Systems, 3rd edition, Pearson Education, 2008.

References:

1. Tanenbaum A S, Woodhull A S, Operating Systems Design and Implementation, 3rd edition, PHI, 2006.
2. Dhamdhere D M, Operating Systems A Concept Based Approach, 3rd edition, Tata McGraw-Hill, 2012.
3. Stallings W, Operating Systems -Internals and Design Principles, 6th edition, Pearson Education, 2009.
4. Nutt G, Operating Systems, 3rd edition, Pearson Education, 2004

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	P S O 1	P S O 2	P S O 3
C301.1	3	2	1	1								2		2	3
C301.2	3	3	3	2								2	1	2	3
C301.3	3	3	2	2	2							2	1	2	2
C301.4	3	3	2	1								2	1		3
C301.5	3	2	2	1								2	1		3
C301.*	3	3	2	2	2							2	1	2	3

* For Entire Course, PO & PSO Mapping

Subject Code	Subject Name	L	T	P	C
R23CSE-PC3102	Computer Networks	3	0	0	3

Course Objectives:

- Understand fundamental concepts of computer networks
- To acquire the knowledge on design principles of network infrastructure. the basics Physical layer and their functionality.
- Understand the functionalities of the Data Link Layer and their protocols.
- Understand the functionalities of the Network Link Layer and routing Algorithms.
- 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, network hardware, network software, reference models: OSI, TCP/IP, Internet.

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: Student will 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, error detection and correction, CRC.**Data Link Layer protocols:** Simplex protocol for Noisy Channel. HDLC configuration and transfer modes, HDLC frame format, point to point protocol (PPP): frame format, 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 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, Hierarchical routing, Broad cast, Multi cast Routing, the network layer in the internet (IPv4), 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, Internet transport layer protocols: UDP and TCP**Application layer:** www architecture , 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. Computer Networks, Andrew S. Tanenbaum, Fifth Edition, Pearson Education
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Reference Books:

1. Computer Networks, Mayank Dave, Cengage India Private Limited; 1st edition (1 January 2012);
2. D. Comer, "Computer Networks and Internets", Pearson; 6th edition (2 January 2014)
3. 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	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO3
Cxx.1	3	3	2	1	3	-	-	-	3	-	-	1	2	2	3
Cxx.2	3	3	2	1	-	-	-	-	3	-	-	1	2	2	3
Cxx.3	3	3	2	1	-	-	-	-	3	-	-	-	2	2	3
Cxx.4	3	3	2	1	3	-	-	-	3	-	-	1	2	2	3
Cxx.5	3	1	1	1	3	-	-	-	3	-	-	1	2	2	3
Cxx.*	3	3	2	1	3	-	-	-	3	-	-	1	2	2	3

** For Entire Course, PO & PSO Mapping*

Subject Code	Subject Name	L	T	P	C
R23CSE-PC3103	Compiler Design	3	0	0	3

Course Objectives: To teach concepts of language translation and phases of compiler design

- To describe the common forms of parsers
- To inculcate knowledge of parser by parsing LL parser and LR parser
- To demonstrate intermediate code using technique of syntax directed translation
- To Illustrate the various optimization techniques for designing various optimizing compiler

Course Outcomes:

1. Understand the functionalities of compilation phases, role of lexical analyzer and Use of LEX Tool in compiler design. [L2]
2. Analyze the working process of top-down parser.[L4]
3. Analyze the working process of Bottom-up parser. [L4]
4. Understand the symbol table and storage organization techniques. [L2]
5. Design the optimized code by applying optimization techniques. [L3]

UNIT-I

Overview of language processing, preprocessors, compiler, assembler, interpreters, linkers & loaders, structure of a compiler, phases of a compiler. Lexical Analysis, Role of Lexical Analysis, Structure of LEX Tool, LEX program to design Lexical analyzer, Lexical Analysis Vs. Parsing, Token, patterns and Lexemes, Lexical Errors, Regular Expressions, Regular definitions for the language constructs, Strings, Sequences, Comments, Transition diagram for recognition of tokens, Reserved words and identifiers, Examples.

Learning outcomes: Student should be able to

1. Analyze the differences between different translators. [L4]
2. Differentiate the various phases of a compiler. [L4]
3. Understands the role of parser. [L2]
4. Designing lexical analyzer for the programming phrase. [L3]

Applications:

1. Program Translations
2. Designing new Tools

UNIT-II

Syntax Analysis, Role of a parser, classification of parsing techniques, Top down parsing, First and Follow, Predictive parsers, LL (1) Grammars, Non-Recursive predictive parsing, String parsing, Error recovery in predictive parsing.

Learning outcomes: Student should be able to

1. Understand the differences between Top-Down and Bottom-Up parsing techniques.[L2]
2. Apply parsing techniques to design Top-Down parser. [L3]
3. Understand the error recovery in Top-Down parsing. [L2]

Applications:

1. Design new parsers
2. String parsing

UNIT -III

Introduction to simple LR, Why LR Parsers, Model of an LR Parsers, Operator Precedence, Shift Reduce Parsing, Difference between Top Down and Bottom up parsing, Construction of SLR Tables, Go to and Closure properties.

More powerful LR parses, construction of CLR (1), LALR Parsing tables, Dangling ELSE Ambiguity, Error recovery in LR Parsing.

Learning outcomes: Student should be able to

1. Understand the model of LR parser. [L2]
2. Apply parsing techniques to design Bottom-Up parser. [L3]
3. Understand the error recovery in Bottom-Up parsing. [L2]

Applications:

1. Design new parsers
2. String parsing

UNIT-IV

Semantic analysis, SDT, evaluation of semantic rules, Role symbol tables, use of symbol tables. Runtime Environment: storage organization, Different types of storage organization techniques, stack allocation, access to non-local data, heap management, parameter passing mechanisms.

Learning outcomes: Student should be able to

1. Apply syntax directed translation techniques. (SDT) [L3]
2. Understand the structure of symbol table. [L2]
3. Understand the storage organization. [L2]

Applications:

1. Data storage organization.
2. Memory management

UNIT-V

Intermediate code, three address code, quadruples, triples, Indirect Triples, abstract syntax trees, Steps to design basic block, basic blocks, Data Flow Diagram. Machine independent code optimization, Common sub expression elimination, constant folding, copy propagation, dead code elimination, strength reduction, code motion, and induction variable elimination.

Machine dependent code optimization: Peephole optimization, register allocation, instruction scheduling, inter procedural optimization, garbage collection via reference counting.

Learning outcomes: Student should be able to

1. Design intermediate code for various statements and expressions. [L6]
2. Design data flow graph and to optimize the data flow graph. [L6]
3. Design code generator and apply code optimization techniques. [L6]

Applications:

1. Code optimization
-

Text Books:

1. Compilers, Principles Techniques and Tools- Alfred V Aho, Monical S Lam, Ravi Sethi, Jeffrey D. Ullman, 2nd ed, Pearson, 2007.
2. Principles of compiler design, V. Raghavan, 2nd ed, TMH, 2011.
3. Principles of compiler design, 2nd ed, Nandini Prasad, Elsevier

Reference Books:

1. <http://www.nptel.iitm.ac.in/downloads/106108052/>
2. Compiler construction, Principles and Practice, Kenneth C Loudon, CENGAGE
3. Implementations of Compiler, A new approach to Compilers including the algebraic methods, Yunlinsu, SPRINGER

COURSE OUTCOMES VS POs MAPPING (DETAILED; HIGH: 3; MEDIUM: 2; LOW: 1):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	3	2			2	2		2	2	2	3
CO2	3	3	3	3		3			2	2		2	2	2	3
CO3	3	3	3	3		3			2	2		2	2	2	3
CO4	3	3	3	3		2			2	2		2	2	1	3
CO5	3	3	3	3		3			2	2		3	3	2	3

Subject Code	Subject Name	L	T	P	C
R23CSE-PE3101.1	Advanced Data Structures	3	0	0	3

Course Objectives:

- Demonstrate the importance of External Sorting Techniques
- Describe the various implements of Hashing Techniques, variants of trees, heaps, queues and analysis
- Understand the Binary Heap operations and Binomial Queues Operations
- Apply different tree balancing operations to perform efficient search operation
- Deal with the Optimal and Efficient binary search trees and Multi-way Trees

Course Outcomes:

1. Apply external sorting algorithms on massive amounts of data.
2. Analyze hashing concepts like static hashing and dynamic hashing.
3. Analyze concepts of Binary Heap and binomial queues in real time applications such as event simulations problem, selection problem.
4. Construct the data structures such as AVL, Red-Black and Optimal Binary Search Trees for faster searching in directories.
5. Apply data structures such as M-way search trees, B trees and B+ trees in data base indexing and Analyze digital search structures such as binary tries and Patricia

UNIT-I:

SORTING: External Sorting, Introduction, K-way Merging - Buffer Handling for parallel Operation- Run Generation- Optimal Merging of Runs.

Learning outcomes: Student should be able to

1. Understand the External sorting techniques with some examples(L2)
2. Understand Differences between internal and external sorting techniques(L2)
3. Implement the K-way Merging Techniques(L6)

UNIT-II:

HASHING: Introduction-Static Hashing- Hash Table- Hash Functions- Overflow Handling-Theoretical Evaluation of Overflow Techniques, Dynamic Hashing- Motivation for Dynamic Hashing -Dynamic Hashing Using Directories- Directory less Dynamic, Hashing,

Learning outcomes: Student should be able to

1. Understand the Hashing Techniques for Dictionaries(L2)
 2. Implement the various techniques of Hashing Techniques(L6)
 3. To identify the differences between Directory less and Directory oriented concepts(L2)
-

UNIT -III:

PRIORITY QUEUES (HEAPS): Model, Simple Implementation, Binary Heap-Structure Property-Heap-Order Property-Basic Heap Operations- Other Heap Operation, Applications of Priority Queues- The Selection Problem Event Simulation Problem, Binomial Queues- Binomial Queue Structure – Binomial Queue Operation- Implementation of Binomial Queues

Learning outcomes: Student should be able to

1. Understand the concepts of Binary Heap and Binomial Queues(L2)
2. Apply the Heap techniques in Priority Queues(L4)

UNIT-IV:

EFFICIENT BINARY SEARCH TREES: Optimal Binary Search Trees, AVL Trees, Red-Black Trees, Definition- Representation of a Red- Black Tree- Searching a Red-Black Tree- Inserting into a Red Black Tree- Deletion from a Red-Black Tree- Joining Red-Black Trees, Splitting a Red-Black tree. Splay tree Introduction

Learning outcomes: Student should be able to

1. Understand different Balanced Binary Search trees like AVL,OBST, Red-Black Trees(L2)
2. Apply the data structures such as AVL, Red-Black and Optimal Binary Search Trees for faster searching in directories. (L4)

UNIT-V:

MULTIWAY SEARCH TREES:M-Way Search Trees, Definition and Properties- Searching an M-Way Search Tree, B-Trees, Definition and Properties- Number of Elements in a B-tree- Insertion into B-Tree- Deletion from a B-Tree- B+-Tree Definition- Searching a B+-Tree- Insertion into B+-tree- Deletion from a B+-Tree.

Learning outcomes: Student should be able to

1. Understand the concepts of B-Trees and B+ Trees(L2)
2. Apply data structures such as M-way search trees, B trees and B+ trees in data base indexing(L4)

Applications:

- Databases: Sorting is crucial in databases for optimizing search operations. ...
- Search Algorithms: Many search algorithms, like binary search, work efficiently on sorted data.
- Systems that are distributed, Compiler Symbol Tables, Compiler Symbol Tables
- A balanced binary search tree called an AVL tree uses rotation to keep things balanced.
- It may be used in games with plotlines as well.
- It is mostly utilized in business sectors where it is necessary to keep records on the employees that work there and their shift changes.

Contemporary Topic :

- Splay Trees
-

TEXT BOOKS:

1. Data Structures, a Pseudo code Approach, Richard F Gilberg, Behrouz A Forouzan, Cengage
2. Fundamentals of DATA STRUCTURES in C: 2nd ed, , Horowitz , Sahani, Andersonfreed, Universities Press
3. Data structures and Algorithm Analysis in C, 2nd edition, Mark Allen Weiss, Pearson

REFERENCE BOOKS:

1. File Structures :An Object oriented approach with C++, 3rd ed, Michel J Folk, Greg Riccardi, Bill Zoellick
2. C and Data Structures: A Snap Shot oriented Treatise with Live examples from Science and Engineering, NB Venkateswarlu & EV Prasad, S Chand, 2010.

WEB REFERENCES:

1. Web : <http://lcm.csa.iisc.ernet.in/dsa/dsa.html>
2. http://utubersity.com/?page_id=878
3. <http://freevideolectures.com/Course/2519/C-Programming-and-Data-Structures>
4. <http://freevideolectures.com/Course/2279/Data-Structures-And-Algorithms>

COURSE OUTCOMES VS POs MAPPING (DETAILED; HIGH: 3; MEDIUM: 2; LOW: 1):

COs	P O1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	3	2	2	2	1				1			2	2	1	2
CO2	2	3	2	1	1				1			2	2	1	1
CO3	3	2	2	1	1				1			2	2	1	1
CO4	3	3	2	2	1				1			2	2	1	3
CO5	3	2	3	1	1				1			2	2	1	2

Subject Code	Subject Name	L	T	P	C
R23CSE-PE3101.2	Advanced Computer Architecture	3	0	0	3

UNIT -I

Fundamentals of Computer Design: Fundamentals of Computer design, Changing faces of computing and task of computer designer, Technology trends, Cost price and their trends, Measuring and reporting performance, Quantitative principles of computer design, Amdahl's law. Instruction set principles and examples- Introduction, Classifying instruction set- Memory addressing- type and size of operands, Operations in the instruction set.

UNIT –II

Pipelines: Introduction, Basic RISC instruction set, Simple implementation of RISC instruction set, Classic five stage pipe lined RISC processor, Basic performance issues in pipelining, Pipeline hazards, Reducing pipeline branch penalties. **Memory Hierarchy Design:** Introduction, Review of ABC of cache, Cache performance, Reducing cache miss penalty, Virtual memory.

UNIT -III

Instruction Level Parallelism the Hardware Approach: Instruction- Level parallelism, Dynamic scheduling, Dynamic scheduling using Tomasulo's approach, Branch prediction, high performance instruction delivery- hardware based speculation. **ILP Software Approach** Basic compiler level techniques, Static branch prediction, VLIW approach, Exploiting ILP, Parallelism at compile time, Cross cutting issues -Hardware verses Software.

UNIT –IV

Multi Processors and Thread Level Parallelism: Multi Processors and Thread level Parallelism- Introduction, Characteristics of application domain, Systematic shared memory architecture, Distributed shared – memory architecture, Synchronization.

UNIT –V

Inter Connection and Networks: Introduction, Interconnection network media, Practical issues in interconnecting networks, Examples of inter connection, Cluster, Designing of clusters. **Intel Architecture:** Intel IA-64 ILP in embedded and mobile markets Fallacies and pit falls.

TEXT BOOKS:

1. John L. Hennessy, David A. Patterson - Computer Architecture: A Quantitative Approach, 3rd Edition, An Imprint of Elsevier.

REFERENCE BOOKS:

1. John P. Shen and Miikko H. Lipasti - Modern Processor Design : Fundamentals of Super Scalar Processors
2. Computer Architecture and Parallel Processing - Kai Hwang, Faye A.Brigs., MC Graw Hill.
3. Advanced Computer Architecture - A Design Space Approach – Dezso Sima, Terence Fountain, Peter Kacsuk , Pearson Ed.

COURSE OUTCOMES v/s Pos MAPPING (Detailed: HIGH: 3; MEDIUM: 2; LOW:1):

S.NO	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	PO 12	PSO 1	PS O 2	PSO 3
CO 1	2	3	3				2							2	2
CO 2	3	3	3			2			3					3	3
CO 3	3	3	3									2		2	3
CO 4	2	3	3			3			2			2		3	3
CO 5	3	2	3			3		3				3		2	3
	3	3	3			3	2	3	2			2		3	3

Subject Code	Subject Name	L	T	P	C
R23CSE-PE3101.3	Principles Of Programming Language	3	0	0	3

Course Objectives:

- To understand and describe syntax and semantics of programming languages
- Understand the significance and implementation of programming languages in a compiler or interpreter
- To implement programs in an Imperative, functional, logical and object-oriented programming languages
- Learning principles to design new programming languages
- Increase capacity to express programming concepts alternative ways

Course Outcomes:

1. Design and implement the concepts of data types, arrays, pointers and control structures in various programming languages (L6)
2. Design and implement basic concepts of subprograms in various programming languages (L6)
3. Design and implement basic concepts of OOPs, Multithreading and Exception handling in various programming languages. (L6)
4. Understand the basic knowledge of lambda calculus, functional programming languages, Programming with Scheme, Programming with ML (L2)
5. Understand the basic knowledge of Logic programming, Prolog and Multi-paradigm languages. (L2)

Unit I: Evolution of programming languages, Names, variables, binding, Type checking, scope Rules, primitive data types, strings, array types, associative arrays, Record types, union types, pointers and references, Arithmetic expressions, overloaded operators, relational & Boolean expressions Statements & mixed mode assignments, control structures

Learning Outcomes: Student should be able to

1. Apply the data types, declarations and expressions in the languages (L3)
2. Understand various control statements (L2)

Unit II: Subprograms & Design issues, Local reference, Parameter passing, Overloaded& Generic Methods, Design issues for functions, Semantics of call & Return, Implementing programs Stack & Dynamic local variables, Nested subprograms, Blocks, Dynamic scoping

Learning outcomes: Student should be able to

1. Understand various parameter passing methods (L2)
2. apply scoping in various languages (L3)

Unit III : Object-Orientation, Design issues for oops languages, Implementation of object oriented constructs, Concurrency: Semaphores, monitors, Message passing, Threads, Statement level concurrency, Exception handling, Event handling.

Learning outcomes: Student should be able to

1. Understand various concurrency techniques (L2)
2. Apply object oriented concepts in the real time applications (L3)

Unit IV: Introduction to lambda calculus, fundamentals of functional programming languages, Programming with Scheme, Programming with ML.

Learning outcomes: Student should be able to

1. Understand the fundamentals concepts of functional programming languages (L2)

Unit V: Introduction, Logic programming overview, Basics of prolog, Applications of Logic programming, Programming with prolog, Multi-paradigm languages.

Learning outcomes: Student should be able to

1. Learn how to implement expert systems with prolog (L2)
2. Understanding the usage of predicate calculus in the logic programming languages (L2)

Text Books:

- 1) Robert W. Sebesta, “Concepts of Programming Languages”, Tenth Edition, Addison Wesley 2012
- 2) Programming Languages, Principles & Paradigms, 2ed, Allen B Tucker, Robert E Noonan, TMH

References:

1. R. Kent Dybvig, “The Scheme programming language”, Fourth Edition, MIT Press, 2009
2. Jeffrey D. Ullman, “Elements of ML programming”, Second Edition, Prentice Hall, 1998
3. W. F. Clocksin & C. S. Mellish, “Programming in Prolog: Using the ISO Standard”, Fifth Edition, Springer, 2003

COURSE OUTCOMES VS POS MAPPING (HIGH: 3; MEDIUM: 2; LOW: 1):

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C2106.1	3	2	2	1	2							2	2		2
C2106.2	3	2	2	1	1							2	2		2
C2106.3	2	3	2	2	1							2	2		2
C2106.4	2	3	3	2	1							2	2		3
C2106.5	2	2	1									2	2		2
C2106.6	2	1	2									2	2		2
C2106.*	2	2	2	2	2							2	2		2

Subject Code	Subject Name	L	T	P	C
R23CSE-PE3101.4	Advanced Python Programming	3	0	0	3

Course Objectives:

- Understand the pattern matching techniques in python.
- Understand the python web scraping libraries.
- Write queries for connecting database using python libraries.
- Analyse different data files using pandas libraries.
- Implement data visualization libraries for data plotting.

Course Outcomes:

1. Understand regular expressions for matching patterns in a String sequences.
2. Analyze web data using python scraping libraries.
3. Create python scripts for database CRUD operations.
4. Implement data analysis using pandas library.
5. Create data visualizations using matplotlib library .

Unit 1: PATTERN MATCHING - Introduction to Regular Expression, RegEx module in python, RegEx Functions, Meta Characters, Sequences, RegEx Sets, Finding Patterns, Searching sequences, Matching Objects

Learning Outcomes: Student will be able to

- Understand RegEx expressions and functions.(L2)
- Create new patterns for matching large sequences. (L5)
- Implement metacharacters for finding patterns. (L4)

Unit 2: WEB SCRAPING: Introduction to Web Scraping, Exploring requests, json, urllib modules, Scraping Web Services, application types (JSON/HTML/XML), Exploring Beautiful Soup: Parsing XML,HTML content.

Learning Outcomes: Student will be able to

- Understand request and urllib modules for web scraping (L2).
 - Implement response application types from web services. (L4).
 - Implement beautiful soup module for parsing web files (L4).
-

Unit 3: PYTHON DATABASE CONNECTIVITY: Introduction to SQLite, Create Connection, Cursor, Creating database, tables, Insert and Update data, Fetch data operation, Drop tables and databases, SQL Execute and Close, SQLite Exceptions, SQL datetime.

Learning Outcomes: Student will be able to

- Understand the structure of SQLite database. (L2)
- Create queries for updating and fetching data.(L4)
- Implement SQL Exceptions for handling errors.(L4)

Unit 4: DATA ANALYSIS: Introduction to PANDAS, Reading and Viewing files, Data Frames & Series Data Types, Indexes, Filtering, Add/Remove/Update rows and Columns, Sorting Data, Grouping & Aggregating Data, Cleaning Data, Date and Time Series.

Learning Outcomes: Student will be able to

- Understand data frames and series data types for data analysis (L2)
- Create indexes and filters on data frames. (L4)
- Implement aggregation , grouping and sorting techniques for data frames. (L4)
- Understand date and time series data analysis. (L2)

Unit 5: DATA PLOTTING : Introduction to matplotlib, Creating and Customizing plots, Bar Charts, Pie Charts, Stack Plots, Plot Fills, Histograms, Scatter Plots, Plotting Time Series, Plotting Streaming Data, Sub plots.

Learning Outcomes: Student will be able to

- Understand matplotlib library for plotting different plots.(L2)
- Implement streaming data plots for live data. (L4)
- Create sub plots for complex time series data. (L4)

APPLICATIONS:

- Web search engines like Yahoo, Bing etc.
- Web Service Applications like Fixer.io, Movie Databases and NetFlix etc.
- Stock Market Analysis, Matrimonial data analysis.

TEXT BOOKS:

- Python Data Science Handbook: Essential Tools for Working with Data, O'Reilly, Jake Vanderplas
- O'Reilly: Web Scraping with Python, 2nd Edition, by Ryan Mitchell
- MySQL for Python: Database Access Made Easy, by Albert Lukaszewski
- O'Reilly: Mastering Python Regular Expressions, Packt Publishing, Victor Romero

REFERENCE BOOKS:

- Python for Data Science For Dummies, 2ed, Luca Massaron John Paul Mueller
-

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
CS2103.1	3	2	2	1	3						1	1	2	3	2
CS2103.2	3	2	2	1	3						1	1	2	3	2
CS2103.3	3	3	3	2	3						1	2	3	3	3
CS2103.4	3	3	3	2	3						1	2	3	3	3
CS2103.5	2	2	2	2	2						1	1	2	2	2
CS2103*	3	2	2	2	3						1	1	2	3	2

Subject Code	Subject Name	L	T	P	C
R23CSE-PC3104	Operating Systems & Compiler Design Lab	0	0	3	1.5

Course Objectives: Course is designed to:

- Simulation of CPU scheduling algorithms
- Simulation of Deadlock Avoidance and prevention.
- Algorithms Simulation of Page replacement algorithms and paging techniques
- Teach the design and development of lexical analyzer
- Teach the design and development of parser
- Describe the concept of lex tool.
- Explain code optimization techniques.

Course Outcomes:

1. Implement various process scheduling programs.(L3)
2. Implement various memory management algorithms(L3)
3. Implement Dead Lock Handling Mechanisms(L3)
4. Understand the implementation of lexical analyzer. (L2)
5. Implement top down and bottom up parsers. (L3)
6. Implement LEX program using LEX tool. (L3)
7. Implement the code optimization techniques on source code. (L3)

Lab Programs:

1. Simulate the following CPU scheduling algorithms
a) FCFS b) SJF c) Priority d) Round Robin
 2. Simulate Bankers Algorithm for Dead Lock Avoidance
 3. Simulate Algorithm for Dead Lock Detection.
 4. Simulate the following
a) Multiprogramming with a fixed number of tasks (MFT)
b) Multiprogramming with a variable number of tasks (MVT)
 5. Write Program to implement Paging Technique
 6. Simulate the following page replacement algorithms.
a) FIFO b) LRU c) Optimal
 7. Multiprogramming-Memory management- Implementation of fork (), wait (), exec() and exit (), System calls.
 8. Design a lexical analyzer for given language
 9. Simulate First and Follow of a Grammar.
 10. Construct a LL (1) parser for an expression
 11. Design a SLR bottom up parser for the given language.
-

12. Implement the lexical analyzer using lex tools.
13. Write a program to perform loop unrolling.
14. Write a program for the implementation of strength reduction.

References:

1. Operating System -Abraham Silberchatz, Peter B. Galvin, Greg Gagne 7th Edition, JohnWiley
2. Leland L. Beck, System Software – An Introduction to Systems Programming, 3rd Edition, Pearson Education Asia, 2008.
3. Alfred V. Aho, Monica S. Lam, Ravi Sethi, Jeffrey D. Ullman, Compilers Principles, Techniques and Tools, Second Edition, Pearson.
4. B. W. Kernighan and D. M. Ritchie, The C Programming Language, Prentice-Hall

COURSE OUTCOMES VS POs MAPPING (DETAILED; HIGH: 3; MEDIUM: 2; LOW: 1):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2		2			2	2		2	2	2	3
CO2	3	3	3	3		3			2	2		2	2	2	3
CO3	3	3	3	3		3			2	2		2	2	2	3
CO4	3	3	3	3	3	2			2	2		2	2	1	3
CO5	3	3	3	3		3			2	2		3	3	2	3

Subject Code	Subject Name	L	T	P	C
R23CSE-PC3105	Computer Networks Lab	0	0	3	1.5

Course Objectives:

- Understanding Network Fundamentals and Familiarization with Packet Tracer.
- Design simple and complex network topologies.
- Configure network devices such as routers, switches, and access points
- Understand static routes and verify connectivity Configure and test dynamic routing protocols (RIP, OSPF).
- Understand how to Create and configure VLANs Set up trunk links and inter-VLAN routing

Course Outcomes:

1. Identify various networking devices and network cables.
2. Implement various simple and complex network topologies and configure the networking devices.
3. Implement static and dynamic routing protocols.
4. Implement the Network Services Configuration (DHCP, FTP) and VLANs.
5. Implement the class full addressing, sub netting planning to assign IP addresses.

Part-A: List of Programs:

STUDY EXPERIMENTS:

week1:

- A. Familiarization with Networking Components and End devices: LAN Adapters, Hubs, Switches, routers etc.
- B. Familiarization with Transmission media and Tools: Co axial cable, UTP Cable, Crimping tool, Connectors etc.

Learning Outcomes: Student will be able to

1. Understand the packet tracer environment.
2. Understand the networking devices and end devices, different mediums.

week2: A Study of various LAN topologies and their creation using network devices, cables and computers

Learning Outcomes: Student will be able to

1. Understand how to configure the simple networks.
2. Understand the network structures, connection among devices.

week3:

- A. To study pc to pc communication using parallel port
- B. Study of Client Server Architecture

Learning Outcomes: Student will be able to

1. Understand the communication between devices.
-

2. Understand the client server communication.

HANDS ON EXPERIMENT

Week4:

- A. Study of Basic network commands.
- B. Implementation file sharing using FTP server.

Learning Outcomes: Student will be able to

1. Understand the various purposes of Basic Network commands.
2. Understand the how to configure file sharing and FTP server.

Week5: Study of networking/ Internet working device configuration commands

Learning Outcomes: Student will be able to

1. Understand basic CISCO IOS commands to configure the switch(initial configuration).
2. Understand basic CISCO IOS commands to configure Router (initial configuration).

Week6: Designing and implementing Class A, B, and C Networks and configure the IP address for a computer

1. Understand how to assign Ip address and subnet mask.
2. Understand the IOS commands to configure and assign IP address.

Week7: Subnet planning and its implementation (VLSM).

1. Understand how to assign Ip address and subnet mask.
2. Understand the IOS commands to configure and assign IP address.

Week8: To configure WLAN

1. Understand how to establish WLAN.

Week9: To configure hub/switch and router with interfaces

Week10: Configuring Network Neighborhood.

1. Understand how to assign ip address and subnet mask .
 2. Understand the IOS commands to configure and assign IP address, default Gateways.
-

PROGRAMMING EXPERIMENTS:

Week11: Configure a network topology using packet tracing software

1. Understand how to simulate topologies.

week12: Static routing using packet tracer software

1. Understand how to configure and assign ip address and subnet mask default Gateway.
2. Understand the IOS commands to configure Static route .

week13: Configure a network using Distance vector routing protocol using packet tracer software (RIP)

1. Understand how to configure and assign ip address and subnet mask default Gateway.
2. Understand the IOS commands to configure Dynamic Routes.

week14: DHCP,DNS,HTTP configuration using packet tracer software

1. Understand how to configure DHCP and DNS and HTTP.

week15: Configure a Network with Virtual LANs

1. Understand how to configure Virtual LANs.

Part-B

1. Write a program to implement Bit Stuffing.

2. Write a program to implement Byte Stuffing.

3. Write a program to implement CRC.

1. Understand the bit stuffing and byte stuffing.
2. Understand the error detection and error corrections.

Applications:

- Network Design and Simulation
- Network Configuration and Troubleshooting
- Protocol Simulation
- IoT and Programming Integration

Reference Books:

1. CCNA Study guide.(Module 1,Module 2,Module 3)
-

Web Links:

1. <https://www.netacad.com>
2. <https://skillsforall.com/dashboard>

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	PSO 1	PSO 2	PSO 3
Cxx.1	3	3	3	3	3				3	2		1	2	3	3
Cxx.2	3	3	3	3	3				3	2		1	2	3	3
Cxx.3	3	3	3	2	2				3	2		1	2	3	3
Cxx2.4	3	3	3	2	3				3	2		1	2	3	3
Cxx2.5	3	3	3	2	3				3	2		1	2	3	3
Cxx2.*	3	3	3	2	3				3	2		1	2	3	3

* For Entire Course, PO & PSO Mapping

Course Code	Subject Name	L	T	P	C
R23CSE-SC3101	Java Full-Stack Development – 1 (Skill Oriented Course)	0	1	2	2

Course Objectives:

- To understand the fundamentals of full-stack development and the software development life cycle.
- To design responsive web interfaces using HTML, CSS, JavaScript, and Bootstrap.
- To develop backend applications using Java Servlets, JSP, and Hibernate.
- To manage relational databases effectively using SQL and integrate with Java applications.
- To build and deploy full-stack projects using development tools and version control systems.

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

1. Describe the architecture and components of a full-stack web application.
2. Develop responsive and interactive user interfaces using HTML, CSS, and JavaScript.
3. Develop backend logic and data access layers using Java Servlets, JSP, and Hibernate.
4. Apply SQL queries and normalization techniques for effective database design.
5. Build, test, and deploy a complete full-stack project using modern development tools.

Unit 1: Introduction to Full-Stack Development

(6 Hours)

- What is Full-Stack Development?
- Overview of Frontend, Backend, and Databases
- Roles and Responsibilities of a Full-Stack Developer
- Software Development Life Cycle

Unit 2: Frontend Development

(12 Hours)

2.1 HTML, CSS & Responsive Design

- HTML5 – Elements, Forms, Tables, Media
- CSS3 – Selectors, Flexbox, Grid, Transitions
- Responsive Design – Media Queries, Bootstrap

2.2 JavaScript & DOM Manipulation

- JavaScript Basics – Variables, Loops, Functions
- DOM Manipulation, Event Handling

Unit3: Backend Development Using Java

(9 Hours)

3.1 Java Servlets & JSP

- Servlet Lifecycle
 - Request/Response Handling
 - JSP – Scripting Elements, Directives, JSTL
-

3.2 Hibernate

(6 Hours)

- Architecture
- Environment
- Configuration
- Sessions
- Persistent Class
- Mapping Files
- Mapping Types

Unit4: Database Management

(6 Hours)

4.1 SQL (MySQL / PostgreSQL)

- Basics of SQL – SELECT, INSERT, JOIN, GROUP BY
- Normalization
- Stored Procedures, Triggers

4.2 ORM – Hibernate

- Hibernate Annotations
- Entity Relationships (One-to-Many, Many-to-Many)
- Hibernate Query Language (HQL)
- Interceptors

Unit5: Project & Deployment

(9 Hours)

5.1 Tools

- Git & GitHub – Version Control
- Maven/Gradle – Build Tools
- Postman – API Testing

5.2 Full-Stack Capstone Project

- Online Book Store / Student Portal

CONTEMPORARY TOPICS:

1. Microservices 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 NoSQL 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 (Backend), React/HTML-CSS-JS (Frontend), MySQL (Database)

2. Student Information Portal

- Features: Student profiles, course registration, grade tracking, admin dashboard
-

- Tech Stack: Java Servlets + Hibernate (Backend), Bootstrap + JavaScript (Frontend), PostgreSQL (Database)

3. Job Placement Management System

- Features: Company registration, student applications, interview tracking, placement stats
- Tech Stack: Spring Boot + JSP (Backend), HTML/CSS + JavaScript (Frontend), MySQL (Database)

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-ES3101	Tinkering Lab	0	0	2	1

Course Objectives:

- A small unique idea can be become big changer when it get the suitable platform and transformed into a product or re-define existing products with better enhancement.
- This lab provides a platform to seed, fertilize and encourage the spirit of curiosity and innovation among young minds. It is a work place where students can give shape to their ideas.

Course Outcomes: In the tinkering lab, students able to

1. Gain hands-on experiences, learning from failures, and unstructured time to explore and invent.
2. Apply the knowledge they gained till date to develop and conceptualize different scientific methods and/or techniques.
3. Design experiment(s) with financial support and guidance to enhance themselves with technical applications.

List of Sample Projects:

- Face Recognition DoorlockSystem
 - Hand gesture recognition
 - Text to speech
 - Smart City
 - Private chatroom
 - Android app controlled robotic arm
 - Smart Traffic System
 - Vehicle Accident Alarm System
 - Smart dustbin
 - Surveillance BOT
 - Automatic Water Gardening System
 - e- Mirror
 - Smart Parking System
 - Service Bot
 - Drone Surveillance
 - Wall painting robot
 - Home automation
 - Automated wheelchair
 - Any Innovative Idea – Real Time application
-

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.

Unit1:

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 proofreading 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.
-

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.
-

Subject Code	Subject Name	L	T	P	C
R23CSE-PC3201	Design And Analysis Algorithms	3	0	0	3

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

- Ability to understand, analyze and denote time complexities of algorithms and Randomized Algorithms.
- To introduce the different algorithmic approaches for problem solving through numerous example problems using divide and Conquer techniques.
- Describe the Greedy Method and dynamic-programming paradigm and explain when an algorithmic design situation calls for it and analyze them.
- To introduce the organization of Basic Traversal and Search Techniques and backtracking Algorithms through numerous example problems.
- To provide some theoretical foundation in terms of finding the Branch and bound and lower bounds of algorithms.

Course Outcomes:

1. Analyze the performance of a given algorithm, denote its time complexity using the asymptotic notation for recursive and non-recursive algorithms
2. List and describe various algorithmic approaches and Solve problems using divide and conquer technique.
3. Synthesize efficient algorithms Greedy and dynamic programming approaches to solve in common engineering design situations.
4. Organize Basic Traversal and Search Techniques and Backtracking algorithms,
5. Demonstrate the branch and bound algorithmic approaches and lower bound theory.

UNIT-I

Introduction:: Algorithm, Algorithm specification, Performance analysis: Space Complexity, Time Complexity, Asymptotic Notations, Practical Complexities, **Randomized Algorithms:** Basics of Probability Theory, Identifying the Repeated Elements, Primality Testing, Advantages and Disadvantages.

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

- Identify the criteria of an algorithms (L1)
- Analyze space requirements of a problem(L4)
- Analyze running times of algorithms using asymptotic notations(L4)
- Identify the Repeated Elements of an Randomized algorithms (L1),

Applications:

To develop and analyse algorithms for operations such as data mining, machine learning, and natural language processing in order to handle large sets of data.

UNIT II

Divide and Conquer: General method, Defective Chess Board, Binary Search, Finding the maximum and minimum, Merge sort, Quick Sort, Selection, Stassen's matrix multiplication

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

- Evaluate algorithms for intractable problems (L5)
- Apply linear and binary searches (L3)
- Compare complexities of Merge sort, quick sort and selection sort techniques(L1)

Applications:

It makes efficient use of cache memory as it solves simple sub problems within the cache memory, reducing the need to access the slower main memory.

UNIT III

Greedy Method: General method, Knapsack problem, Job Scheduling with Deadlines, Minimum cost Spanning Trees, Optimal storage on tapes, Optimal merge patterns, Single- source shortest paths.

Dynamic programming: General Method, Multistage graphs, All-pairs shortest paths, Optimal binary search trees, 0/1 knapsack, String Edition.

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

- Implementing Greedy method and multistage graphs (L3)
- Create minimum spanning trees (L6)
- Implementing Dynamic Programming method and multistage graphs (L3)
- Apply 0/1 knapsack, String Editino (L3).

Applications:

The purpose of the Greedy method here is to find an optimal solution to maximize CPU utilization.

Dynamic programming is applicable in graph theory; game theory; AI and machine learning; economics and finance problems; bioinformatics; as well as calculating the shortest path, which is used in GPS.

UNIT IV

Basic Traversal and Search Techniques: Techniques for binary trees, Techniques for Graphs, Connected components and Spanning trees, Bi-connected components and DFS.

Back tracking: General Method, 8 – queen’s problem, Sum of subsets problem, Graph colouring and Hamiltonian cycles, Knapsack Problem.

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

- Implement Techniques for binary trees & Graphs (L3)
- Apply 8-queen problem using back tracking (L3)
- Apply algorithms for graph colouring and knapsack problem (L3)

Applications:

It can efficiently to solve the larger instances of combinatorial problems. It follows a systematic

approach for obtaining solution to a problem.

UNIT V

Branch and Bound: The method, Least Cost Search (LC) , The 15 - Puzzle An Example, Travelling salesperson, 0/1 Knapsack problem, Efficiency considerations.

Lower Bound Theory: Comparison trees, Lower bounds through reductions – Multiplying triangular matrices, inverting a lower triangular matrix, computing the transitive closure.

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

- Describe the Branch and Bound conception (L2)
- Apply 15-Puzzle problem using Branch and Bound concept (L3)
- Apply Model Travelling salesperson, 0/1 Knapsack problem using Branch & Bound Method (L3)
- Describe the lower bound theory concept (L2)

Applications:

Branch and Bound is widely used in solving combinatorial optimization problems and Resource Allocation.

Text Books :

1. Ellis Horowitz, Sartaj Sahni and Rajasekaran, Fundamentals of Computer Algorithms, 2nd Edition, 2012, University Press.
2. Parag Himanshu Dave and Himanshu Bhalchandra Dave, Design and Analysis of Algorithms, Second Edition, Pearson Education.

References :

1. Anany Levitin, “Introduction to the Design and Analysis of Algorithms”, Third Edition, Pearson Education, 2012.
2. Thomas H.Cormen, Charles E.Leiserson, Ronald L. Rivest and Clifford Stein, “Introduction to Algorithms”, Third Edition, PHI Learning Private Limited, 2012.
3. Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, “Data Structures and Algorithms”, Pearson Education, Reprint 2006.
4. Donald E. Knuth, “The Art of Computer Programming”, Volumes 1& 3 Pearson Education, 2009. Steven S. Skiena, “The Algorithm Design Manual”, Second Edition, Springer, 2008.

Link: <http://nptel.ac.in>

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	PSO 1	PSO 2	PSO 3
C312.1	3	3	1									2			2
C312.2	2	2	2	1								2			2
C312.3	2	2	2	1								2			2
C312.4	2	2	2	2								2			2
C312.5	2	2	2	2								2			2

Subject Code	Subject Name	L	T	P	C
R23CSE-PC3202	Data Warehousing & 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:

1. Understand the process of knowledge discovery from data.[L2].
2. Analyze the Data Pre-processing techniques.[L4]
3. Apply classification techniques to various data sets.[L3]
4. Apply the association rule mining to real time applications.[L3]
5. Apply the clustering algorithms to various data sets.[L3]

Syllabus:

UNIT –I:

10-HOURS

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:

09-HOURS

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

10-HOURS

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:

09-HOURS

Association Analysis: Basic Concepts and Algorithms: Problem definition, Frequent Item Set generation, Mining Frequent Itemsets Using the Vertical Data Format 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:

10-HOURS

Cluster Analysis: Basic Concepts and Algorithms: Overview: What Is Cluster Analysis? Requirements for Cluster Analysis, 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)

Applications:

- Marketing and Retail
- Banking and Finance
- Healthcare
- Telecommunications
- Government and Public Sector
- Entertainment and Media

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.
-

COURSE OUTCOMES VS POs MAPPING (DETAILED; HIGH: 3; MEDIUM:2; LOW:1):

SNO	P O1	PO 2	P O3	P O 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
Cxx.1	3	2							2					2	
Cxx.2	3	3	3	3	3				2					3	2
Cxx.3	3	3	3	3	3				2				1	3	3
Cxx.4	3	3	3	3	3				2				1	3	2
Cxx.5	3	3	3	3	3				2				1	3	3
CO*	3	3	3	3	3				2				1	3	3

** For Entire Course, PO & PSO Mapping PO1, PO2, PO3, PO4, PO5, PO12/PSO1, PSO2, PSO3*

Subject Code	Subject Name	L	T	P	C
R23CSE-PC3203	Machine Learning	3	0	0	3

Course Objectives:

- To familiarizewith a set of well-known MachineLearning (ML) algorithms.
- The ability to implement machine learning algorithms.
- To understandhow 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:

1. Illustrate the characteristics of machine learning algorithms.
2. Summarize the process of classification usingdecision tree approach.
3. Apply Bayesian classifier to label data points an ML approach.
4. Understand computational and instance-basedlearning.
5. Understand advanced computational and types oflearning.

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
-

Web links:

- (i) <https://nptel.ac.in/courses/106106139>
- (ii) <https://www.coursera.org/learn/machine-learning-duke>
- (iii) <https://www.edx.org/learn/machine-learning>
- (iv) <https://www.geeksforgeeks.org/machine-learning/>
- (v) <https://www.udemy.com/topic/machinelearning>
- (vi) <https://altair.com/altair-rapidminer>

COURSE OUTCOMES VS POs MAPPING (DETAILED; HIGH: 3; MEDIUM: 2; LOW: 1):

CO	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	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-PE3201.1	DevOps	3	0	0	3

Course Objectives: DevOps improves collaboration and productivity by automating infrastructure and workflows and continuously measuring applications performance.

- Analyze Agile Methodologies
- Explain DevOps Essential Tools and Processes:
- Evaluate Strategies for DevOps Adoption in Real Projects
- Develop Skills in Creating and Managing Jenkins Jobs
- Continuous Integration Using Jenkins

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 serviceability
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

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:

1. 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.
2. Jason Cannon, “Linux for Beginners: An Introduction to the Linux Operating System and Command Line”, Kindle Edition, 2014

Reference Books:

1. 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
2. Jeff Geerling, “Ansible for DevOps: Server and configuration management for humans”, First Edition, 2015.
3. David Johnson, “Ansible for DevOps: Everything You Need to Know to Use Ansible for DevOps”, Second Edition, 2016.
4. 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 :

1. <https://www.jenkins.io/user-handbook.pdf>
 2. <https://maven.apache.org/guides/getting-started/>
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COURSE OUTCOMES VS POs MAPPING (DETAILED: HIGH: 3, MEDIUM: 2, LOW: 1)

Course	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
DevOps	C3106.1	3	3	2	2					2			1	3	1	2
	C3106.2	3	3	2	2					2			1	3	1	2
	C3106.3	3	3	2		2				2			1	3	1	2
	C3106.4	3	3	2		2				2			1	3	1	2
	C3106.5	3	3	2		2				2			1	3	1	2
	C3106.*	3	3	2	2	2				2			1	3	1	2

**For Entire Course, PO & PSO Mapping*

POs & PSO REFERENCE:

PO1	Engineering Knowledge	PO7	Environment & Sustainability	PSO1	Ability to grasp advanced programming techniques to solve contemporary issues.
PO2	Problem Analysis	PO8	Ethics	PSO2	Have knowledge and expertise to analyze data and networks using latest tools and technologies.

Course Code	Subject Name	L	T	P	C
R23CSE-PE3201.2	Mobile Computing	3	0	0	3

Course Objectives:

- To understand the fundamental concepts, architecture, and paradigms of mobile computing and GSM.
- To 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.
- To analyze the IP and Mobile IP network layers, focusing on packet delivery, handover management, location management, registration, tunnelling, encapsulation and DHCP.
- To 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.
- To 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).

Syllabus:

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 Outcomes: Student able to understand the basic concepts of mobile communications and GSM.

Applications: Mobile health monitoring, Mobile banking and Smart Cities.

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.

Applications: Mobile health monitoring, Mobile banking and Smart Cities.

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.

Applications: Education, Mobile health monitoring, Mobile banking and Smart Cities.

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.

Applications: Entertainment, Education, Mobile health monitoring, Mobile banking and Smart Cities.

Text Books:

1. Jochen Schiller, "Mobile Communications", Addison-Wesley, Second Edition, 2009.
2. Raj Kamal, "Mobile Computing", Oxford University Press, 2007, ISBN: 0195686772

Reference Books:

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.

CO-PO MAPPING:

[illegible]

Subject Code	Subject Name	L	T	P	C
R23CSE-PE3201.3	Software Testing Methodologies	3	0	0	3

Course Objectives:

- To Understand the purpose of Testing.
- To Study about Logic Based Testing.
- To Learn how to Test a Project, Starting from Planning, Design Test Cases with Data, perform Testing operations, manage defects and generate test reports.
- To Understand the Software Testing automation process.
- To gain the techniques of using testing tools

Course Outcomes:

- Understand the concepts of Software Testing.
- Design the test cases to check the functionality of software.
- Design the test cases to structural aspects of software.
- Understand various software testing problems and be able to design the solutions.
- Apply knowledge to design the test cases effectively and using the modern tools.

Unit I:

Software Testing: Introduction, Evolution, Myths & Facts, Goals, Psychology, Definition, Model for testing, Effective Vs Exhaustive Software Testing. Software Testing Terminology and Methodology: Software Testing Terminology, Software Testing Life Cycle, relating test life cycle to development life cycle Software Testing Methodology

Verification and Validation: Verification & Validation Activities, Verification of Requirements, High level and low level designs, How to verify code, Validation

Learning Outcomes:

- Understand the purpose of Testing
- Apply software testing knowledge and engineering methods.
- Verify and validate the test process

Unit II:

Static Testing: inspections, Structured Walkthroughs, Technical reviews

Dynamic Testing I: Black Box testing techniques: Boundary Value Analysis, Equivalence class Testing, State Table based testing, Decision table based testing, Cause-Effect Graphing based testing, Error guessing

Learning Outcomes:

- Perform the static testing
- Design test cases using black box testing techniques

Unit III:

Dynamic Testing II: White-Box Testing: need, Logic coverage criteria, Basis path testing, Loop testing, data flow testing, mutation testing

Graph matrices and Applications: Motivational overview, matrix of graph, relations, power of a matrix, node reduction algorithm

Learning Outcomes:

- Design test cases using white box testing techniques
- Design test cases with 100% coverage.

Unit IV:

Validation activities: Unit testing, Integration Testing,. Function testing, system testing, acceptance testing.

Regression Testing: Objectives, Types, Techniques.

Learning Outcomes:

- Design the test cases for regression testing.
- Perform system testing

Unit V:

Efficient Test Suite Management: Test case design Why does a test suite grow, Minimizing the test suite and its benefits, test suite prioritization, Types of test case prioritization, prioritization techniques, measuring the effectiveness of a prioritized test suite

Automation and Testing Tools: need for automation, categorization of testing tools, selection of testing tools, Cost incurred, Guidelines for automated testing.

Learning Outcomes:

- Design the test suite effectively
- Automate the testing process

Text Books:

- Software Testing, Principles and Practices, Naresh Chauhan, Oxford
- Software testing techniques - Baris Beizer, International Thomson computer press, second edition.
- Foundations of Software testing, Aditya P Mathur, 2ed, Pearson

Reference books:

- Software Testing- Yogesh Singh, CAMBRIDGE
- Software Testing, Principles, techniques and Tools, M G Limaye, TMH
- Effective Methods for Software testing, Willian E Perry, 3ed, Wiley

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
CXXX.1	3	2		2					2	2		3	3		3
CXXX.2	3	3	3	3	3				3	3	2	3	3	3	3
CXXX.3	3	3	3	3	3				3	3	2	3	3	3	3
CXXX.4	3	3	3	3	3				3	3		3	3	3	3
CXXX.5	3	3	3	3	3				3	3	2	3	3	3	3
CXXX.*	3	3	3	3	3				3	3	2	3	3	3	3

Subject Code	Subject Name	L	T	P	C
R23CSE-PE3201.4	Human Computer Interface	3	0	0	3

Course Objectives:

- To get student to think constructively and analytically about how to design and evaluate interactive technologies.
- Describe the various styles and interactive devices in designing.
- Analyze the quality and different strategies in language processing.
- Study the design principles and guidelines of HCI.
- Apply different search patterns on data.

Course Outcomes:

1. Understand the capabilities of both humans and computers from the viewpoint of human information processing.
2. Understand human-computer interaction (HCI) models, styles, and various historic HCI paradigms.
3. Apply an interactive design process and universal design principles to designing HCI systems.
4. Analyse HCI design principles, standards and guidelines.
5. Analyzed tasks and dialogs of relevant HCI systems based on task analysis and dialog design.

Unit 1

Introduction: Usability of Interactive Systems- introduction, usability goals and measures, usability motivations, universal usability, goals for our profession

Managing Design Processes: Introduction, Organizational design to support usability, Four pillars of design, development methodologies, Ethnographic observation, Participatory design, Scenario Development, Social impact statement for early design review, legal issues, Usability Testing and Laboratories

Learning Outcomes: student will be able to

- Describe basic concepts of interactive systems.
- Analyze basic design and development methods.

Applications: useful for managing design process.

Unit 2

Menu Selection, Form Fill-In and Dialog Boxes: Introduction, Task- Related Menu Organization, Single menus, Combinations of Multiple Menus, Content Organization, Fast Movement Through Menus, Data entry with Menus: Form Fill-in, dialog Boxes, and alternatives, Audio Menus and menus for Small Displays.

Interaction Devices: Introduction, Keyboards and Keypads, Pointing Devices, Speech and Auditory Interfaces, Displays- Small and large.

Learning Outcomes: student will be able to

- Describe utilisation of menus & dialog boxes.
- Analyze the interactive devices.

Applications: useful for designing of menus & dialog boxes in newly developed user applications.

Unit 3

Command and Natural Languages: Introduction, Command organization Functionality, Strategies and Structure, Naming and Abbreviations, Natural Language in Computing

Quality of Service: Introduction, Models of Response-Time impacts, Expectations and attitudes, User Productivity, Variability in Response Time, Frustrating Experiences

Learning Outcomes: student will be able to

- Describe structure & strategies of natural language computing.
- Analyze working quality of designed applications.

Applications: useful for verifying quality of service by taking certain parameters.

Unit 4

Balancing Function and Fashion: Introduction, Error Messages, Non anthropomorphic Design, Display Design, Web Page Design, Window Design, Color

User Documentation and Online Help: Introduction, Online Vs Paper Documentation, Reading from paper Vs from Displays, Shaping the content of the Documentation, Accessing the Documentation, Online tutorials and animated documentation, Online communities for User Assistance, The Development Process.

Learning Outcomes: student will be able to

- Analyze and design different web pages.
- Analyze documentation generation.

Applications: useful for designing of different pages, documentation for each application

Unit 5

Information Search: Introduction, Searching in Textual Documents and Database Querying, Multimedia Document Searches, Advanced Filtering and Searching Interfaces Information Visualization: Introduction, Data Type by Task Taxonomy, Challenges for Information Visualization

Learning Outcomes: Student will be able to

- Analysis of information search in textual documentation.

Applications: Easy to apply information search in all categories.

Text Books

1. Designing the User Interface, Strategies for Effective Human Computer Interaction, 5ed, Ben Shneiderman, Catherine Plaisant, Maxine Cohen, Steven M Jacobs, Pearson
2. The Essential guide to user interface design, 2/e, Wilbert O Galitz, Wiley DreamaTech.

Reference Books

1. Human Computer, Interaction Dan R.Olsan, Cengage ,2010.
 2. Designing the user interface. 4/e, Ben Shneidermann , PEA.
 3. User Interface Design, Soren Lauesen , PEA.
 4. Interaction Design PRECE, ROGERS, SHARPS, Wiley
-

Course Code	Subject Name	L	T	P	C
R23CSE-PE3202.1	Distributed Systems ((Professional Elective- III)	3	0	0	3

Course Objectives:

- Understand fundamental concepts of distributed computing models, communication protocols and System Models.
- To provide hardware and software issues in modern distributed systems.
- Understand the Local and Remote procedure calls between processes.
- Design and Implementation issues in Distributed File Systems
- Apply Distributed Transaction for communication and 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 1:(10 Hours)

Introduction and types of distributed systems: Introduction,Architecture of DS - Overview of Processes, characteristics of Distributed Systems, Examples of Distributed Systems–Trends in Distributed Systems – Focus on resource sharing – 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 2:(8 Hours)

Interprocess Communication: Introduction, The API for the Internet Protocols- The Characteristics of Interprocess communication, Sockets, UDP Datagram Communication, TCP Stream Communication;Case Study: IPC in UNIX.

External Data Representation and Marshalling: Client Server Communication; Group 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 3:(10 Hours)

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

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

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)
- Compare coordination and Agreement. (L2)

Unit 4: (10 Hours)

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

Name Services: Introduction, Name Services and the Domain Name System, Directory Services, Case study of the Global Name Service.

Distributed Shared Memory: Introduction Design and Implementation issues, Sequential consistency other consistency models

Learning Outcomes: Student will be able to

- Understand Design and Implementation issues. (L2)
- Illustrate the file server Architecture. (L2)
- Understand the Sequential consistency other consistency models (L2)

Unit 5:(10 Hours)

Transactions and Concurrency Control: Introduction, Transactions, Nested Transactions, Locks, Optimistic concurrency control, Timestamp ordering, Comparison of methods for concurrency control,Replication-Introduction, Passive (Primary) Replication, Active Replication.

Distributed Transactions: Introduction, Flat and Nested Distributed Transactions, Atomic commit protocols, Concurrency control in distributed transactions, Distributed deadlocks, Transaction recovery

Learning Outcomes: Student will be able to

- ExtendTransactions and Concurrency Control. (L2)
- Understand various methods for Replication. (L2)
- Analyze the challenges of Distributed Transactions. (L4)

Applications:

1. Internet and Web Services
2. Cloud Computing
3. Social Media Platforms
4. Financial Systems
5. Online Marketplaces

Contemporary Topics:

Mastering Distributed Systems: Architectures, Patterns, and Technologies. Conflict-free Replicated Data Types (CRDTs), distributed systems security.

Textbooks:

1. 1.Ajay D Kshemkalyani, MukeshSigal, “*Distributed Computing, Principles, Algorithms and Systems*”, Cambridge.
 2. 2.George Coulouris, J Dollimore and Tim Kindberg,”*Distributed Systems, Concepts and Design* “, Pearson Education, 4th Edition,2009.
-

Reference Books:

1. Andrew S. Tanenbaum, Maarten Van Steen, "Distributed Systems, Principles and paradigms", Second Edition, PHI.
2. Sikumar Ghosh, Chapman & Hall/CRC, "Distributed Systems, An Algorithm Approach", Taylor & Francis Group, 2007.

Web links:

1. [A Comprehensive Guide to Distributed Systems - DEV Community](#)
2. <https://www.cl.cam.ac.uk/teaching/2021/ConcDisSys/>
3. Tanenbaum, A.S. and van Steen, M. (2017). *Distributed systems*, 3rd edition. [available online](#).

COURSE OUTCOMES VS POs MAPPING (DETAILED; HIGH:3; MEDIUM:2; LOW:1):

SNO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C3204.1	3	2	1	-	-	-	-	-	-	-	-	1	-	-	1
C3204.2	3	3	2	2	-	-	-	-	-	-	-	1	2	-	1
C3204.3	3	2	2	-	-	-	-	-	-	-	-	2	2	-	-
C3204.4	3	2	1	1	2	-	-	-	-	1	-	1	-	-	1
C3204.5	3	2	2	2	2	-	-	-	-	1	-	1	1	2	-
C3204*	3	2	2	2	2	-	-	-	-	1	-	1	2	2	1

* For Entire Course, PO & PSO Mapping

Course Code	Subject Name	L	T	P	C
R23CSE-PE3202.2	Advanced Computer Networks	3	0	0	3

Course Objectives:

- Understand the concept of IPv4, NAT, ICMPv4, Mobile IP.
- Understand the allocation of address space in IPv6 and different types of IPv6 addresses
- Analyze different Unicast & Multicast Routing protocols and their operating principles
- Analyze the structure of a UDP packet header, mechanisms used by TCP & SCTP for flow control, error control, and congestion control
- Analyze the architecture of WWW, HTTP in web communication, Role of MIME in Mail Communication.

Course Outcomes:

1. Apply CIDR notation to configure and analyze IP subnets
2. Analyze the header format of IPv6 packets and compare it to IPv4 headers
3. Analyze intra-domain and inter-domain routing and their protocols.
4. Analyze the applications and services that utilize UDP, TCP & SCTP for Communication.
5. Analyze the architecture of WWW and the functionalities of HTTP for Web Communication, MIME, POP & IMAP for E-mail Communication.

Unit-I – Network Layer and Protocols (Specify number of hours)

IPv4 Addresses: Introduction - Classful Addressing - Classless Addressing - Special Addresses - NAT - Datagram's - Fragmentation – Options

Internet Control Message Protocol Version 4(ICMPv4): Introduction - Messages - Debugging Tools - ICMP Package

Mobile IP : Addressing - Agents - Three Phases - Inefficiency In Mobile Ip

Learning Outcomes:

- Identify the different components of an IPv4 address
- Understand the different classes of IPv4 addresses (A, B, C) and their allocation ranges
- Interpret CIDR notation (slash notation) for subnet mask and network prefix length
- Understand the benefits and limitations of using NAT in network design.
- Understand ICMPv4's role in error reporting and troubleshooting network issues

Unit – II: Next Generation IP (Specify number of hours)

IPv6 Addressing: Introduction - Address Space Allocation - Global Unicast Addresses – Auto Configuration - Renumbering

IPv6 Protocol: Introduction - Packet Format - Transition From Ipv4 To Ipv6

Learning Outcomes:

- Understand the structure and allocation of IPv6 address space, including global unicast addresses.
- Describe auto configuration mechanisms for assigning IPv6 addresses on a network.
- Analyze the header format and functionalities of IPv6 packets compared to IPv4 datagrams.

Unit – III: Unicast and Multicast Routing Protocols (Specify number of hours)

Unicast Routing Protocols (RIP, OSPF, and BGP): Introduction - Intra- And Inter - Domain Routing - Distance Vector Routing - RIP - Link State Routing - OSPF - Path Vector Routing - BGP

Multicasting and Multicast Routing Protocols: Introduction - Multicast Addresses - IGMP - Multicast Routing - Routing Protocols (Multicast Link State Routing: MOSPF, DVMRP, CBT, PIM) - MBONE

Learning Outcomes:

- Differentiate between intra-domain and inter-domain routing and the protocols used for each
- Understand the principles of distance vector routing protocols and analyze how RIP operates
- Understand the purpose and functionalities of IGMP (Internet Group Management Protocol) for managing multicast groups
- Analyze different multicast routing protocols like MOSPF, DVMRP, CBT, PIM, and MBONE, and their functionalities

Unit – IV: Transport Layer Protocols (Specify number of hours)

User Datagram Protocol (UDP): Introduction - User Datagram - Udp Services - Udp Applications - Udp Package

Transmission Control Protocol (TCP): TCP Services - TCP Features - Segment - A TCP Connection - State Transition Diagram - Windows In TCP - Flow Control - Error Control - Congestion Control - TCP Timers - Options - TCP Package

Stream Control Transmission Protocol (SCTP): Introduction - SCTP Services - SCTP Features - Packet Format - An SCTP Association - State Transition Diagram - Flow Control - Error Control - Congestion Control

Learning Outcomes:

- Identify common applications and services that utilize UDP for communication
- Describe the core functionalities provided by TCP, including flow control, error control, and congestion control.
- Analyze the functionalities of SCTP, including its packet format, association establishment, flow control, error control, and congestion control

Application:

Unit – V: Application Layer (Specify number of hours)

File Transfer: FTP and TFTP

World Wide Web and HTTP : Architecture - Web Documents - HTTP

Electronic Mail: SMTP, POP, IMAP, and MIME Architecture - User Agent - Message Transfer Agent: SMTP - Message Access Agent: POP AND IMAP - MIME

Learning Outcomes:

- Describe the functionalities of FTP (File Transfer Protocol) and TFTP (Trivial File Transfer Protocol) for file transfer applications
 - Analyze the architecture of the World Wide Web and the role of HTTP (Hypertext Transfer Protocol) in web communication.
 - Understand the structure of web documents
-

Application:

- Network engineers configuring and managing IP networks
- Network engineers planning for the future and migrating networks to IPv6
- Network engineers configuring routing protocols to ensure packets are delivered to the correct destination on the network.
- Application developers and network engineers working on reliable or unreliable data transfer between applications
- Application developers and users interacting with various network applications

Contemporary Topics need to mention (Compulsory)

Remote Login: TELNET and SSH TELNET - Secure Shell(SSH)

Host Configuration: DHCP Introduction - DHCP Operation - Configuration

Domain Name System (DNS): Need For DNS - Name Space - DNS In The Internet - Resolution - DNS Messages - Types Of Records - Compression – Encapsulation

Text Books:

1. TCP_IP Protocol Suite 4th ed. – B. Forouzan (McGraw-Hill, 2010)
2. Internetworking With TCP/IP Vol I: Principles, Protocols, and Architecture Sixth Edition

References Books:

Title of the Reference book, Author Name, publisher Name, year of publication, Edition

COURSE OUTCOMES VS POs MAPPING (DETAILED; HIGH: 3; MEDIUM: 2; LOW: 1):

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
C3205.1	3	3	3	2	2				1				1	3	1
C3205.2	3	3	3	2	2				1				1	3	1
C3205.3	3	3	3	2	2								1	3	1
C3205.4	3	3	3	2	2								1	3	1
C3205.5	3	3	3	2	2				1				1	3	1

Course Code	Subject Name	L	T	P	C
R23CSE-PE3202.3	Introduction to Cloud Computing	3	0	0	3

Course Objectives:

- To understand the fundamental concepts, principles, and applications of various computing paradigms, with a focus on cloud computing.
- To understand the foundational concepts and practical aspects of cloud computing architecture.
- To understand the various cloud service models (Infrastructure as a Service, Platform as a Service, Software as a Service, and other models) and the concept of virtualization.
- To understand and evaluate the technological drivers for cloud computing.
- To analyse and evaluate the various perspectives and challenges of SaaS, PaaS and various cloud service providers.

Course Outcomes: Upon successful completion of Students will be able to

1. Comprehend and articulate the various computing paradigms, with an emphasis on cloud computing, understanding its core motivations
2. Analyse the cloud architectures, effectively manage cloud resources, deploy and manage applications on the cloud.
3. Analyse and differentiate between various cloud service models, understand their applications and benefits, and analyse the concept of virtualization.
4. Understand and explain the key technological drivers for cloud computing, evaluate the impact of technologies such as SOA, virtualization.
5. Understand the different perspectives and challenges of SaaS and PaaS with cloud service providers.

Syllabus :

Unit-I – Computing Paradigms: High-Performance Computing- Parallel Computing -Distributed Computing- Cluster Computing - Grid computing -Cloud Computing - Biocomputing - Mobile Computing - Quantum Computing - Optical Computing - Nanocomputing - Network Computing. **Cloud Computing Fundamentals:** Motivation for Cloud Computing, Defining Cloud Computing-5-4-3 Principles of Cloud computing -Cloud Ecosystem - Requirements for Cloud Services- Cloud Application - Benefits and Drawbacks. **(8 Hours)**

Learning Outcomes: Student will be able to Remember the fundamental concepts of cloud computing along with various paradigms of computing.

Application:

- 1) **Web Hosting:** Hosting websites and applications with scalable resources.
- 2) **Big Data Analytics:** Analysing large datasets with tools like Hadoop and Spark.
- 3) **AI and Machine Learning:** Providing platforms for training and deploying AI models.

Unit – II: Cloud Computing Architecture and Management: Introduction-Cloud Architecture- Anatomy of the Cloud-Applications on the Cloud - Managing the Cloud - Migrating Application to Cloud. **Cloud Deployment Models:** Introduction- Private Cloud -Public cloud – Community Cloud – Hybrid Cloud.**(8 Hours)**

Learning Outcomes: Students will be able to analyse and design cloud architectures, understand the anatomy of the cloud, manage cloud resources effectively, deploy and manage applications on the cloud, and execute the migration of applications to the cloud.

Applications:

- 1) Deploying web applications, databases, and microservices on cloud platforms such as AWS, Azure, and Google Cloud.
- 2) Managing and scaling cloud-based applications to handle varying workloads and traffic.

Unit – III: Cloud Service Models: Introduction - Infrastructure as a Service - Platform as a Service - Software as a Service - Other Cloud Service Models. **Virtualization:** Introduction -Virtualization Opportunities - Approaches to Virtualization -Hypervisors -From Virtualization to Cloud Computing. **(8 Hours)**

Learning Outcomes: Students will be able to understand and differentiate between various cloud service models (Infrastructure as a Service, Platform as a Service, Software as a Service, and other models), grasp the concepts and benefits of virtualization

Applications: 1) Accessing software applications over the internet on a subscription basis.
2) Managing and optimizing virtual machine resources and configurations.

Unit – IV: Technological Drivers for Cloud Computing- Introduction - SOA and Cloud – Virtualization- Multicore Technology - Memory and Storage Technologies - Networking Technologies - Web 2.0 - Web 3.0 - Software Process Models for Cloud - Programming Models- Pervasive Computing.**(8 Hours)**

Learning Outcomes: Students will be able to analyze and comprehend the key technological drivers that facilitate cloud computing adoption, including Service-Oriented Architecture (SOA) integration, virtualization benefits

Application:

1. Adopting agile and DevOps methodologies for continuous integration and deployment.
2. Designing scalable and fault-tolerant distributed applications.

Unit – V: Software Development in Cloud: Introduction - Different Perspectives on SaaS Development - New Challenges - New Challenges - Cloud-Aware Software Development Using PaaS Technology. **Cloud Service Providers:** Introduction - EMC - Google - Amazon Web Services - Microsoft - IBM - SAP Labs - Salesforce - Rackspace - VMware - Manjrasoft. **(8 Hours)**

Learning Outcomes: Students will be able to analyse the various perspectives on Software as a Service (SaaS) development, understand the new challenges posed by cloud computing environments,

Application:

1. Comparing and selecting cloud providers based on service offerings, pricing models, and reliability.
2. Building and deploying applications without managing the underlying infrastructure.

Text Books:

1. Chandrasekara, K. . *Essentials of Cloud Computing*. ABC Publishers. 2015, 2nd edition

References Books:

1. Distributed and Cloud Computing, Kai Hwang, Geoffrey C. Fox, Jack J. Dongarra MK Elsevier.
 2. Cloud Computing, Theory and Practice, Dan C Marinescu, MK Elsevier.
 3. Cloud Computing, A Hands on approach, Arshadeep Bahga, Vijay Madiseti, University Press
 4. Cloud Computing, A Practical Approach, Anthony T Velte, Toby J Velte, Robert Elsenpeter, TMH
 5. Mastering Cloud Computing, Foundations and Application Programming, Raj Kumar Buyya, Christen vecctiola, S Tammarai selvi, TMH.
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COURSE OUTCOMES VS POs MAPPING (DETAILED; HIGH: 3; MEDIUM: 2; LOW: 1):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2										1			1
CO2	3	2										1			1
CO3	3	2										1			1
CO4	3	2										1			1
CO5	3	2										1			1

Subject Code	Subject Name	L	T	P	C
R23CSE-PE3202.4	Natural Language Processing	3	0	0	3

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 modelling

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

1. Illustrate fundamentals of basic Language features
2. Analyze the words involved in NLP
3. Outline the syntactic analysis involved in NLP
4. Utilize semantics of NLP
5. Compare different statistical approaches of NLP applications.

UNIT I:

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.

Learning Outcomes: Student will be able to

1. Outline different grammar based languages (L2)
2. Illustrate the fundamentals of natural language processing(L2)

UNIT II :

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 PoS tagging – Hidden Markov and Maximum Entropy models.

Learning Outcomes: Student will be able to

1. Demonstrate N-Grams in NLP (L2)
2. Analyze the Different Stochastic and Transformation-based tagging (L4)

UNIT III:

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.

Learning Outcomes: Student will be able to

1. Interpret CFG and PCFG in NLP (L2)
2. Outline the syntactic importance in NLP (L2)

UNIT IV:

Semantics Analysis

Requirements for representation, First-Order Logic, Description Logics – Syntax-Driven Semantic analysis, Semantic attachments – Word Senses, Relations between Senses, Thematic Roles, selectional restrictions – Word Sense Disambiguation

Learning Outcomes: Student will be able to

1. Understand different order logics **(L2)**
2. Understand requirements of semantics of NLP **(L2)**

UNIT V:

Discourse Analysis And Lexical Resources

(9 Periods)

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).

Learning Outcomes: Student will be able to

1. Understand Segmentation and Coherence **(L2)**
2. Determining statistical approaches for NLP applications **(L3)**

Text Books:

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.

References:

1. Breck Baldwin, —Language Processing with Java and LingPipe Cookbook, Atlantic Publisher, 2015.
 2. Richard M Reese, —Natural Language Processing with Java, O'Reilly Media, 2015.
 3. Nitin Indurkha and Fred J. Damerau, —Handbook of Natural Language Processing, Second Edition, Chapman and Hall/CRC Press, 2010.
 4. Tanveer Siddiqui, U.S. Tiwary, —Natural Language Processing and Information Retrieval, Oxford University Press, 2008.
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COURSE OUTCOMES VS POs MAPPING (DETAILED; HIGH: 3; MEDIUM: 2; LOW: 1)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	3	2	1	1								2	2		
CO2	3	2	1	1								2	2		
CO3	3	2	1	1								2	2		
CO4	3	2	1	1								2	2		
CO5	3	2	1	1								2	2		
CO.*	3	2	1	1								2	2		

Subject Code	Subject Name	L	T	P	C
R23CSE-PC3204	Machine Learning Lab	0	0	3	1.5

Course Objectives:

- To learn about computing central tendency measures and Data preprocessing techniques
- To learn about classification and regression algorithms
- To apply different clustering algorithms for a problem.

Course Outcomes:

1. Understand the statistical aspects of algorithms used in pre-processing.
2. Design and evaluate supervised models for classification.
3. Evaluate the machine learning models using unsupervised algorithms.
4. Design and apply clustering algorithms for refinement of the data.
5. Design, develop and test the performance of the machine learning model.

Software Required: Python/R/Weka

Lab should cover the concepts studied in the course work, sample list of Experiments:

1. Compute Central Tendency Measures: Mean, Median, Mode Measure of Dispersion: Variance, Standard Deviation.

2. Apply the following Pre-processing techniques for a given dataset.

- a. Attribute selection
- b. Handling Missing Values
- c. Discretization
- d. Elimination of Outliers

3. Apply KNN algorithm for classification and regression

4. Demonstrate decision tree algorithm for a classification problem and perform parameter tuning for better results

5. Demonstrate decision tree algorithm for a regression problem

6. Apply Random Forest algorithm for classification and regression

7. Demonstrate Naïve Bayes Classification algorithm.

8. Apply Support Vector algorithm for classification

9. Demonstrate simple linear regression algorithm for a regression problem

10. Apply Logistic regression algorithm for a classification problem

11. Demonstrate Multi-layer Perceptron algorithm for a classification problem

12. Implement the K-means algorithm and apply it to the data you selected. Evaluate performance by measuring the sum of the Euclidean distance of each example from its class center. Test the performance of the algorithm as a function of the parameters K.

13. Demonstrate the use of Fuzzy C-Means Clustering

14. Demonstrate the use of Expectation Maximization based clustering algorithm

Subject Code	Subject Name	L	T	P	C
R23CSE-PC3205	Data warehousing & Data Mining 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 various python packages for data preprocessing and analyzing data.(L2)
2. Understand various pre-processing Techniques.(L2)
3. Analyze various classification Algorithms.(L4)
4. Apply the Association rule mining to various data sets to Extract Patterns.(L3)
5. Analyze various clustering Algorithms.(L4)

System/Software Requirements: python

Introduction to Python libraries for Data Mining : NumPy, Pandas, Matplotlib, Scikit-Learn.

WEEK-1:Library: NumPy

- (a).Implement various n-dimensional array creation ,access,find dimentions.
- (b).Write a Program to perform the various operations on matrices.

Learning Outcomes: Student will be able to

- Apply the NumPy Library to create arrays and access them . (L3)
- Apply various matrix operation on arrays using Numpy package.(L3)

WEEK-2: Write a Program to find the Min, Max, Mean, Median and Standard Deviation and Mode using statistical functions on arrays.

- Apply the NumPy Library to create arrays and access them . (L3)

WEEK-3 : Understanding Data. Library: Pandas

- a) Create a data frame with columns at least 10 observations
- b) Loading data from CSV file
- c) Compute the basic statistics of given data - shape, no. of columns, mean
- d) Retrieve a particular column from the Data Frame
- e) Summarize the data frame and observe the statistics of the Data Frame created.

Learning Outcomes: Student will be able to

- Apply the pandas Library to create data frames and data series . (L3)
- Apply various basic statistics commands on Data Frames and data series .(L3)

WEEK-4: Library: Matplotlib

- (a).Write a program to use Loc and iLoc in pandas for data accessing.
- b) Splitting a data frame on values of categorical variables
- c) Visualize data using histogram, Scatter plot.

Learning Outcomes: Student will be able to

- Apply the various Matplotlib Functions on data sets to extract data . (L3)

- Apply various function to 2D Visualization .(L3)

WEEK-5: Correlation Matrix Library : Scipy

- a) Load data, describe the given data and identify missing, outlier data items
- b) Find correlation among all attributes
- c) Visualize correlation matrix.

Learning Outcomes: Student will be able to

- Apply the various Scipy functions on pre-process the data. (L3)
- Apply various function to correlate the data .(L3)

WEEK-6 : Data Preprocessing

Write a python program to impute missing values with various techniques on given dataset.

- a) Remove rows/ attributes
- b) Replace with mean or mode
- c) Write a python program to perform transformation of data using Discretization (Binning) and Normalization (MinMaxScaler or MaxAbsScaler) on given dataset.

Learning Outcomes: Student will be able to

- Apply the various functions to pre-process the data. (L3)

WEEK-7 : Implement linear regression using python

Learning Outcomes: Student will be able to

- Apply the linear regression data set . (L3)

WEEK-8: Classification

Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample

Learning Outcomes: Student will be able to

- Apply classification on any data set to find the labels. (L3)

WEEK-9: Classification (statical Model)

Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.

Learning Outcomes: Student will be able to

- Apply statical classification on any data set to find the labels. (L3)

WEEK-10:Association Rule Mining

Implement Association rule mining using python libraries.

- a) Display top 5 rows of data
- b) Find the rules with min_confidence : 0.2, min_support= 0.0045, min_lift=3, min_length=2

Learning Outcomes: Student will be able to

- Apply Association Rule Mining on any data set . (L3)

WEEK-11 : Partition based Clustering Libraries: Pandas, NumPy, Sklearn, Seaborn, Matplotlib

Implement K-means clustering using algorithm On any dataset .

Learning Outcomes: Student will be able to

- Apply Partition based Clustering on any data set . (L3)

WEEK-12 : Implement DBSCAN Clustering Algorithm using Python libraries.

Learning Outcomes: Student will be able to

- Apply DBSCAN Clustering on any data set . (L3)

Applications:

- Marketing and Retail
- Banking and Finance
- Healthcare
- Telecommunications
- Government and Public Sector
- Entertainment and Media

Text Books:

1. Python Data Science Handbook by Jake VanderPlas
2. Python Data Analytics: With Pandas, NumPy, and Matplotlib

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	PSO 1	PSO 2	PSO 3
C322.1	3	3	3		3				3					3	3
C322.2	3	3	3	3	3				3					3	3
C322.3	3	3	3	3	3				3					3	3
C322.4	3	3	3	3	3				3					3	3
C322.5	3	3	3	3	3				3					3	3
C322*	3	3	2	3	3				3					3	3

** For Entire Course, PO & PSO Mapping*

Course Code	Subject Name	L	T	P	C
R23CSE-SC3201	Java Full-Stack Development –2 (Skill Course)	0	1	2	2

Course Objectives:

- To master Enterprise Java technologies (JPA, EJB, JMS) and Spring Framework (IoC, AOP)
- To implement Spring Boot applications for rapid development and microservices
- To design RESTful APIs using industry best practices (statelessness, versioning, documentation)
- To deploy applications using cloud platforms (AWS) and DevOps tools (Docker, CI/CD)
- To architect a scalable, secure capstone project (e.g., E-Commerce App) with end-to-end implementation

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

1. Develop enterprise-grade applications using Spring Framework (DI, MVC, Security) and JPA.
2. Leverage Spring Boot features (Auto-Configuration, Actuator) to build production-ready apps.
3. Design and document scalable REST APIs with Swagger, adhering to stateless principles.
4. Containerize applications using Docker and deploy them on cloud platforms like AWS EC2/S3.
5. Develop a secure, payment-integrated e-commerce application with CI/CD pipelines.

Unit 1: Enterprise Java (Java EE):JSF – Components, Facelets, JPA – EntityManager, JPQL, EJB – Stateless/Stateful Beans, JMS – Queues/Topics, JTA – Distributed Transactions.

Unit 2: Spring Framework: IoC Container, Dependency Injection (Constructor/Setter), Bean Scopes, Spring MVC, AOP – Logging/Security, Spring JDBC, Transaction Management.

Unit 3: Spring Boot: Auto-Configuration, Starter Packs, Spring Boot Actuator, DevTools, Spring Data JPA (Repositories), Spring Security (OAuth2/JWT), Thymeleaf.

Unit 4: RESTful APIs & Microservices: REST Principles (Resources, URIs), HTTP Methods (GET/POST/PUT/DELETE), Statelessness, HATEOAS, API Versioning, Swagger/OpenAPI, Spring REST Controllers, Microservices Basics.

Unit 5: Cloud & DevOps:Docker – Containers/Images, Kubernetes – Pods/Deployments, CI/CD (Jenkins/GitHub Actions), AWS EC2/S3 Basics, Capstone Project – E-Commerce App with Payment Gateway.

CONTEMPORARY TOPICS:

1. Serverless Computing with AWS Lambda and API Gateway
2. Reactive Programming with Spring WebFlux
3. Service Mesh and API Gateway using Istio & Spring Cloud Gateway
4. Zero Trust Security with OAuth2.1, JWT, and Multi-Factor Authentication (MFA)

APPLICATIONS:

1. Online Banking System with Microservices Architecture
2. Healthcare Appointment and Management Portal
3. E-Commerce Platform with Real-Time Order Tracking

TEXT BOOKS:

1. "Spring in Action" by Craig Walls, 6th Edition, Manning Publications
2. "Java EE 8: The Complete Reference" by Keogh, Sharan, 8th Edition, McGraw Hill Education

REFERENCE BOOKS:

1. "Cloud Native Java"by Josh Long, Kenny Bastani, Published 2017, O'Reilly Media.
2. "Pro Spring Boot 3" By Felipe Gutierrez,3rd Edition, Apress

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-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)

Application:

- 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_CSE (MINORS)

Track-I (DATA SCIENCE)							
S. No	Year & Semester	Course Code	Subject title	L	T	P	C
1	II-II	R23CSE-MT2201	Database Management System	3	0	0	3
2	III-I	R23CSE-MT3101	Data Mining	3	0	0	3
3	III-I	R23CSE-ML3101	Database Management System Lab	0	0	3	1.5
4	III-II		Elective-1	3	0	0	3
		R23CSE-MT3201.1	1.Machine Learning				
		R23CSE-MT3201.2	2.Artificial Intelligence & Neural Networks				
5	III-II		Elective-2	0	0	3	1.5
		R23CSE-ML3201.1	1.Machine Learning Lab				
		R23CSE-ML3201.2	2.Artificial Intelligence & Neural Networks Lab				
6	IV-I		Elective-3	3	0	0	3
		R23CSE-MT4101.1	1.Deep Learning				
		R23CSE-MT4101.2	2.Image Processing				
7	II Year to IV Year	R23CSE-MM0001	Minors MOOCS-1	0	0	0	3
Total							18

Track-II (ARTIFICIAL INTELLIGENCE)							
S. No	Year & Semester	Course Code	Subject title	L	T	P	C
1	II-II	R23CSE-MT2202	Mathematics for Machine Learning	3	0	0	3
2	III-I	R23CSE-MT3102	AI Tools & Techniques	3	0	0	3
3	III-I	R23CSE-ML3102	AI Tools Lab	0	0	3	1.5
4	III-II	R23CSE-MT3202	Machine Learning Using Python	3	0	0	3
5	III-II	R23CSE-ML3202	Machine Learning Using Python Lab	0	0	3	1.5
6	IV-I	R23CSE-MT4102	AI for Data Science	3	0	0	3
7	II Year to IV Year	R23CSE-MM0001	Minors MOOCS-1	0	0	0	3
Total							18

Track-III (APPLICATION PROGRAMMING)							
S. No	Year & Semester	Course Code	Subject title	L	T	P	C
1	II-II		Elective-1	3	0	0	3
		R23CSE-MT2203.1	1.Python Programming				
		R23CSE-MT2203.2	2.Object Oriented Programming through C++				
2	III-I	R23CSE-MT3103	Java Programming	3	0	0	3
3	III-I	R23CSE-ML3103	Java Programming Lab	0	0	3	1.5
4	III-II	R23CSE-MT3203	Advanced Java Programming	3	0	0	3
5	III-II		Elective-2	0	0	3	1.5
		R23CSE-ML3203.1	1.Advanced Java Programming Lab				
		R23CSE-ML3203.2	2.Advanced Python Programming Lab				
			3.Object Oriented Programming through C++ Lab				
6	IV-I		Elective-3	3	0	0	3
		R23CSE-MT4103.1	1.Dot Net Programming				
		R23CSE-MT4103.2	2.Java Enterprise Framework				
7	II Year to IV Year	R23CSE-MM0001	Minors MOOCS-1	0	0	0	3
Total							18

Track-IV (WEB PROGRAMMING)							
S. No	Year & Semester	Course Code	Subject title	L	T	P	C
1	II-II	R23CSE-MT2204	Web UI Framework	3	0	0	3
2	III-I	R23CSE-MT3104	Angular Framework	3	0	0	3
3	III-I	R23CSE-ML3104	Angular Framework Lab	0	0	3	1.5
4	III-II		Elective-1	3	0	0	3
		R23CSE-MT3204.1	1.Mobile App Development				
		R23CSE-MT3204.2	2.DJango Framework				
5	III-II		Elective-2	0	0	3	1.5
		R23CSE-ML3204.1	1.MobileApp Development Lab				
		R23CSE-ML3204.2	2.DJango Framework Lab				
6	IV-I		Elective-3	3	0	0	3
		R23CSE-MT4104.1	1.React Framework				
		R23CSE-MT4104.2	2.Node Framework				
7	II Year to IV Year	R23CSE-MM0001	Minors MOOCS-1	0	0	0	3
Total							18

Course Code	Subject Name	L	T	P	C
R23CSE-MT2201	Database Management Systems	3	0	0	3

Course Objectives:

- Learn the fundamental concepts of database systems.
- Enable students to design ER diagrams for any customized applications
- Learn simple and Complex queries using SQL.
- Learn schema refinement techniques (Normalization).
- Knowledge about transaction and recovery techniques, and advanced databases.

Course Outcomes:

1. Design the ER model using the basic concepts of DBMS, and RDBMS
2. Apply SQL concepts to Construct simple and complex queries.
3. Analyze schema refinement techniques.
4. Understand the transaction serializability and concurrency control.
5. Apply the concepts of file organization on B & B+ Trees.

UNIT-I

[10 Hours]

Introduction- Database – Purpose, Characteristics, advantages, disadvantages and applications, Database Users, Data Models; Instance and Data Independence; Three Tier Schema Architecture, Database System Structure.

RDBMS Design: Introduction, Entities, Attributes Entity Set, Relationship Set, Specialization, and **Generalization Types of Keys**

Applications: Design ER Diagrams for Library Management System, Banking System, Other applications

Learning outcomes:

Students will be able to

1. Distinguish between Database System and File System (L2)
2. Design a database relational model using ER diagrams. (L5)

UNIT-II

[10 Hours]

Relational Operations & Basic SQL: Relational Algebra, Relational Operations, Relational Calculus, Tuple And Domain Relational Calculus.

PL/ SQL: Database Languages, Data Types, Integrity Constraints, Simple And Nested Queries, Implementation Of Different Types Of Joins, Stored Procedures

Learning Outcomes:

Students will be able to

1. Understand relational operations and calculus (L2)
2. Implement simple and complex queries for relational data (L3)

Applications: SQL Query generation for Different databases.

UNIT-III

[8 Hours]

Schema Refinement (Normalization): Types Of Anomalies, Concept Of Functional Dependency, Normalization, Advantages, Types Of Normal forms(1NF, 2NF, And 3NF), Boyce-Codd Normal Form(BCNF), Fourth Normal Form(4NF). Lossless Join And Dependency Preserving Decomposition.

Learning Outcomes:

Students will be able to

1. Identify anomalies and remove redundancies using Normal Forms (L2)
2. Analyze the lossy and lossless decomposition on databases (L3)

Unit-IV**[10 Hours]**

Transaction Management: Transaction, Transaction States, ACID Properties, Schedule, Serializability And Types, Concurrent Control, Concurrency Control Protocols-Two Phase Locking- Timestamp – Multi version – Validation and Snapshot isolation– Multiple Granularity locking, Crash Recovery: Introduction To ARIES, The Log, Write-Ahead Log Protocol.

Learning Outcomes:

Students will be able to

1. Understand transaction and serializability schedules. (L2)
2. Understand concurrency control protocols on transactions. (L2)

UNIT-V**[10 Hours]**

Implementation Techniques: File Organization and Indexing - RAID, File Organization, Indexing - B & B+ Tree Index files, Hashing Vs Indexing.

Advanced Databases - NoSQL, NewSQL, and Not-yet-SQL

Learning Outcomes:

Students will be able to

1. Understand basic concepts of File Organization and storage (L2).
2. Apply the concepts of file Organization and Indexing on B Trees and B+ Trees. (L3)
3. Understand the Advanced Database Systems (L2)

Contemporary Topics:

1. Big Data and No SQL Databases:
2. Cloud Databases:
3. Distributed Databases
4. Database Security
5. Artificial Intelligence and Machine Learning in Databases

Text Books:

1. Database Management Systems, 3/e, Raghuram Krishnan, Johannes Gehrke, TMH
2. Database System Concepts, 5/e, Silberschatz, Korth, TMH

Reference Books:

1. Database Management System, 6/e Ramez Elmasri, Shamkant B. Navathe, PEA
2. Database Principles Fundamentals of Design Implementation and Management, Carlos Coronel, Steven Morris, Peter Robb, Cengage Learning.
3. Introduction to Database Systems, 8/e C J Date, PEA.

NPTEL Web Course:

1. https://onlinecourses.nptel.ac.in/noc18_cs15/preview
2. <http://nptel.ac.in/courses/106106093/>
3. <http://nptel.ac.in/courses/106106095/>

NPTEL Video Course:

1. <https://www.youtube.com/watch?v=EUzsy3W4I0g>
2. <https://www.youtube.com/playlist?list=PL52484DF04A264E59>

Relevant syllabus for GATE: Databases:

ER-model, Relational model (relational algebra, tuple calculus), Database design (integrity constraints, normal forms), Query languages (SQL), File structures (sequential files, indexing, B and B+ trees), Transactions, and concurrency control.

COURSE OUTCOMES VS POs MAPPING (DETAILED; HIGH:3; MEDIUM:2; LOW:1):

S NO	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
C2102.1	3	3	2	1	2	1			1	1		1	2	2	2
C2102.2	3	2	3	2	2							2	2	1	2
C2102.3	3	2	2									2	2	1	2
C2102.4	2	2										2		2	
C2102.5	2	2	2		2							1	1	2	2
C2102 *	3	2	2	2	2	1			1	1		2	2	2	2

Subject Code	Subject Name	L	T	P	C
R23CSE-MT3101	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:

1. Understand the process of knowledge discovery from data.[L2].
2. Analyze the Data Pre-processing techniques.[L4]
3. Apply classification techniques to various data sets.[L3]
4. Apply the association rule mining to real time applications.[L3]
5. Apply the clustering algorithms to various data sets.[L3]

Syllabus:

UNIT –I:

10-HOURS

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:

09-HOURS

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:

10-HOURS

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:**09-HOURS**

Association Analysis: Basic Concepts and Algorithms: Problem definition, Frequent Item Set generation, Mining Frequent Itemsets Using the Vertical Data Format 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**10-HOURS**

Cluster Analysis: Basic Concepts and Algorithms: Overview: What Is Cluster Analysis? Requirements for Cluster Analysis, 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)

APPLICATIONS:

- Marketing and Retail
- Banking and Finance
- Healthcare
- Telecommunications
- Government and Public Sector
- Entertainment and Media

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.

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	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
Cxx.1	3	2							2					2	
Cxx.2	3	3	3	3	3				2					3	2
Cxx.3	3	3	3	3	3				2				1	3	3
Cxx.4	3	3	3	3	3				2				1	3	2
Cxx.5	3	3	3	3	3				2				1	3	3
CO*	3	3	3	3	3				2				1	3	3

* For Entire Course, PO & PSO Mapping PO1, PO2, PO3, PO4, PO5, PO12/PSO1, PSO2, PSO3

Course Code	Course Name	L	T	P	Credits
R23CSE-ML3101	Database Management Systems Lab	0	0	3	1.5

Course Objectives:

- Populate and query a database using SQL DDL/DML Commands
- Declare and enforce integrity constraints on a database
- Writing Queries using advanced concepts of SQL
- Programming PL/SQL including procedures, functions, cursors and triggers.

Course Outcomes:

1. Design the ER model using the basic concepts of DBMS, and RDBMS.
2. Apply SQL commands such as DDL, DML, DCL, and TCL with integrity constraints..
3. Applying String, Date, and Conversion Functions in DBMS.
4. Implement simple and nested queries.
5. Develop PL/SQL stored procedures, functions, cursors, and Triggers.

List of Experiments:

SQL

Experiment 1: Conceptual Designing using ER Diagrams (Identifying entities, attributes, keys, and relationships between entities, cardinalities, generalization, specialization, etc.)

[Note: Student must submit a document by drawing an ER Diagram for the lab teacher.]

Experiment 2: Converting ER Model to Relational Model (Represent entities and relationships in Tabular form, Represent attributes as columns, identifying keys)

[Note: Student must submit a document showing the database tables created from the ER Model.]

Experiment 3: Creation of Tables using SQL- Overview of using SQL tool, Data types in SQL, User creation with DCL commands, Creating Tables (along with NOT NULL, CHECK, UNIQUE, Primary and Foreign key constraints), Altering Tables, Dropping Tables. Experiment 4a: Create a sequence on a table for generating IDs

Experiment 4b: Practicing DML commands(Insert, Select, Update, Delete), and TCL commands (commit, Save point, Rollback)

Experiment 5: Practicing Queries using ANY, ALL, IN, EXISTS, NOT EXISTS, UNION, INTERSECT, etc.

Experiment 6: Practice Queries using COUNT, SUM, AVG, MAX, MIN, GROUP BY, ORDER BY, HAVING.

Experiment 7a: Practicing String functions, conversion functions, and date functions

Experiment 7b: Practicing Sub queries (Nested, Correlated) and Joins (Inner, Outer, and Equi).

[Note: All the queries need to be developed for the library management system or university management system, banking system, etc.]

PL/SQL

1. Create a PL/SQL block for implementing declare, begin, and exception blocks.
2. Create a PL/SQL block for implementing decision and looping statements.
3. Create a user-defined exception and raise, raise_application_error.
4. Create a procedure with In and Out parameters.
5. Create a function and call the function using the stored procedure.
6. Develop programs using feature parameters in a CURSOR, FOR UPDATE CURSOR, WHERE CURRENT of clause and CURSOR variables.
7. Develop Programs using BEFORE and AFTER Triggers, Row and Statement Triggers.

Text Books:

1. Oracle Database 12c: The Complete Reference by Oracle Press, 12C, Bob Byrla, Kevin Loney, 2013
2. Nilesh Shah, "Database Systems Using Oracle, PHI, 2007.
3. Rick F Vander Lans, Introduction to SQL, Fourth Edition, Pearson Education, 2007.
4. Ramez Elmasri, Shamkant, B. Navathe, "Database Systems", Pearson Education, 6th Edition, 2013.

Web Resources:

1. <http://www.scoopworld.in>
2. <http://vlabs.iitb.ac.in/vlabs-dev/labs/dblab/index.php>

Subject Code	Subject Name	L	T	P	C
R23CSE-MT3201.1	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

Weblinks:

- (i) <https://nptel.ac.in/courses/106106139>
- (ii) <https://www.coursera.org/learn/machine-learning-duke>
- (iii) <https://www.edx.org/learn/machine-learning>
- (iv) <https://www.geeksforgeeks.org/machine-learning/>
- (v) <https://www.udemy.com/topic/machinelearning>
- (vi) <https://altair.com/altair-rapidminer>

COURSE OUTCOMES VS POs MAPPING (DETAILED; HIGH: 3; MEDIUM: 2; LOW: 1):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
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-MT3201.2	Artificial Intelligence & Neural Networks	3	0	0	3

Course objectives:

- Understand the role of neural networks in engineering, artificial intelligence, and cognitive modeling.
- Understand the role of supervised learning in neural networks.
- Understand the role of computation and dynamical systems using neural networks.
- Apply knowledge of reinforcement learning using neural networks.
- Make use of unsupervised learning using neural networks.

Course outcomes:

1. Understand the basics of artificial neural networks (ANN) and its architecture.
2. Understand the learning mechanisms of ANN using matrix and vector algebra concepts.
3. Understand the concept of single layer perceptron and its limitations.
4. Apply the back propagation algorithm using multi-layer perceptron and its limitations.
5. Apply the concept of radial basis functions to overcome the limitation of multilayer perceptron and SVM.

UNIT-I: Introduction and ANN Structure: Biological neurons and artificial neurons. Model of an ANN. Activation functions used in ANNs. Typical classes of network architectures.

Learning Outcomes: Students will be able to

- Understand the difference between Biological neurons and artificial neurons.
- Understand different network architectures.

Applications:

- Architectures are influenced by different activation functions
- System stakeholders
- Predicting the performance of the system.

UNIT-II: Mathematical Foundations and Learning mechanisms. Re-visiting vector and matrix algebra. State-space concepts. Concepts of optimization. Error-correction learning. Memory-based learning. Hebbian learning. Competitive learning.

Learning Outcomes: Students will be able to

- Understand the different learning mechanisms of artificial neurons.
- Understand concept of optimization.

Applications:

- Error correction mechanism of artificial neurons.
- Predicting the errors and performance of the system.

UNIT-III: Single layer perceptrons. Structure and learning of perceptrons. Pattern classifier - introduction and Bayes' classifiers. Perceptron as a pattern classifier. Perceptron convergence. Limitations of a perceptrons.

Learning Outcomes: Students will be able to

- Understand the structure of perceptrons.
- Understand concept of pattern classification.
- Limitations of perceptrons.

Applications:

- Computational space required for perceptron pattern.
- The topological structure used in pattern classification

UNIT-IV: Feed forward ANN: Structures of Multi-layer feed forward networks. Back propagation algorithm. Back propagation-training and convergence. Functional approximation with back propagation. Practical and design issues of back propagation learning.

Learning Outcomes: Students will be able to

- Apply the structure of perceptrons.
- Apply the concept of pattern classification.
- Limitations of perceptrons.

Applications:

- Spectroscopy.
- Multiple criteria decision making.
- Ability to use a feed-forward neural network as a mapping tool.

UNIT-V: Radial Basis Function Networks: Pattern separability and interpolation. Regularization Theory. Regularization and RBF networks. RBF network design and training. Approximation properties of RBF.

Support Vector machines: Linear separability and optimal hyperplane. Determination of optimal hyperplane. Optimal hyperplane for nonseparable patterns. Design of an SVM. Examples of SVM.

Learning Outcomes: Students will be able to

- Use the Radial Base Functions in pattern classification and interpolation problems.
- Design the RBF network.
- Use the optimal hyperplanes using SVM

Applications:

- Image retrieval process.
- Intrusion detection.
- Ability to use a feed-forward neural network as a mapping tool.
- Predictors to diagnosis of students with learning disabilities.

Contemporary Topics: Gradient Descendent Problem

TEXT BOOKS:

1. Simon Haykin, "Neural Networks: A comprehensive foundation", Second Edition, Pearson Education Asia.
2. Satish Kumar, "Neural Networks: A classroom approach", Tata McGraw Hill, 2004.

REFERENCE BOOKS:

1. Robert J. Schalkoff, "Artificial Neural Networks", McGraw-Hill International Editions, 1997.

COURSE OUTCOMES VS POs MAPPING (DETAILED; HIGH: 3; MEDIUM: 2; LOW: 1):

CO	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O 2	PS O 3
CO1	3	2										2		2	
CO2	3	2	2									2		2	
CO3	3	2	2									2		2	
CO4	3	1	2									2		2	
CO5	3	2	2									2		2	
CO*	3	2	2									2		2	

Subject Code	Subject Name	L	T	P	C
R23CSE-ML3201.1	Machine Learning Lab	0	0	3	1.5

Course Objectives:

- To learn about computing central tendency measures and Data preprocessing techniques
- To learn about classification and regression algorithms
- To apply different clustering algorithms for a problem.

Course Outcomes:

1. Understand the statistical aspects of algorithms used in pre-processing.
2. Design and evaluate supervised models for classification.
3. Evaluate the machine learning models using unsupervised algorithms.
4. Design and apply clustering algorithms for refinement of the data.
5. Design, develop and test the performance of the machine learning model.

Software Required: Python/R/Weka

Lab should cover the concepts studied in the course work, sample list of Experiments:

1. Compute Central Tendency Measures: Mean, Median, Mode Measure of Dispersion:

Variance, Standard Deviation.

2. Apply the following Pre-processing techniques for a given dataset.

a. Attribute selection

b. Handling Missing Values

c. Discretization

d. Elimination of Outliers

3. Apply KNN algorithm for classification and regression

4. Demonstrate decision tree algorithm for a classification problem and perform parameter tuning for better results

5. Demonstrate decision tree algorithm for a regression problem

6. Apply Random Forest algorithm for classification and regression

7. Demonstrate Naïve Bayes Classification algorithm.

8. Apply Support Vector algorithm for classification

9. Demonstrate simple linear regression algorithm for a regression problem

10. Apply Logistic regression algorithm for a classification problem

- 11.** Demonstrate Multi-layer Perceptron algorithm for a classification problem
- 12.** Implement the K-means algorithm and apply it to the data you selected. Evaluate performance by measuring the sum of the Euclidean distance of each example from its class center. Test the performance of the algorithm as a function of the parameters K .
- 13.** Demonstrate the use of Fuzzy C-Means Clustering
- 14.** Demonstrate the use of Expectation Maximization based clustering algorithm

Course Code	Course Name	L	T	P	Credits
R23CSE-ML3201.2	Artificial Intelligence & Neural Networks Lab	0	0	3	1.5

Course Objectives:

- To introduce the fundamental concepts of Artificial Intelligence (AI) and provide hands-on experience using Python for developing AI-based solutions.
- To develop the ability to apply AI techniques in solving real-world problems across various domains.
- To familiarize students with Natural Language Processing (NLP) and provide practical exposure to the use of Natural Language Toolkit (NLTK).
- To equip students with the knowledge of neural networks and enable them to implement architectures for processing input and output data.
- To build a strong foundation in machine learning by implementing and analyzing linear regression and logistic regression models.

Course Outcomes:

1. Use of python to understand the concept of AI and Implementation of Different AI Techniques
2. Application of AI techniques in practical Life
3. Practical Application of Natural Language Tool Kit.
4. Implement the neural networks for input and output nodes.
5. Implement Linear and Logistic regression

Name of Experiment - Artificial Intelligence

1. Write a python program to implement Breadth First Search Traversal?
2. Write a python program to implement Water Jug Problem?
3. Write a python program to remove punctuations from the given string?
4. Write a python program to sort the sentence in alphabetical order?
5. Write a program to implement Hangman game using python.
6. Write a program to implement Tic-Tac-Toe game using python.
7. Write a python program to remove stop words for a given passage from a text file using NLTK?
8. Write a python program to implement stemming for a given sentence using NLTK?
9. Write a python program to POS (Parts of Speech) tagging for the give sentence using NLTK?
10. Write a python program to implement Lemmatization using NLTK?
11. Write a python program to for Text Classification for the give sentence using NLTK

Name of Experiment - Neural Networks

1. Create a perceptron with appropriate no. of inputs and outputs. Train it using fixed increment learning algorithm until no change in weights is required. Output the final weights.
2. Create a simple ADALINE network with appropriate no. of input and output nodes. Train it using delta learning rule until no change in weights is required. Output the final weights.
3. Train the autocorrelator by given patterns:
 $A1=(-1,1,-1,1)$, $A2=(1,1,1,-1)$, $A3=(-1,-1,-1,1)$. Test it using patterns: $Ax=(-1,1,-1,1)$, $Ay=(1,1,1,1)$, $Az=(-1,-1,-1,-1)$.
4. Train the hetrocorrelator using multiple training encoding strategy for given patterns:
 $A1=(000111001)$ $B1=(010000111)$, $A2=(111001110)$ $B2=(100000001)$,
 $A3=(110110101)$ $B3=(101001010)$. Test it using pattern A2.
5. Implement Linear/Logistic regression

Reference Books:

1. Bishop, C. M. Neural Networks for Pattern Recognition. Oxford University Press. 1995.
2. Neural Networks, Fuzzy Logic and Genetic Algorithms, by S. Rajasekaran and G.A. Vijayalakshmi Pai.
3. Neuro-Fuzzy Systems, Chin Teng Lin, C. S. George Lee, PHI.
4. Build_Neural_Network_With_MS_Excel_sample by Joe choong.

Course Code	Subject Name	L	T	P	C
R23CSE-MT4101.1	Deep Learning	3	0	0	3

Course Objectives:

- Understand the fundamentals of machine learning algorithms and their challenges.
- Learn the architecture and training of deep feed forward networks.
- Master regularization techniques to improve deep learning model performance.
- Explore optimization methods for training deep neural networks.
- 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 feed forward 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 neuro scientific principles.

Unit-I – Machine Learning Basics (8 Hours)

Learning Algorithms-Capacity, Over fitting and Under fitting – Hyper parameters and Validation Sets- Estimators, Bias and Variance –Super vised Learning Algorithms – Unsupervised Learning Algorithms – Challenges Motivating Deep Learning.

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: Deep Networks (8 Hours)

Deep Feed forward Networks: Example: Learning XOR - Gradient-Based Learning - Hidden Units - Architecture Design – Back Propagation 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 – Dataset Augmentation –Noise Robustness- Semi Supervised Learning- Multi Task Learning- Early Stopping – Parameter Tying and Parameter Sharing – Sparse Representations – Bagging and Other Ensemble Methods –Drop out.

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 Good fellow 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	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
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-MT4101.2	Image Processing	3	0	0	3

Course Objectives: Students will be able to understand

- The fundamentals of Computer Graphics and Image Processing
- The basic concepts of edge detection
- The concepts of segmentation and transformation techniques
- The techniques of morphology.
- The basics of image compression methods.
- The basic concepts of Image Data Properties.

Course Outcomes: Student will be able to

1. Understand the fundamentals of Image processing.
2. Apply transformations and reflection techniques.
3. Understand the Image pre processing techniques.
4. Understand the basic concepts of Morphology.
5. Analyze various Image Segmentation techniques

UNIT I:

Introduction: Applications of Computer Graphics and Image Processing, Fundamentals on Pixel concepts, effect of Aliasing and Jaggles, Advantages of high resolution systems

DDA line algorithms: Bresenham's line and circle derivations and algorithms

At the end of this module the student will:

1. Summarize the fundamentals of Computer Graphics and Image Processing. (L2)
2. Recall the applications of Image Processing (L1)

UNIT II:

2-D Transformations: Translations, Scaling, rotation, reflection and shear transformations, Homogeneous coordinates,

Composite Transformations- Reflection about an arbitrary line; Windowing and clipping, viewing transformations, Cohen- Sutherland clipping algorithm

At the end of this module the student will:

1. Distinguish between 2D Transformations and Composite Transformation techniques.(L2)
2. Describe the transformation techniques.(L1)

UNIT III:

Digital Image Properties: Metric and topological properties of Digital Images, Histogram, entropy, Visual Perception, Image Quality, Color perceived by humans, Color Spaces, Palette Images, color Constancy

Color Images: Pixel brightness transformations, Local Preprocessing, image smoothing, Edge detectors, Robert Operators, Laplace, Prewitt, Sobel, Fri-chen, Canny Edge detection

At the end of this module the student will:

1. Classify the pixel transformations.(L2)
2. Summarize the image smoothing techniques.(L2)

UNIT IV:

Mathematical Morphology: Basic Mathematical Concepts, Binary dilation and Erosion, Opening and closing, Gray Scale dilation and erosion, Skeleton, Thinning , Thickening Ultimate erosion, Geodesic transformations, Morphology and reconstruction, Morphological Segmentation

At the end of this module the student will:

1. Recall the basic mathematical concepts.(L1)
2. Explain the Morphological techniques.(L2)

UNIT V:

SEGMENTATION: Threshold detection methods, Optimal Thresholding, Edge based Segmentation-Edge image thresholding, Edge relaxation, Border tracing, Hough Transforms, Region based segmentation: Region Mergingm Region Splitting, Splitting and Merging, Watershed Segmentation.

At the end of this module the student will:

1. Identify Threshold detection techniques.(L2)
2. Discover splitting and merging techniques for image processing.(L3)

Text Books:

1. Computer Graphics C Version, Donald Hearn, M Paulli Baker , Pearson (Unit I and Unit II)
2. Image Processing, Analysis and Machine Vision, Millan Sonka, Vaclov Halvoc, Roger Boyle, Cengage Learning, 3ed, (Unit III, Unit IV, Unit V and Unit VI)

Reference Books:

1. Computer & Machine Vision, Theory , Algorithms , Practicles, E R Davies, Elsevier, 4ed
2. Digital Image Processing with MATLAB and LABVIEW, Vipul Singh, Elsevier
3. Digital Image Processing, R C Gonzalez &R E woods, Addison Pearson, 3ed.

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	PO 12	PSO1	PSO2	PSO3
CO1	3	2	1	2	1							2	2	2	2
CO2	3	2	1	2	1							1	2	2	2
CO3	2	2	1	2	1							1	2	2	2
CO4	3	3	2	2	1							1	2	2	2
CO5	3	2	1	2	1							2	2	2	2
CO.*	3	2	1	2	1							2	2	2	2

Course Code	Subject Name	L	T	P	C
R23CSE-MT2202	Mathematics For Machine Learning	3	0	0	3

Course Objective: The purpose of this course is to provide a mathematically rigorous introduction to these developments with emphasis on methods and their analysis.

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

- Understand the strengths and weaknesses of many popular machine learning approaches.
- Justify the underlying mathematical relationships within and across Machine Learning algorithms.
- Evaluate the several areas of mathematics beyond calculus
- Solve problems in a range of mathematical applications
- Apply various methods to compute the probabilities of events, Analyze and interpret statistical data using appropriate probability distributions.

UNIT-1: (10 Hours)

Linear Algebra: Systems of Linear Equations, Matrices, Solving systems of linear equations, Vector Spaces, Linear Independence, Basis and Rank, Linear Mappings.

Analytic Geometry: Norms, Inner Products, Lengths and Distances, Angles and Orthogonality, Orthonormal Basis, Orthogonal Complement, Inner Product of Functions, Orthogonal Projections.

UNIT-2: (10 Hours)

Matrix Decompositions: Determinant and Trace, Eigen values and Eigen vectors, Cholesky Decomposition, Eigen decomposition and Diagonalization, Singular Value Decomposition, Matrix Approximation.

Vector Calculus: Differentiation of Univariate Functions, Partial differentiation and Gradients, Gradients of vector valued functions, Gradients of Matrices, Useful identities for computing gradients, Backpropagation and Automatic Differentiation

UNIT-3: (10 Hours)

Probability and Distributions: Construction of a Probability space, Discrete and Continuous probabilities, sum rule, product rule and Bayes Theorem, Summary statistics and Independence, Gaussian Distribution.

Continuous Optimization: Optimization using Gradient Descent, Constrained optimization and Lagrange Multipliers, Convex Optimization.

UNIT-4: (10 Hours)

Linear Regression: Problem Formulation, Parameter Estimation, Bayesian Linear Regression, Maximum Likelihood as Orthogonal Projection.

Dimensionality Reduction with Principal Component Analysis: Problem setting, Maximum Variance Perspective, Projection Perspective, Eigenvector computation and Low Rank Approximations, PCA in High Dimensions, Latent Variable Perspective.

UNIT-5 (08 Hours)

Density Estimation with Gaussian Mixture Models: Gaussian Mixture Model, Parameter Learning via Maximum Likelihood, EM Algorithm, Latent-Variable Perspective.

Classification with Support Vector Machines: Separating Hyperplanes, Primal Support Vector Machine, Dual Support Vector Machine, Kernels, Numerical Solution.

Text Books:

1. <https://mml-book.github.io/book/mml-book.pdf> - c 2021 M. P. Deisenroth, A. A. Faisal, C. S. Ong. Published by Cambridge University Press (2020).

References:

1. <https://www.youtube.com/watch?v=1VSZtNYMntM>

Course Code	Subject Name	L	T	P	C
R23CSE-MT3102	Artificial Intelligence for All	3	0	0	3

Course Objective:

- Define and explain the fundamental concepts and subfields of AI.
- Identify real-world applications of AI across various industries.
- Analyze the ethical, social and economic implications of AI.

Course Outcomes: Student will be able to

1. Illustrate the scope of Artificial Intelligence (AI) in gaming and expert systems.
2. Demonstrate various applications of AI related to perception and biometrics.
3. Summarize and learn different case studies in classification and recognition systems.
4. Describe and apply natural language processing techniques for designing AI Bots,
5. Illustrate the role of AI in robotics.
6. Demonstrate the state of AI in solving human labour problems for social equity.

Unit -I: (12 Hours)

AI for Everyone, Gaming and Expert Systems

AI for Everyone - What is AI? AI Explosion, AI at work, AI at Society, Applications of AI. **Gaming** – Games as search problems- Mini Max Search, Alpha Beta Cutt-Offs, State of the Art Games- Chess & Checkers Problem.

Expert Systems- Representing and using domain knowledge, Expert System Shells, Explanation and Knowledge Acquisition.

Case Study: MYCIN expert system using AI to identify bacteria causing Infections.

Unit -II: (10 Hours)

Perceptions and Biometrics

Perceptions- Image formation, Image Processing Operations, Object Recognition by appearance, Reconstructing the 3D world, Object recognition from structural information. Using Vision for manipulation and navigation.

Biometrics- Understanding the Biometric finger prints, facials, voice, iris, palm, and finger vein patterns Identifies Challenges in Biometric Systems.

Case Study I: Text Classification System

Case Study II: Face Recognition System.

Unit -III: (10 Hours)

Natural Language Processing and Natural Language Communication

Natural Language Processing- Language Models, Text Classification, Information Retrieval and Information Extraction.

Natural Language Communication- Phrase Structure Grammars, Syntactic Analysis, Augmented Grammars and Semantic Analysis, Machine Translation and Speech Recognition. **Case Study I:** Automatic Speech Recognition System.

Case Study II: Understand the development and deployment of AI Chat Bots.

Unit -IV: (08 Hours)

Robotics and Impact of AI on Human Labor and Social Equity

Robotics- Robot Hardware- Robot Perception- Planning to Move- Planning Uncertain Movements- Planning Moves- Robotic Software Architectures and Domains.

Unit -V: (08 Hours)

Impact of AI on Human Labor and Social Equity -Benefits on this Technological Revolution- Need and Necessity of Labor based Economy and Society- Distribute future assets more equitably- Support for Unemployed.

Text Books:

1. Russel and Norvig, Artificial Intelligence A Modern Approach, 4th Edition, Pearson Education 2021.
2. Stevan Finaly, Artificial Intelligence for Everyone, Relativistic Publications, Great Britan, 2020.
3. E. Rich K. Knight and B.Nair – Artificial Intelligence– Third Edition – Tata McGraw Hill, 2017.
4. Jerry Kaplan, Artificial Intelligence- What everyone needs to know, Oxford University Press, 2016.

References:

1. Artificial intelligence: a very short introduction; Margaret A. Boden; Oxford University Press; 2018.
2. Artificial Intelligence and Social Work; Milind Tambe, Eric Rice; Cambridge University Press; 2018.
3. Artificial Unintelligence; Meredith Broussard; The MIT Press; 2018.
4. Tom M. Mitchell, —Machine Learning, McGraw-Hill Education (India) Private Limited, 2013.

Course Code	Subject Name	L	T	P	C
R23CSE-ML3102	AI Tools Lab	0	0	3	1.5

Course Objectives: This course is introduced to

- Learn the fundamentals of most widely used Python packages NumPy, Pandas and Matplotlib, and then apply them to Data Analysis and Data Visualization projects.
- To introduce the fundamental techniques and principles of Neural Networks
- Teach students the leading trends and systems in natural language processing

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

1. Apply the tools of AI in the field of Engineering.
2. Identify the deep learning algorithms which are more appropriate for various types of learning tasks in various domains.
3. Design and implement solutions to classification, regression, and clustering problems
4. Implement deep learning algorithms and solve real-world problems
5. Understand machine learning techniques used in NLP, including hidden Markov models and probabilistic context-free grammars, clustering and unsupervised methods

List of Experiments:

1. **Numpy:** Illustrate the concepts multi-dimensional arrays and matrices, along with a large library of high-level mathematical functions to operate on these arrays using numpy
2. **Pandas:** Visualize New York Motor Vehicle Crash Data Using Python, Pandas, and Matplotlib.

Datasets Details:

- a. <https://data.ny.gov/Transportation/Motor-Vehicle-Crashes-Case-Information-Three-Year-/e8ky-4vqe>
 - b. <https://data.ny.gov/Transportation/Motor-Vehicle-Crashes-Individual-InformationThree/ir4y-sesj>
 - c. <https://data.ny.gov/Transportation/Motor-Vehicle-Crashes-Violation-InformationThree-/abfj-y7uq>
 - d. <https://data.ny.gov/Transportation/Motor-Vehicle-Crashes-Vehicle-Information-ThreeYe/xe9x-a24f>
3. **Tensor-Flow:** Learn simple data curation by creating a pickle with formatted datasets
 4. for training, development and testing in Tensor Flow and develop visualizations in
 5. tensor board.
 5. Create convolutional neural networks in TensorFlow.
 6. **Image recognition** (or image classification) : identifying images and categorizing
 - a. them in one of several predefined distinct classes using neural network models.
 6. **OpenCV:** Develop an online writing Whiteboard with minimal features for online
 - a. classes
 7. **Keras:** Recognize handwritten digits from MNIST using Keras
 8. **Scikit-learn** : Write a Python program using Scikit-learn to split the iris dataset into 70% train data and 30% test data. Out of total 150 records, the training set will contain 120 records and the test set contains 30 of those records. Print both datasets
 9. Design a perceptron classifier to classify handwritten numerical digits (0-9). Implement using scikit or Weka.

10. **NLP:** Program to illustrate the concepts sentence segmentation, word tokenization, stemming and lemmatization, Hidden markov model(HMM) for Parts of speech (PoS) Tagging

Text Book (s):

1. Machine Learning: The art and Science of algorithms that make sense of data, Peter Flach, Cambridge University Press, 2012
2. Tom M. Mitchell, Machine Learning, India Edition 2013, McGraw Hill Education
3. Chris Albon : Machine Learning with Python Cookbook , O'Reilly Media, Inc. 2018

Web Resources:

1. <https://scikit-learn.org/stable//downloads/scikit-learn-docs.pdf>
2. docs.python.org › library
3. <https://opencv.org/>
4. <https://matplotlib.org/>

Course Code	Subject Name	L	T	P	C
R23CSE-MT3202	Machine Learning Using Python	3	0	0	3

Course Objectives:

- To illustrate the concepts of Python Language to introduce.
- To explore the basics of Machine Learning & their types.
- To understand data pre processing for Machine Learning.
- To apply machine learning algorithm on given data.
- To evaluate and visualize the model performance.
- To make predictions using machine learning algorithms.
- To solve real world problems through machine learning implementation leading to predictions.

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

1. Illustrate the concepts of Python Language and basics of Machine Learning & their types.
2. Apply various data visualization tools.
3. Understand data pre processing for Machine Learning.
4. Make predictions using machine learning algorithms.
5. Solve real world problems through machine learning implementation leading to predictions.

UNIT-1: (10 Hours)

Introduction of Python: Python Installation with various IDE's, Python data Types, Control Structures, Functions, Introduction of OOP's

UNIT-2: (10 Hours)

Data analysis and Exploration: Data Analysis & Visualization using, NumPy, Pandas, Matplotlib, SciPy etc

UNIT-3: (10 Hours)

Machine learning & Its Applications: Introduction to machine learning, Supervised machine learning, Unsupervised machine learning, Study of various machine learning algorithms including, Classification, Regression, KNN, K Means, Logistic Regression, Support Vector Machines (SVM), Decision Tree, Naïve Bayes, Ensemble Methods, Random Forest etc

UNIT-4: (10 Hours)

Regression: Introduction to Regression, Simple Linear Regression, Multiple Linear Regression, Non-Linear Regression, Polynomial Regression, Logistic Regression vs Linear Regression, Model Evaluation in Regression Models, Evaluation Metrics in Regression Models.

UNIT-5 (08 Hours)

Classification & Clustering: Introduction to Classification, K-Nearest Neighbors (KNN), **Decision Trees:** Building Decision Trees, Support Vector Machines (SVM), Evaluation Metrics in Classification, **Clustering:** Introduction to Hierarchical Clustering,

Text Books:

- “Introduction to Machine Learning with Python” by Andreas C Muller, Sarah Guido.
- “Python Programming - A modular Approach with Graphics, database, Mobile and Web Applications” by Sheetal Taneja and Naveen Kumar, Pearson.

References:

- “Beginning Programming with Python Dummies” by John Paul Meuller.
- “Machine Learning an Algorithmic Perspective” by Stephen Marshland.

Course code	Course Name	L	T	P	C
R23CSE-ML3202	Machine Learning Using Python Lab	0	0	3	1.5

Course Objectives:

- To introduce fundamental concepts of machine learning.
- To develop skills to implement machine learning algorithms using Python.
- To apply machine learning techniques to real-world problems.

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

1. Understand and implement various machine learning algorithms.
2. Analyze data for machine learning applications.
3. Evaluate the performance of machine learning models.
4. Utilize Python libraries such as scikit-learn, pandas, and matplotlib for machine learning tasks
5. Solve real world problems through machine learning implementation

List of Experiments:

1. **Data Preprocessing:**
 - Handling missing values, encoding categorical variables, and feature scaling.
2. **Regression Analysis:**
 - Implementing linear and polynomial regression models.
3. **Classification Techniques:**
 - Applying algorithms like k-Nearest Neighbors (k-NN), Decision Trees, and Naive Bayes.
4. **Clustering Methods:**
 - Using k-Means and hierarchical clustering for unsupervised learning tasks.
5. **Model Evaluation:**
 - Assessing model performance using confusion matrices, accuracy scores, and cross-validation.
6. **Dimensionality Reduction:**
 - Applying Principal Component Analysis (PCA) to reduce feature space.
7. **Real-world Applications:**
 - Developing machine learning models for practical problems such as spam detection or sentiment analysis.

Text Books:

1. “Introduction to Machine Learning with Python” by Andreas C Muller, Sarah Guido., O'Reilly
2. “Python Machine Learning”, by Sebastian Raschka and Vahid Mirjalili, Packt Publishing, 3rd Edition

References:

3. Python Programming - A modular Approach with Graphics, database, Mobile and Web Applications” by Sheetal Taneja and Naveen Kumar, Pearson.
4. “Beginning Programming with Python Dummies” by John Paul Meuller.
5. “Machine Learning an Algorithmic Perspective” by Stephen Marshland.

Course Code	Subject Name	L	T	P	C
R23CSE-MT4102	AI for Data Science	3	0	0	3

Course Objective: To understand AI systems often utilize machine learning algorithms via data science for predictive modeling and pattern recognition.

Course Outcomes:

1. Illustrate the concepts of traditional AI with its agents and environment.
2. Explore the concepts of problem solving techniques.
3. Understand the role of Big Data and how to gather data.
4. Summarize the concepts of Data Science Process.
5. Understand the various applications of data science.

UNIT-I:(10Hours)

AI Introduction: The Foundation of Artificial Intelligence, The History of Artificial Intelligence, **Intelligent Agents:** Agents and Environments, **Good Behaviour:** The Concept of Rationality, The Nature of Environments, Structure of Agents.

UNIT-II:(10 Hours)

Problem Solving by Searching: Problem Solving Agents, Example Problems, Searching for Solutions, Uninformed Search Strategies, Informed (Heuristic) Search Strategies, Heuristic Functions.

UNIT-III:(09 Hours)

Preparing and Gathering Data and Knowledge: Philosophies of Data Science-Data science in a Big Data World - Benefits and Uses of Data Science and Big Data.

Facets of Data: Structured data, Unstructured data, Natural Language, Machine generated data, Graph-based or network data, Audio, Image and Video Streaming data.

UNIT-IV:(09 Hours)

The Data Science Process: Overview of the Data Science Process - Defining Research Goals and Creating Project Charter, Retrieving Data, Cleansing, Integrating and Transforming Data, Exploratory Data Analysis, Build the Models. Presenting Findings and Building Applications on top of them.

UNIT-V:(10 Hours)

Applications of Data Science: Technologies for Visualization, Bokeh (Python), Recent trends in various Data Collection and Analysis Techniques, Various Visualization Techniques, Application Development Methods used in Data Science.

Text Books

1. Stuart Russel, Peter Norvig: “Artificial Intelligence A Modern Approach”, Pearson Education.
2. “Introducing Data Science”, Davy Cielen, Arno D. B. Meysman and Mohamed Ali, Manning Publications.

References

1. Elaine Rich, Kevin Knight: “Artificial Intelligence”, Tata McGraw Hill.
2. Nils J. Nilsson: “Principles of Artificial Intelligence”, Elsevier.
3. Doing Data Science, Straight Talk from the Frontline, Cathy O' Neil, Rachel Schutt, O' Reilly.
4. Think Like a Data Scientist, Brian Godsey, Manning Publications.

Course Code	Subject Name	L	T	P	C
R23CSE-MT2203.1	Python Programming Common to CSE, CSSE,CSIT	3	0	0	3

Course Objectives:

- Understand structure and data types of python script.
- Implement iterations and functions in python.
- Implement modules and data structures using mutable & immutable objects.
- Understand object oriented concepts on real world scenarios.
- Understand packages for statistics and gaming.

Course Outcomes:

1. Understand installation of python and different types of variable allocations. (L2)
2. Implement control flow and functions for data processing. (L3)
3. Applying modules and Packages in programming. (L3)
4. Analyze different data structures and their functionalities. (L4)
5. Understand Object oriented concepts and handle different errors through exceptions. (L3)

Unit I:

Introduction: what is python programming , History of Python, Features of Python, Applications, python installation steps, Python Using the REPL(Shell), Running Python Scripts, Variables, Assignment forms, Program Comments and Doc strings, Keywords, Input-Output, Indentation.

Operators and Type Conversion: Data Types: Numeric, Booleans, Sequence, Strings, Operations in python, Type conversions, Expressions.

Learning Outcomes:

After completing this chapter, student will be able to

1. Understand the environment of python.(L2)
2. Create and run simple scripts in python.(L2)
3. Understand data types and their conversions.(L2)
4. Understand operators for doing operations on different expressions.(L2)

Applications:

1. Operating Systems
2. Web and Internet Development

Unit II:

Control Flow: Control Flow-if, elif, for, range (), while, break, continue, pass, nested loops.

Functions: Defining Functions, Calling Functions, Passing Arguments, Keyword Arguments, Default Arguments, Variable-length arguments, Fruitful Functions (Function Returning Values), recursive function, Scope of the Variables in a Function - Global and Local Variables, Anonymous Functions, Lambdas, map, reduce and filter.

Learning Outcomes:

After completing this chapter, student will be able to

1. Understand the iterations using looping structures.(L2)
2. Make decisions through conditional statements.(L2)
3. Understand functions to define call and pass as arguments.(L2)
4. Write anonymous functions for resolving complex problems.(L2)

Applications:

1. Game Development
2. Artificial Intelligence and Machine Learning

Unit III:

Modules: why module programming, Creating modules, import statement, from Import statement, namespace, builtin modules- os, random, math, json, request, date, RegEx, itertools.

Packages: Introduction to PIP, Installing packages using PIP.

Learning Outcomes:

After completing this chapter, student will be able to

1. Create and implement modules using import.(L3)
2. Understand different built-in modules.(L2)
3. Understand data science libraries.(L2)

Applications:

1. Game Development
2. Business Applications

Unit IV:

Exploring Data Science Libraries: NumPy, Pandas, Matplotlib

Strings & Data Structures: String, String Formatting, List, String and List Slicing, Tuple, Sets, Frozen Sets, Dictionaries, Comprehensions, Built-in methods of all sequences, File I/O Operations. **Learning Outcomes:**

After completing this chapter, student will be able to

1. Implement String operations and formatting.(L3)
2. Understand fundamentals of data structures and their methods.(L2)
3. Implementing file operations for data processing.(L3)

Applications:

1. Data Science
2. Data Structures
3. Artificial Intelligence and Machine Learning

Unit V:

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

1. Implement Object oriented concepts with real world scenarios.(L3)
2. Understand class hierarchies and abstraction.(L2)
3. Understand error handling and handle exceptions.(L2)

Applications:

1. Desktop GUI
2. Business Applications

Text Books:

1. Python Programming: Using Problem Solving Approach by ReemaTheraja,Oxford publications
2. Python Programming: A Modern Approach, Vamsi Kurama, Pearson.

Reference Books:

1. Fundamentals of Python by Kenneth HL ambert, Cengage
2. Learning Python, Mark Lutz, Orielly.
3. Python Programming by Ashok N Kamathane, McGrawhill

COURSE OUTCOMES VS POs MAPPING (DETAILED; HIGH: 3; MEDIUM: 2; LOW: 1):

CO	PO1	PO2	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	3	3		2				2		3	3	2	3
CO2	3	3	3	3		2				2		3	3	3	3
CO3	3	3	3	3		2				2		3	3	3	3
CO4	3	3	3	3		2				2		3	3	3	3
CO5	3	3	3	3		2				2		3	3	2	3

Subject Code	Subject Name	L	T	P	C
R23CSE-MT2203.2	Object Oriented Programming Through C++	3	0	0	3

Course Objectives:

- This course is designed to provide a comprehensive study of the C programming language.
- It Stresses the strengths of C, which provide students with the means of writing efficient, Maintainable and portable code.
- The nature of C language is emphasized in the wide variety of Examples and applications.
- To learn and acquire art of computer programming. To know about some popular programming
- Languages and how to choose
- Programming language for solving a problem.

Course Outcomes:

1. Understand the basic fundamentals of OOP language and its learning environment.
2. Acquire the knowledge of classes, objects and member functions, constructors, Destructors.
3. Analyze the concepts of Operator overloading, Inheritance
4. Apply the concept of pointers, polymorphism, and virtual functions to solve complex problems.
5. Design generic programs using templates and handle different errors through exceptions.

UNIT-I: Introduction to C++

Difference between C and C++- Evolution of C++- The Object Oriented Technology- Disadvantage of Conventional Programming- Key Concepts of Object Oriented Programming- Advantage of OOP- Object Oriented Language.

Learning Outcomes: Student should be able to

- Understanding the object oriented concepts
- Differentiate Procedural and object oriented paradigms

UNIT-II: Classes and Objects & Constructors and Destructor Classes in C++-Declaring Objects- Access Specifiers and their Scope- Defining Member Function Overloading Member Function- Nested class, Constructors and Destructors, Introduction- Constructors and Destructor- Characteristics of Constructor and Destructor-Application with Constructor- Constructor with Arguments (parameterized Constructor-Destructors- Anonymous Objects.

Learning Outcomes: Student should be able to

- Understand the Concepts of classes, objects and member functions, constructors, Destructors.
- Construct the classes with member functions

UNIT-III: Operator Overloading and Type Conversion & Inheritance The Keyword Operator- Overloading Unary Operator- Operator Return Type- Overloading Assignment Operator (=)- Rules for Overloading Operators, Inheritance, Reusability- Types of Inheritance- Virtual Base Classes- Object as a Class Member- Abstract Classes- Advantages of Inheritance-Disadvantages of Inheritance

Learning Outcomes: Student should be able to

- Analyze the concepts of Operator overloading, Inheritance
- Analysis the different types of inheritances

UNIT-IV: Pointers & Binding Polymorphisms and Virtual Functions Pointer, Features of Pointers- Pointer Declaration- Pointer to Class- Pointer Object- The this Pointer to Derived Classes and Base Class, Binding Polymorphisms and Virtual Functions, Introduction Binding in C++- Virtual Functions- Rules for Virtual Function- Virtual Destructor.

Learning Outcomes: Student should be able to

- Understanding the pointers in polymorphism.
- Apply the concept of pointers, polymorphism, and virtual functions to solve complex problems

UNIT-V: Generic Programming with Templates & Exception Handling Generic Programming with Templates, Need for Templates- Definition of class Templates- Normal Function Templates- Over Loading of Template Function-Bubble Sort Using Function Templates Difference Between Templates and Macros- Linked Lists with Templates, Exception Handling- Principles of Exception Handling- The Keywords try throw and catch- Multiple Catch Statements – Specifying Exceptions.

Learning Outcomes: Student should be able to

- Design generic programs using templates and handle different errors through exceptions
- Handle Exceptions and create own exception sub classes.

Learning Outcomes: Student should be able to

- Understanding utilization of different STL Library
- Understanding vectors ,lists and maps

Applications: Operating Systems, Distributed Systems, Online tools

Text Books:

1. A First Book of C++, Gary Bronson, Cengage Learning.
2. The Complete Reference C++, Herbert Schildt, TMH.
3. Programming in C++, Ashok N Kamathane, and Pearson 2nd Edition.

Reference Books:

1. The C++ Programming Language, Bjarne Stroustrup, 4th Edition.
2. Object oriented Programming in C++, Robert Lafore,4th Edition.
3. Object Oriented Programming C++, Joyce Farrell, Cengage.
4. C++ Programming: From problem analysis to program design, DS Malik, Cengage Learning

URL:

Course Outcomes VS POs Mapping (High: 3; Medium: 2; Low: 1)

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PS O1	PSO 2	PS O3
C1205.1	3	3	3	2		2			2			2	3	2	3
C1205.2	3	3	3	2	1	1						2	3	1	3
C1205.3	3	3	3	2		1			2			2	3	1	3
C1205.4	3	3	3	2		1							3	1	3
C1205.5	3	3	3	2		2						2	3	2	3
0C1205.*	3	3	3	2	1	2			2			2	3	2	3

Course Code	Subject Name	L	T	P	C
R23CSE-MT3103	Java Programming	3	0	0	3

Course Objectives:

- Understand the structure and environment of Java.
- Implement the relationship between objects.
- Understand the Strings and Organize data using different data
- Implement text processes and error handling.
- 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

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

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

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

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

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)
3. Create graphical components using Abstract window toolkit. (L3)

Applications:

- Desktop GUI Applications
- Mobile Applications
- Artificial intelligence
- Web applications
- Big Data technology
- Gaming applications
- Business applications
- Embedded systems
- Cloud applications
- Scientific applications

Contemporary Topics:

Annotations, Reflections

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.

WEB LINKS:

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	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
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

Course Code	Subject Name	L	T	P	C
R23CSE-ML3103	Java Programming Lab	0	0	3	1.5

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 input/output operations and exception handling.
5. Implement multi-threading and GUI applications.

Course Outcomes:

1. Understand the Environment of Java Run-time Environment and Control Structures. (L2)
2. Implement real-world objects using class Hierarchies. (L3)
3. Implement programs using a collection Framework. (L3)
4. Implement exception handling and file handling. (L3)
5. Design GUI for real-time problems (L3)

Exercise-1: Programs on Input/output, Class & Object, Type Conversion and Wrapper Classes

Sample Programs

- a. Write a Java program to create Class as Registration with properties as Full Name(String) , Gender(char), Age(int), Height(double), Phone Number(long), and isMarried(Boolean) and print their values.
- b. Write a Java program to implement Type Casting and Conversion.
- c. Write a Java program to implement Wrapper Classes.

Exercise-2: Programs on Control Statements, Command Line Arguments, Arrays

Sample Programs

- a. Write a Java program to take input as Regd.No and print the branch depending upon the department code in that Regd.No using else-if and switch statements. (Eg Regd. No: 23KD1A0505, 8th character is department Code, 5-CSE, 4-ECE, 3-MECH, 2-EEE etc.
- b. Write a Java program to read input integers from Command Line Arguments and print first and second largest numbers.
- c. Write a Java program to take input as Integer array and print even indexed even numbers and odd indexed odd numbers.

Exercise-3: Programs on Control Statements, Operators, Arrays

Sample Programs

- a. Write a Java program to take input as Decimal number and convert into Roman Number.
- b. Write a Java program to check whether given number is Extension number. The extension number is the number which is present in the last digit(s) of its square.(Eg.N=25, 625 is Extension number since it contains 25).
- c. Write a Java program to take input as Amount in rupees and print their denominations and total number notes.

Exercise-4: Programs on Class & Object, Method, Constructor

Sample Programs

- Create a Class named Student with properties as Student Id, Student Name, gender, department, Age, Aggregate and methods as insert Student() for inserting student details and display Student() for printing student details.
- Create a class Student with same properties as above and create a constructor to insert student details and return the data using toString() method.

Exercise-5: Programs on Method Overloading, Constructor Overloading

Sample Programs

- Design a Class named Transaction to transfer amount (double) in different ways using Account Number(int) , Phone Number(Long) and qr Code (String) as parameter into a method transfer Amount() to achieve Method or Constructor Over Loading
- Design a super Class Account and sub Classes as Loan Account, Savings Account and Current Account and implement relationship between parent and child classes.
(Implement Packages for the above classes)

Exercise-6: Programs on Super, Static and Final Keywords

Sample Programs

- Write a Java program to implement this and super keywords.
- Write a Java program to implement Static property, method, block and package.
- Write a Java program to implement final property, method and class.

Exercise-7: Programs on Data abstraction, Inheritance and Interface

Sample Programs

- Write a Java program to implement Data Abstraction using Abstract class and Interface.
- Write a Java program to implement Multiple Inheritance through Interfaces.

Exercise-8: Programs on Strings, String Methods, StringBuffer, StringBuilder

Sample Programs

- Write a Java program to take input as String Sentence S and print largest and shortest word in S.
- Write a Java program to take input as String S and remove the consecutive repeated characters from S. (Eg. S = Raaaamaaa then, Rama)
- Write a Java program to take input as String Sentence S and print sentence again with all the words with the first letter as capital letter using StringBuffer.

Exercise-9: Programs on Collections like Maps, Set, List and Comparable & Comparator

Sample Programs

- Write a Java program to implement Map interface.
- Write a Java program to implement Set Interface.
- Write a Java program to implement List Interface.
- Write a Java program to implement Comparator Interface.

Exercise-10: Programs on IO Streams, Reading & Writing Data, Serialization

Sample Programs

- Write a Java program to read data from Employee file and print highest salary employee information. (Employee File Contains: ID, name, Dept, Salary).
- Write a Java program to implements Serializable Interface to read and write Objects to/from the file.

Exercise-11: Programs on Exception Handling (try, catch, throw, throws, finally blocks)**Sample Programs**

- Write a Java program to implement tries, catch, finally blocks.
- Write a Java program to create user defined Exception and implement throw and throws handlers.

Exercise-12: Programs on Thread, Thread Synchronization**Sample Programs**

- Write a Java program to create Thread using Thread Class and Runnable Interface.
- Write a Java program to implement multi threading and synchronization.
- Write a Java program to implement Producer and Consumer Problem.

Exercise-13: Programs on AWT Components, Event Delegation Model, Applets**Sample Programs**

- Create an Applet that changes the Font and background Color depending upon the user selection from the input.
- Write a Java program to implement Event Delegation model through AWT Components.
- Write a Java program to implement Layout Manager with AWT components.

Text books:

- The complete Reference Java, 8th edition, Herbert Schildt, TMH.
- Programming in JAVA, Sachin Malhotra, SaurabhChoudary, Oxford.

Reference books:

- Introduction to java programming, 7th edition by Y Daniel Liang, Pearson.
- Java: How to Program, 9th Edition (Deitel) 9th Edition.
- Core Java: An Integrated Approach, Java 8 by R. Nageswara Rao.

Web links:

- <https://www.javapoint.com/>
- <https://www.sitesbay.com/java/index>
- <https://www.tutorialspoint.com/java/index.htm>
- <https://www.w3schools.com/java/>
- <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	PSO 1	PSO 2	PSO 3
CO1	3	3	2	1	2				1			2	3	1	2
CO2	3	3	2	2	2				2			2	3	1	2
CO3	3	3	2	1	2				2			2	3	1	2
CO4	3	3	2	1	2				2			2	3	1	2
CO5	3	3	2	1	2				2			2	3	1	2

Subject Code	Subject Name	L	T	P	C
R23CSE-MT3203	Advanced Java Programming	3	0	0	3

Course Objectives:

- Create GUI screens for stand alone applications.
- Understand the features of lambdas and streams.
- Understand the different driver specific database connections.
- Implement server-side programming using Servlets.
- Implement server-side programming using Java Server pages.

Course Outcomes:

1. Create GUI based applications using Panels and Components.
2. Analyze the collections using Lambdas and Streams.
3. Implement JDBC connections using java SQL packages.
4. Create Server Side programs for request-response handling using Servlets.
5. Apply JSP for server side tag implementation.

Unit 1: GUI Programming: Basics of Swing, Swing Features, Components and Containers, Event Handling, Various Swing components, Writing Swing Application

Learning Outcomes: student will be able to

- Understand the fundamentals of GUI programming. (L2)
- Understand components and panels for user interface. (L2)
- Create Stand-alone GUI components using Swing Components. (L4)

Unit 2: Lambdas & Streams : Functional Interface, Lambda expressions, scope, streams-creation, collections, filtering, pipeline, lazy invocation, reduction, collect method

Learning Outcomes: Student will be able to

- Understand the functional interface and expressions. (L2).
- Apply streams and lambdas for data collectors. (L4).
- Create Filters and maps for generated collection data. (L4)

Unit 3: Java database Programming: Basics of Java database, JDBC Architecture, Different Types of Drivers of JDBC, Establishing JDBC Database Connections, JDBC Statements, ResultSet Interface, RowSet interface, JDBC Batch Processing, exploring java.sql.*, javax.sql.*

Learning Outcomes: Student will be able to

- Understand fundamentals of SQL and its operations (L2)
- Create JDBC drivers for different database vendors. (L4)
- Implement JDBC connections for CRUD operations. (L4)

Unit 4: Java Servlet Programming: Servlet: Basics of Servlet, Types of Servlet, Servlet Life Cycle, HTTP request, HTTP response, Servlet init parameters, ServletRequest, ServletConfig, ServletContext, Session Tracking, Database Handling

Learning Outcomes: Student will be able to

- Understand the life cycle of servlet. (L2)
- Implement HTTP Request and response handling using HTTP Servlet APIs. (L4)
- Implement Sessions and Cookies using servlet APIs. (L4)

Unit 5: Java Server Pages (JSP): Basics of JSP, Life cycle of JSP, Scripting elements, Implicit Objects, Directive Elements, JSP actions: include and forward, Session Tracking, Page redirection, Database Handling

Learning Outcomes: Student will be able to

- Understand Life cycle of JSP over Servlet. (L2)
- Implement scripting elements of JSP in web pages. L4)
- Apply implicit objects and actions on server side APIs. (L4)

APPLICATIONS:

- Building stand-alone applications
- Building Financial, banking applications, gateways etc
- Online and Social media applications

TEXT BOOKS:

1. Web Technologies: HTML, JAVASCRIPT, PHP, JAVA, JSP, ASP.NET, XML and Ajax, Black Book Paperback – 1 January 2009
by Kogent Learning Solutions Inc, Dreamtech Press; 1st edition.
2. Java for Web Development (English, Paperback, Vivek, Gupta Sarika, Agarwal), BPB Publications

REFERENCE BOOKS:

1. Java: How to Program, 9th Edition (Deitel) 9th Edition by Paul Deitel (Author), Harvey M. Deitel (Author).
2. Java 8 in Action: Lambdas, Streams, and functional-style programming Paperback, 2014 by Raoul-Gabriel Urma (Author), Mario Fusco (Author), Alan Mycroft (Author)

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	PSO\	PSO2	PS O3
CS41.1	3	2	2	1	3						1	1	2	3	3
CS41.2	3	2	2	1	3						1	1	2	3	3
CS41.3	3	3	3	2	3						1	2	3	3	3
CS41.4	3	3	3	2	3						1	2	3	3	3
CS41.5	2	2	2	2	2						1	1	2	2	2
CS41*	3	2	2	2	3						1	1	2	3	3

Course Code	Subject Name	L	T	P	C
R23CSE-ML3203.1	Advanced Java Programming Lab	0	0	3	1.5

Course Objectives :

- To familiarize students with **GUI programming** concepts using Swing and event handling in Java.
- To enable students to apply **functional programming** paradigms using Lambdas and Streams for effective coding.
- To provide hands-on practice with **Java Database Connectivity (JDBC)** for building data-driven applications.
- To develop skills in designing and implementing **Java Servlets** for dynamic web applications.
- To impart knowledge and practical experience in developing **Java Server Pages (JSP)** for interactive and database-enabled web solutions.

Course Outcomes :

1. Design GUI-based desktop applications using Swing. (*Apply – L3*)
2. Implement lambda expressions and Stream API. (*Apply – L3*)
3. Integrate relational databases with Java applications using JDBC. (*Analyze – L4*)
4. Develop dynamic server-side applications using Java Servlets. (*Create – L6*)
5. Construct web applications using JSP with database handling. (*Create – L6*)

List of Lab Programs

1. Write a Java program to create a simple calculator using Swing components. (*CO1, Apply – L3*)
2. Develop a student registration form using JFrame, JLabel, JTextField, JButton with event handling. (*CO1, Apply – L3*)
3. Implement a notepad-like text editor using Swing with menu options and event listeners. (*CO1, Apply – L3*)
4. Write a Java program to demonstrate functional interfaces using lambda expressions. (*CO2, Apply – L3*)
5. Implement a program to filter and sort employee data using Stream API. (*CO2, Apply – L3*)
6. Demonstrate reduction and collection operations on a list of numbers using Streams. (*CO2, Apply – L3*)
7. Write a JDBC program to establish a connection with MySQL database and display table contents. (*CO3, Analyze – L4*)
8. Implement CRUD operations (Insert, Update, Delete, Retrieve) on a Student table using PreparedStatement. (*CO3, Analyze – L4*)

9. Develop a mini-application for library management using JDBC batch processing. (CO3, Analyze – L4)
10. Write a servlet program to display a welcome message using doGet() and doPost() methods. (CO4, Create – L6)
11. Develop a servlet to demonstrate session tracking using cookies and HttpSession. (CO4, Create – L6)
12. Create a servlet-based login application with JDBC integration. (CO4, Create – L6)
13. Write a JSP program to display the current date and time using scripting elements. (CO5, Create – L6)
14. Develop a JSP page for user registration using implicit objects and directive elements. (CO5, Create – L6)
15. Implement an online student portal using JSP + JDBC with page redirection and session management. (CO5, Create – L6)

CO–PO Mapping Table (NBA Format)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	2	3				1	2		2	2	2	2
CO2	3	2	2	2	3				1	1		3	2	2	2
CO3	3	3	3	3	3				2	2		3	2	2	2
CO4	3	3	3	3	3				2	2		3	2	2	2
CO5	3	3	3	3	3				2	3		3	2	2	2

Scale: 3 = Strong, 2 = Moderate, 1 = Low Contribution

Subject Code	Subject Name	L	T	P	C
R23CSE-ML3203.3	Object Oriented Programming Through C++ Lab	0	0	3	1.5

Course objectives:

- To strengthen their problem solving ability by applying the characteristics of an Object oriented Approach.
- To introduce object oriented concepts in C++ and Java Programming:

Course outcomes:

1. Explain what constitutes an object-oriented approach to programming and identify potential benefits of object-oriented programming over other approaches.
2. The understanding of computer programming concepts facilitates the better implementation of object oriented programming.
3. Acquires the basic knowledge in C++ programming, parameter passing mechanisms, function overloading, friend functions, exception handling and recursion.
4. Understanding the C++ concepts classes, objects and member functions, constructors, Destructors, variants in them, operator overloading, type conversions.
5. Real time applicability can be accomplished through inheritance and delegation.
6. Analyze the templates, function templates for generic programming and understand the Exception handling mechanism for program recovery.

Exercise – 1 (Basics)

Write a Simple Program on printing “Hello World” and “Hello Name” where name is the input from the user

- a) Convert any two programs that are written in C into C++
- b) Write a description of using g++ (150 Words)

Exercise – 2 (Expressions Control Flow)

- a) Write a Program that computes the simple interest and compound interest payable on Principle amount (in Rs.) of loan borrowed by the customer from a bank for a given period of time (in years) at specific rate of interest. Further determine whether the bank will benefit by charging simple interest or compound interest.
- b) Write a Program to calculate the fare for the passengers travelling in a bus. When a Passenger enters the bus, the conductor asks “What distance will you travel?” On knowing distance from passenger (as an approximate integer), the conductor mentions the fare to the passenger according to following criteria.

Exercise – 3 (Variables, Scope, Allocation)

- a) Write a program to implement call by value and call by reference using reference variable.
- b) Write a program to illustrate scope resolution, new and delete Operators. (Dynamic Memory Allocation)
- c) Write a program to illustrate Storage classes
- d) Write a program to illustrate Enumerations

Exercises –4 (Functions)

Write a program illustrating Inline Functions

- a) Write a program illustrates function overloading. Write 2 overloading functions for power.
- b) Write a program illustrate the use of default arguments for simple interest function.

Exercise -5 (Functions –Exercise Continued)

- a) Write a program to illustrate function overloading. Write 2 overloading functions for adding two Numbers.
- b) Write a program illustrate function template for power of a number.
- c) Write a program to illustrate function template for swapping of two numbers.

Exercise -6 (Classes Objects)

Create a Distance class with:

- Feet and inches as data members
- Member function to input distance
- Member function to output distance
- Member function to add two distance objects

- a). Write a main function to create objects of DISTANCE class. Input two distances and output the sum.
- b). Write a C++ Program to illustrate the use of Constructors and Destructors (use the above program.)
- c) Write a program for illustrating function overloading in adding the distance between objects (use The above problem)
- d). Write a C++ program demonstrating a Bank Account with necessary methods and variables

Exercise – 7 (Access)

Write a program for illustrating Access Specifies public, private, protected

- a) Write a program implementing Friend Function
- b) Write a program to illustrate this pointer
- c) Write a Program to illustrate pointer to a class

Exercise -8 (Operator Overloading)

- a). Write a program to Overload Unary, and Binary Operators as Member Function, and Non Member Function.
 - i. Unary operator as member function
 - ii. Binary operator as non-member function
- b). Write a c ++ program to implement the overloading assignment = operator
- c). Write a case study on Overloading Operators and Overloading Functions (150 Words)

Exercise -9 (Inheritance)

- a) Write C++ Programs and incorporating various forms of Inheritance
 - i. Single Inheritance
 - ii. Hierarchical Inheritance
 - iii. Multiple Inheritances
 - iv. Multi-level inheritance
 - v. Hybrid inheritance
- b) Write a program to show Virtual Base Class
- c) Write a case study on using virtual classes (150 Words)

Exercise-10 (Inheritance –Continued)

- a) Write a Program in C++ to illustrate the order of execution of constructors and destructors in inheritance
- b) Write a Program to show how constructors are invoked in derived class

Exercise -11 (Polymorphism)

- a) Write a program to illustrate runtime polymorphism
- b) Write a program to illustrate this pointer
- c) Write a program illustrates pure virtual function and calculate the area of different shapes by using abstract class.
- d) Write a case study on virtual functions (150 Words)

Exercise -12(Templates)

- a) Write a C++ Program to illustrate template class
- b) Write a Program to illustrate class templates with multiple parameters
- c) Write a Program to illustrate member function templates

Exercise -13 (Exception Handling)

- a).Write a Program for Exception Handling Divide by zero
- b). Write a Program to re-throw an Exception

Exercise -14 (STL)

- a) Write a Program to implement List and List Operations
- b) Write a Program to implement Vector and Vector Operations

Exercise -15 (STL Continued)

- a) Write a Program to implement Dequeue and Dequeue Operations
- b) Write a Program to implement Map and Map Operations

Subject Code	Subject Name	L	T	P	C
R23CSE-MT4103.1	Dot NET Programming	3	0	0	3

Course Objectives:

- To understand the working environment of Microsoft Visual Studio.
- Understand the OOPS concepts, Threads and File handling
- Understand and gain practical knowledge of Collections and Reflection framework
- To make the student to create websites using ASP.NET
- Understand the concept of session tracking mechanism in real time applications.

Course Outcomes:

1. Understand structure of C# program constructs.
2. Implement object oriented concepts with files and threads.
3. Implement generics and reflections for data collection.
4. Create user interactive web pages using ASP.NET
5. Develop secure web applications with persistence and state.

DOT NET Syllabus

Unit I: The .NET Technology & Introduction to C#: Understanding the fundamentals of the .NET Core framework and its architecture, Overview of .NET Core vs .NET Framework, CTS, CLS, Base Class Library (BCL) and Common Language Runtime (CLR).

C# features and basics-Program structure, data types, Operators, decision-making statements, loops, Arrays and strings

Learning Outcomes:

- Understand .NET Core program structure (L2)
- Understand decision-making and iterations in C# (L2)

Unit II: OOPS Concepts- Class, Object, Inheritance, abstract classes, Interfaces, polymorphism, operator overloading, exception handling, Collections in c#

Learning Outcomes:

- Understand object-oriented concepts with real-time applications (L2)
- Understand error and exception handling strategies (L2)

Unit III: ASP.NET & ASP.NET Core Web Development: Overview of ASP.NET framework, ASP.NET Page – lifecycle, Web Forms, introduction to Server Controls, HTML Controls, Validation

Controls, User control, Master Pages, themes and skins. Creating web applications using ASP.NET & ASP.NET Core

Learning Outcomes:

- Implement the Model-View-Controller architecture for creating web applications (L4)
- Implement ASP.NET Core life cycle through user controls and navigation (L4)
- Implement web applications using ASP.NET Core (L3)

UNIT-IV ASP.NET Session Management–Overview of session state, its importance, and the challenges of maintaining user state in web applications, Client side session management and Server-side session management

Learning outcomes:

- Understand and identify the challenges associated with maintaining user state.(L2)
- Compare client-side and server-side session management techniques in ASP.NET(L4)
- Implement both client-side and server-side techniques.(L3)

Unit V: ADO.NET(Working with Database):Overview of ADO.NET ,Connected and Disconnected Architecture, Database Connectivity using- DataConnection object, Data Command, DataAdapter, ,DataReader,Dataset.

Learning Outcomes:

- Describe the components and architecture of ADO.NET, including connected and disconnected models(L2)
- Demonstrate database connectivity in ADO.NET application.(L3)
- Analyze connected and disconnected architectures in ADO.NET and their impact on application performance.(L4)

TEXT BOOKS:

1. A Text book on C#- Pearson Education,S.TamaraiSelvi,R.Murugesan.
2. Programming C# 8.0: Build Cloud, Web, and Desktop Applications,Orielly Publications
3. C# 9 and .NET 5 – Modern Cross-Platform Development - Fifth Edition,by Mark J. Price, November 2020,Publisher(s): Packt Publishing

REFERENCE BOOKS:

3. The Complete Reference ASP.NET, Mathew Mc Donald,Mc Graw Hill
4. C# in depth, manning publications, John Skeet
5. ASP.NET Core in Action, Andrew Lock,Manning publication.

COURSE OUTCOMES VS POs MAPPING (DETAILED; HIGH: 3;

Cos	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	P O 10	PO 11	PO 12	PS O1	PS O2	PS O3
CS22.1	3	3	2		2				2			1	3	1	2
CS22.2	3	3	2		2				2			1	3	1	2
CS22.3	3	3	2		2				2			1	3	1	2
CS22.4	3	3	2		2				2			1	3	1	2
CS22.5	3	3	2		2				2			1	3	1	2
CS223 *	3	3	2		2				2			1	3	1	2

Subject Code	Subject Name	L	T	P	Credits
R23CSE-MT4103.2	Java Enterprise Frame work	3	0	0	3

Course Objectives:

- Implement CRUD operations using Java APIs
- Understand server side environment using Servlets.
- Create server side web pages using Java Server Pages.
- Understand Object relational mapping using Hibernate.
- Write business logics using Spring MVC and AOP programming.

Course Outcomes:

1. Implement database operations from front end java APIs.
2. Write server side programs for controlling HTTP requests.
3. Create dynamic server side web pages using JSP tags.
4. Create Hibernate objects for mapping objects and data base relations.
5. Create model based java objects for controlling server based applications.

Unit-I:

Java Database Connectivity - JDBC Overview & Architecture, JDBC Driver Types, Types of Result Set, Statement, Prepared Statement, Callable Statement, Executing DDL and DML Commands.

Learning Outcomes: Student will be able to

- Understand JDBC Drivers for connecting Database.(L2)
- Write complex queries for retrieving data from database.(L4)
- Create call able statements for executing data base procedures.(L4)

Unit-II:

Servlets: Web Server, Container, Servlet Overview, Life cycle of Servlet, Handling Web Form Data in Servlets., Dynamically including Content in Servlets, Handling Exceptions in Web Applications, Reading and Setting Cookies, Session Tracking, Servlet Filters, Accessing Databases.

Learning Outcomes: Student will be able to

- Understand Web container for storing server side programs (L2).
- Implement Request and response handling using Http libraries.(L4).
- Create Servlet for retrieving data from databases.(L4)

Unit-III:

Java Server Pages: Overview of JSP, JSP Architecture & lifecycle, Components of Java Server Pages, Implicit Objects & Standard JSP Tags, Scope of JSP objects, Dynamically including content in JSPs, Handling Form data in JSPs, Accessing Databases, Tag Libraries.

Learning Outcomes: Student will be able to

- Understand the structure of JSP and its Life Cycle.(L2)
- Create dynamic webpages using JSP tag libraries.(L4)
- Implement JSP scope for switching between pages.(L4)

Unit-IV:

HIBERNATE: Introduction to Hibernate, Hibernate Architecture, Understanding Object Persistence, Hibernate Basics, Types of Relations, Querying Persistent Objects, Hibernate Query Language (HQL)

Learning Outcomes: Student will be able to

- Understand Hibernate Object relational mapping (L2)

- Create Hibernate objects for implementing relations between tables.(L4)
- Implement Hibernate queries for persisting java objects. (L4)

Unit-V:

Spring Framework: Spring Architecture and Container, Spring Setup in Eclipse, Spring Bean Factory, Bean factory VS Application Context, Dependency Injection (DI), Types of DI, Bean Auto wiring, Collections with Spring, Bean Scopes, Event Handling in Spring, Introduction to Aspect Oriented Programming (AOP).

Learning Outcomes: Student will be able to

- Understand architecture of spring container.(L2)
- Implement depend ency injection for setting data for beans.(L4)
- Create spring beans for handling events and aspects.(L4)

Applications:

- Building enterprise level applications like IRCTC.
- Building Financial, banking applications, gateways etc
- Online and Social media applications

Text Books:

1. JDBC, Servlets and JSP Black Book, by Kogent Solutions Inc. Santosh Kumar K, Dreamtech Publications. 2nd Edition, 2016.
2. Java Servlet & JSP Cook book by Bruce W. Perry Publisher(s): O'Reilly Media, 2004
3. Spring and Hibernate - 2ed, by K. Santosh Kumar, McGraw-Hill Education

Reference Books:

1. Spring in Action, 4ed (Manning), by Craig Walls (Author), Dream tech.
2. Java Persistence with Hibernate: Revised of Hibernate in Action, Dream tech, by Christian Bauer.

Subject Code	Subject Name	L	T	P	C
R23CSE-MT2204	Web UI Framework	3	0	0	3

Course Objectives:

- Understand the design functionalities of static web pages
- Implement cascading features to the web pages.
- Create dynamic web pages using Jscript.
- Implement XML Processing and Parsing techniques with AJAX.
- Create responsive web pages using Web framework.

Course Outcomes:

1. Create static web pages using different tags.
2. Implement look and feel style sheets for static web pages.
3. Create dynamic web pages using objects and events.
4. Implement XML processing and traversing techniques
5. Create responsive web pages using Bootstrap web framework.

Unit I: HTML - Introduction to WWW, HTML Tags, Hyperlinks, images, Lists, Layouts: frames, table, div; HTML forms, HTML5 Tags

Learning Outcomes: Student will be able to

- Understand various singleton and paired tags.(L2)
- Create Hyperlinks and layout design. (L5)
- Understand advanced HTML5 tags. (L2)

Unit II: CSS: Introduction to CSS, Style sheets Types, CSS Selectors, CLASS vs ID, CSS Properties, CSS 2D & 3D Transforms, CSS Animations

Learning Outcomes: Student will be able to

- Understand different types of style sheets (L2).
- Implement CSS properties and selectors. (L4).
- Implement CSS3 transforms and animations.(L4).

Unit III: JAVA SCRIPT: Introduction to JScript, Variables & Operators, Data Types, Conditional statements, Loops, Arrays, Functions, Jscript Objects, Event Handling, JSON & Reg Exp.

Learning Outcomes: Student will be able to

- Understand the structure of Jscript in various browsers (L2)
- Create dynamic web pages using Jscript Events.(L4)
- Implement jscript objects for parsing and pattern recognition.(L4)

Unit IV: XML & AJAX: Introduction to XML, XML vs HTML, XML Document rules, Document Type Definition(DTD), Types of DTD, XSD Schema, XML Styles with XSL & CSS, XPath, XQuery, Introduction to AJAX, XML Http, AJAX Request and Response, GET & POST methods

Learning Outcomes: Student will be able to

- Understand XML document rules and features. (L2)
- Create and validate XML using DTD and XSD. (L4)
- Implement XML searching using XPath and XQuery. (L4)
- Understand request and response handling using AJAX calls. (L2)

Unit V: WEB UI FRAMEWORK: Building Responsive Website, Introduction to Bootstrap, Bootstrap Grid System, Containers, Colors, Tables, Buttons, DropDowns& Navigations, Input groups, Images & Media, Pagination

Learning Outcomes: Student will be able to

- Understand responsiveness of web pages using meta tag.(L2)

- Understand Bootstrap tool and its usage. (L2)
- Create dynamic web site with plug-ins and add-ons. (L4)

TEXT BOOKS:

1. Web Technologies Black Book (Covers CSS3, JavaScript, XML, XHTML, AJAX, PHP, jQuery) 2Ed.
2. Web Technologies by Achyut Godbole, 3Ed
3. Programming the World Wide Web, Robert. W. Sabesta, pearson Publisher

WEBLINKS:

4. <https://getbootstrap.com/docs/5.0/getting-started/introduction/>

REFERENCE BOOKS:

1. Web Technologies (Oxford Higher Education), Uttam. K.Roy
2. Web Technology: A Developer's Perspective, PHI, 2E, N.P.Gopalan

COURSE OUTCOMES Vs POs MAPPING : (DETAILED; HIGH: 3; MEDIUM: 2; LOW: 1)

COs	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
CS22.1	3	2	2	1	3						1	1	2	3	2
CS22.2	3	2	2	1	3						1	1	2	3	2
CS22.3	3	3	3	2	3						1	2	3	3	3
CS22.4	3	3	3	2	3						1	2	3	3	3
CS22.5	2	2	2	2	2						1	1	2	2	2
CS223*	3	2	2	2	3						1	1	2	3	2

Subject Code	Subject Name	L	T	P	C
R23CSE-MT3104	Angular Framework (Minors Course)	3	0	0	3

Course Objectives:

- To understand model view framework for building applications.
- To create modules for binding the application.
- To understand dependency injection for implementing services.
- To create and establish routes redirects and navigation.
- To validate forms for the submission of data.

Course Outcomes:

1. Understand the fundamentals of Angular JS and its architecture.
2. Apply data binding objects for implementing modules.
3. Implement service and retrieve rest call data.
4. Understand routes and their configuration in angular.
5. Implement form handling with event driven apps.

Unit-1 (8 Hours)

Angular JS – Introduction to Angular JS, Java Script vs Angular, MVC Framework, Component Based Model, Setting Up Angular, Installation of Node and NPM, Angular CLI, Creating and Running Project, Dependencies, App Component, Anatomy of Component, Creating Components.

Learning Outcomes: Student will be able to

- Understand MVC framework for building applications. (L2)
- Understand the installations of Node, NPM and angular. (L2)
- Implement Components using angular dependencies. (L3)

Unit-2 (10 Hours)

Data Binding: Introduction to Data Binding, Types of Binding, Binding Data from Component, Async, Template Interpolation, Looping with ngFor, Condition with ngIf, Passing inputs and variables to Components, ngModel for 2-way binding, ngOnInit, Styling with components, Creating multiple modules.

Learning Outcomes: Student will be able to

- Understand data binding for components. (L2)
- Implement looping and decision making for components. (L3)
- Implement components and modules for binding data from the applications. (L3)

Unit-3 (10 Hours)

Dependency Injection: Understanding Dependency Injection (DI), Services, Creating a Service, Service Injection Context, Rest Calls with Http Client, Building Angular Project.

Learning Outcomes: Student will be able to

- Understand the dependency injection and its types. (L2)
- Implement rest based calls from client using Http Client. (L3)
- Implement Angular project by building angular services. (L3)

Unit-4 (12 Hours)

Routing: Introduction to Routing, Angular Project with routing, Creating routes, Route redirects and wild cards, Configuring child routes, Navigation for routes.

Learning Outcomes: Student will be able to

- Understand routing with angular. (L2)
- Implement and redirect routes for navigation. (L3)
- Implement wild cards for building angular project. (L3)

Unit-5 (8 Hours)

Form Handling : Introduction to Form Handling, Form Validation, ng-minlength, ngmaxlength, ng-pattern, ng-required, Submitting Forms, Event Handling with Forms.

Learning Outcomes: Student will be able to

- Understand the working of forms and its validations. (L2)
- Implement event handling methods for form submissions. (L3)

CONTEMPORARY TOPICS:

- Pipes
- HTTP Requests
- Authentication
- Angular Modules
- Animations

APPLICATIONS:

- Online Web Applications
- Financial, Banking Applications and Gateways etc
- Online and Social Media Applications

TEXT BOOKS:

1. Angular 6 by Example: Get up and running with Angular by building modern realworld web apps, 3rd Edition, by Chandermani Arora.
2. Pro Angular 6, Apress, by Adam Freeman

REFERENCE BOOKS:

1. Angular JS by Green, Orielly
2. Professional AngularJS (WROX), by Valeri Karpov

COURSE OUTCOMES VS POs MAPPING (DETAILED; HIGH: 3; MEDIUM: 2; LOW: 1)

Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PS O3
HN3103.1	3	2	2	1	3				1		1	1	2	3	3
HN3103.2	3	2	2	1	3				1		1	1	2	3	3
HN3103.3	3	3	3	2	3				1		1	2	3	3	3
HN3103.4	3	3	3	2	3				1		1	2	3	3	3
HN3103.5	2	2	2	2	2				1		1	1	2	2	2
HN3103*	3	2	2	2	3				1		1	1	2	3	3

Subject Code	Subject Name	L	T	P	C
R23CSE-ML3104	Angular Framework Lab	0	0	3	1.5

Course Objectives:

1. Set up and configure the Angular development environment using Node.js, NPM, Angular CLI, and Visual Studio Code for building dynamic web applications.
2. Develop modular, component-based applications using data binding, directives, and structured architecture in Angular.
3. Design and implement services and dependency injection mechanisms for efficient data management and API communication.
4. Build Single Page Applications (SPAs) by implementing routing, navigation, and route guards for secure and seamless user experiences.
5. Design and validate interactive web forms using template-driven and reactive approaches with custom validation logic.

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

1. Set up and configure the Angular environment using Node.js, NPM, and Angular CLI for web application development.
2. Develop component-based web applications employing data binding, directives, and reusable UI components.
3. Implement services and dependency injection for managing data and interacting with RESTful APIs.
4. Develop Single Page Applications by configuring routing, navigation, and route guards for secured page access.
5. Design and validate web forms using template-driven and reactive forms with appropriate validation logic.

Lab Programs:

1. Create an Angular project and set up the basic application structure for an e-commerce platform.
2. Design a responsive layout using Angular components to define the header, footer, and navigation bar.
3. Implement Angular routing to navigate between product listing, product details, and cart pages.
4. Develop a Product component to display a list of products dynamically using *ngFor and data binding.
5. Build a Product Details component that retrieves and displays specific product information using route parameters.
6. Apply property binding and event binding to enable user interaction such as adding products to the cart.
7. Create and use Angular services to share product data and manage cart functionality across components.
8. Implement two-way data binding in a form for user registration or profile update within the e-commerce application.
9. Use Angular Pipes to format prices, dates, and display product search filters.
10. Apply dependency injection to manage services for product and order data efficiently.
11. Consume a mock REST API using HttpClient to retrieve product and order information dynamically.
12. Develop a Cart component that allows users to view, update, and remove selected items before checkout.
13. Integrate a simple Order Management module that stores order details and confirms successful transactions.
14. Combine all developed modules — Home, Product Listing, Product Details, Cart, and Order — to form a complete functional E-Commerce Web Application.
15. Deploy the Angular e-commerce application using a hosting service such as Firebase or

APPLICATIONS:

- Financial, Banking Applications and Gateways etc
- Online and Social Media Applications

TEXT BOOKS:

1. Angular 6 by Example: Get up and running with Angular by building modern realworld web apps, 3rd Edition, by Chandermani Arora.
2. Pro Angular 6, Apress, by Adam Freeman

REFERENCE BOOKS:

1. Angular JS by Green, Orielly
2. Professional AngularJS (WROX), by Valeri Karpov

COURSE OUTCOMES VS POs MAPPING (DETAILED; HIGH: 3; MEDIUM: 2; LOW: 1)

Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PS O3
HN3103.1	3	2	2	1	3	1	1	1	1	2	1	1	2	3	3
HN3103.2	3	2	2	1	3	1	1	1	1	2	1	1	2	3	3
HN3103.3	3	3	3	2	3	1	1	1	1	2	2	3	3	3	3
HN3103.4	3	3	3	2	3	1	1	1	1	2	2	3	3	3	3
HN3103.5	2	2	2	2	2	1	1	1	1	2	1	2	2	2	2
HN3103*	3	2	2	2	3	1	1	1	1	2	1	2	3	3	3

Subject Code	Subject Name	L	T	P	C
R23CSE-MT3204.1	Mobile App Development (Minors Course)	3	0	0	3

Course Objectives:

- To facilitate students to understand android SDK
- To help students to gain a basic understanding of Android application development.
- To inculcate working knowledge of Android Studio development tool.

Course Outcomes:

1. Identify various concepts of mobile programming that make it unique from programming for other platforms.
2. Critique mobile applications on their design pros and cons.
3. Utilize rapid prototyping techniques to design and develop sophisticated mobile interfaces.
4. Program mobile applications for the Android operating system that use basic and advanced phone features.
5. Deploy applications to the Android marketplace for distribution.

Unit 1 (10 Hours)

Android and its tools – Introduction to Android: The Android Platform, Android SDK, Eclipse Installation, Android Installation, Building the first Android application, Understanding Anatomy of Android Application.

Learning Outcomes: Student will be able to

- Explain the given basic terms related to Android System. (L2)
- Explain with sketches Android architecture for the given application. (L2)
- Identify tools and software required for developing the given Android application with justification. (L4)

Unit 2 (8 Hours)

Android Application Design Essentials: Android terminologies, Application Context, Activities, Services, Intents, Receiving and Broadcasting Intents, Android Manifest File and its common settings, Using Intent Filter, Permissions.

Learning Outcomes: Student will be able to

- Explain with relevant analogy the given Directory Structure. (L2).
- Describe the steps to use the given Android rich UI component. (L3).
- Develop the given basic Android application. (L3)

Unit 3 (10 Hours)

Android User Interface Design Essentials: User Interface Screen elements, Designing User Interfaces with Layouts, Drawing and Working with Animation.

Learning Outcomes: Student will be able to

- Develop rich User Interfaces for the given Android application. (L3)
- Explain the significance of the given display Alert. (L2)
- Develop the given application using time and Date Picker. (L3)

Unit 4 (12 Hours)

Testing Android applications: Publishing Android application, Using Android preferences, Managing Application resources in a hierarchy, working with different types of resources.

Learning Outcomes: Student will be able to

- Write the steps to publish the given android App (L2)
- Explain the features of the given android security service. (L3)
- Write the steps to customize the given permissions for users. (L2)

Unit 5 (8 Hours)

Using Common Android APIs: Using Android Data and Storage APIs, Managing data using Sqlite, Sharing Data between Applications with Content Providers, Using Android Networking APIs, Using Android Web APIs, Using Android Telephony APIs, Deploying Android Application to the World.

Learning Outcomes: Student will be able to

- Understand Android Data and Storage (L2)
- Write the query to perform the given database management operation (L3)
- Explain the given location-based service. (L2)

CONTEMPORARY TOPICS:

- Sharing Data in Android
- SMS Messaging
- Consuming Web Services Using HTTP

APPLICATIONS:

- Develop Mobile App on Online Shopping.
- Develop Mobile App on Traffic Surveying
- Develop Mobile App for Making a Calculator.
- Develop Mobile App for a Game

TEXT BOOKS:

1. Lauren Darcey and Shane Conder, “Android Wireless Application Development”, Pearson Education.

REFERENCE BOOKS:

1. Reto Meier, “Professional Android 2 Application Development”, Wiley India Pvt Ltd.
2. Mark L Murphy, “Beginning Android”, Wiley India Pvt Ltd.
3. Android Application Development All in one for Dummies by Barry Burd, Edition.

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-ML3204.1	Mobile App Development Lab (Minors Lab)	0	0	3	1.5

Course Objectives:

1. To introduce students to the Android operating system, its architecture, and the Android Software Development Kit (SDK).
2. To enable students to design and develop user-friendly mobile applications using Java and Android Studio.
3. To impart knowledge of core Android components such as Activities, Intents, Services, Broadcast Receivers, and Content Providers.
4. To provide hands-on experience with Android APIs for data storage, multimedia, and networking.
5. To familiarize students with the process of testing, debugging, signing, and publishing Android applications.

Course Outcomes:

6. Identify various concepts of mobile programming that make it unique from programming for other platforms.
7. Critique mobile applications on their design pros and cons.
8. Utilize rapid prototyping techniques to design and develop sophisticated mobile interfaces.
9. Program mobile applications for the Android operating system that use basic and advanced phone features.
10. Deploy applications to the Android marketplace for distribution.

Lab Programs

1. Install/configure Android Studio & and build/run a basic Hello World app.
2. Demonstrate activity lifecycle transitions and examine project directory structure.
3. Design screens using LinearLayout, RelativeLayout, and ConstraintLayout and use common widgets.
4. Use explicit intents to start activities and implicit intents to perform external actions (dialer, browser).
5. Display messages using Toast and Alert Dialog, and capture date/time using pickers.
6. Implement Options Menu and Context Menu; persist simple user settings using Shared Preferences.
7. Play audio from raw resource and animate a view using Object Animator or Animation XML.
8. Perform CRUD (Create, Read, Update, Delete) operations using SQLite database in Android.

9. Fetch data from a web server using HTTP / JSON API (e.g., fetch quotes or weather data from a public API).
10. Generate a signed APK, test on a physical device, and demonstrate steps to publish the app on Google Play Store.

Applications:

- Develop Mobile App on Online Shopping.
- Develop Mobile App on Traffic Surveying
- Develop Mobile App for Making a Calculator.
- Develop Mobile App for a Game

Text books:

2. Lauren Darcey and Shane Conder, “Android Wireless Application Development”, Pearson Education.

Reference books:

4. Reto Meier, “Professional Android 2 Application Development”, Wiley India Pvt Ltd.
5. Mark L Murphy, “Beginning Android”, Wiley India Pvt Ltd.
6. Android Application Development All in one for Dummies by Barry Burd, Edition.

COURSE OUTCOMES VS POs MAPPING (DETAILED: HIGH: 3, MEDIUM: 2, LOW: 1)

COs	PO1	PO2	PO3	PO4	PO5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
MN.1	3	2	2	1	3	-	-	-	1	-	1	1	2	3	2
MN.2	3	2	1	1	3	-	-	-	1	-	1	1	1	3	3
MN.3	3	1	2	2	3	-	-	-	1	-	1	1	2	3	2
MN.4	3	1	2	2	3	-	-	-	1	-	1	1	2	3	3
MN.5	2	2	1	1	2	-	-	-	1	-	1	1	1	2	2
MN*	3	2	2	2	3	-	-	-	1	-	1	1	2	3	3

Subject Code	Subject Name	L	T	P	C
R23CSE-ML3204.2	Django Framework (Minors Course)	3	0	0	3

Course Objectives:

- To understand the fundamentals of Django Framework.
- To implement Basic Templates for Client-side web pages.
- To implement Django model objects for generating data processing.
- To implement Django Forms for input processing and signals for profiles.
- To implement Serializers and Models using Rest APIs.

Course Outcomes:

1. Understand the environment of Django Web Server Framework. (L2)
2. Implement URL Mappings and Views using Templates. (L3)
3. Implement Django models for processing data from templates. (L3)
4. Implement Django Forms and Signals. (L3)
5. Implement Restfull APIs using Django Rest Framework. (L3)

Unit 1 (10 Hours)

Introduction to Django: Introduction to web development and MVC architecture, Overview of Django framework and its features, Setting up a Django development environment, Creating a Django project and understanding its structure, Introduction to Django applications and creating your first app, URL routing and views, Templates and template inheritance.

Learning Outcomes: Student will be able to

- Understand the basics of web development and MVC architecture.
- Set up a Django development environment.
- Create and configure a Django project and applications.
- Implement URL routing and create views.
- Use templates and template inheritance for dynamic HTML generation.

Unit 2 (8 Hours)

Models and Databases: Introduction to Django ORM (Object-Relational Mapping), Defining models and fields, Database migrations and schema management, Querying the database with Django ORM, Relationships: One-to-One, One-to-Many, and Many-to-Many, Admin interface: Customizing the Django admin site

Learning Outcomes: Student will be able to

- Understand and implement Django ORM for database management.
- Define models and perform database migrations.
- Query the database using Django ORM.
- Implement relationships between models.
- Customize and use the Django admin interface for database management.

Unit 3 (12 Hours)

Forms and User Input: Creating and processing forms in Django, Form validation and error handling, Advanced form handling with ModelForm, File uploads and management, Handling user authentication and authorization, User registration and profile management

Learning Outcomes: Student will be able to

- Create and process forms in Django.
- Implement form validation and handle errors.
- Use Model Form for advanced form handling.
- Manage file uploads in Django applications.
- Implement user authentication and authorization.
- Handle user registration and profile management.

Unit 4 (10 Hours)

Advanced Django Features: Middleware: Custom and built-in middleware, Caching strategies in Django, Internationalization and localization, Using Django REST framework for building APIs, Django Channels for real-time applications, Signals and asynchronous tasks with Celery

Learning Outcomes: Student will be able to

- Understand and implement custom middleware.
- Implement caching strategies to optimize performance.
- Internationalize and localize a Django application.
- Build and consume APIs using Django REST framework.
- Develop real-time applications using Django Channels.

Unit 5 (8 Hours)

Django Rest Framework: Introduction to Django Rest Framework, Features of Rest APIs, Installation of Django Rest Framework, API_view, Response, JsonResponse, Models and Serializers, PATH and urlpatterns, HTTP methods GET, POST, PUT and DELETE methods

Learning Outcomes: Student will be able to

1. Understand Django Rest framework and its packages. (L2)
2. Implement Models and Serializers for rest api. (L3)
3. Implement GET, POST, PUT and DELETE calls using rest framework package. (L3)

CONTEMPORARY TOPICS:

- Building a Pages Application.
- Building a Message Board Application.
- Building a Blog Application.
- Building a Password Change and Reset.

APPLICATIONS:

- Building enterprise level applications.
- Building Financial, banking applications, gateways etc.

- Online and Social media applications.

TEXT BOOKS:

- “Django for Beginners” by William S. Vincent
- “Building Websites with Django”, by Awanish Ranjan

REFERENCE BOOKS:

- Light Weight Django by O'Reilly Media, by Julia Elman and Mark Lavin
- Python Web Development with Django, by O'Reilly – Paul Bissex and Jeff Forcier

COURSE OUTCOMES VS POs MAPPING (DETAILED; HIGH: 3; MEDIUM: 2; LOW: 1)

Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PS O3
SC3201.1	2	1	1	1	2				1		1	1	2	3	3
SC3201.2	1	3	2	1	3				1		1	1	2	3	3
SC3201.3	2	3	2	1	3				1		2	2	2	3	3
SC3201.4	2	3	2	1	3				1		2	2	2	3	3
SC3201.5	2	3	3	1	3				1		2	2	2	3	3
SC3201*	2	3	2	1	3				1		1	1	2	3	3

Subject Code	Subject Name	L	T	P	C
R23CSE-ML3204.2	Django Framework lab (Minors Lab)	0	0	3	1.5

Course Objectives:

- To understand the fundamentals of Django Framework.
- To implement Basic Templates for Client-side web pages.
- To implement Django model objects for generating data processing.
- To implement Django Forms for input processing and signals for profiles.
- To implement Serializers and Models using Rest APIs.

Course Outcomes:

11. Understand the environment of Django Web Server Framework. (L2)
12. Implement URL Mappings and Views using Templates. (L3)
13. Implement Django models for processing data from templates. (L3)
14. Implement Django Forms and Signals. (L3)
15. Implement Restfull APIs using Django Rest Framework. (L3)

Lab Programs

1. Create Django environment setup and installation in Windows/Linux.
2. Create a DJANGO project and app structure with django-admin commands.
3. Deployment of a project to the server.
4. Implement a simple HTTP response using Django.
5. Implement template inheritance with views and images.
6. Create a simple web page using django templates and static files.
7. Create a django web page to render templates to multiple routes.
8. Create a Django model named customer having fields name, age, phone number, address and print the customer details in web page.
9. Create a Django model named customer having fields name, age, phone number, address and print the customer details in web page.
10. Create a registration form to store details of a customer into database.
11. Create a login page for the customers who have registered in the database.
12. Create a rest API call for get Customers to get (GET method) customer records from database using django rest framework.
13. Create a rest API call for save Customer to save (POST method) customer records into database using django rest framework.
14. Create a rest API call for update Customer to update (PUT method) customer records into database using django rest framework.
15. Create a rest API call for delete Customer to delete (DELETE method) customer records from database using django rest framework.

APPLICATIONS:

- Building enterprise level applications.
- Building Financial, banking applications, gateways etc.
- Online and Social media applications.

TEXT BOOKS:

- Django RESTful Web Services: The easiest way to build Python RESTful APIs by Gaston C Hillar, Packt
- Building Website with Django, 1 Edition, by Awanish Ranjan

REFERENCE BOOKS:

- Light Weight Django by O'Reilly Media, by Julia Elman and Mark Lavin
- Python Web Development with Django, by O'Reilly – Paul Bissex and Jeff Forcier

COURSE OUTCOMES VS POs MAPPING (DETAILED; HIGH: 3; MEDIUM: 2; LOW: 1)

S. No	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
C328.1	3	1	2	1	2	-	-	-	1	-	1	1	2	2	3
C328.2	1	2	2	1	3	-	-	-	1	-	1	1	2	3	2
C328.3	2	1	2	2	3	-	-	-	1	-	1	2	2	1	1
C328.4	3	2	1	2	3	-	-	-	1	-	1	2	2	1	2
C328.5	2	1	2	1	3	-	-	-	1	-	1	2	1	3	2
C328.*	3	2	2	2	3	-	-	-	1	-	1	1	2	3	2

**For Entire Course, PO & PSO Mapping*

Subject Code	Subject Name	L	T	P	C
R23CSE-MT4101.4	React Framework (Minors Course)	3	0	3	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)

Introduction: Introduction to Single Page Applications (SPAs), Overview of ReactJS and its features, Setting up a React development environment, Understanding JSX and rendering elements, **Components:** Functional and Class-based components, Props and State, Component lifecycle methods

Learning Outcomes: Student will be able to

- Understand the basics of ReactJS and its place in modern web development. (L2)
- Set up a ReactJS development environment. (L3)
- Implement simple React components using JSX. (L3)
- Understand and implement functional and class-based components. (L3)
- Manage component state and props effectively. (L3)

Unit 2 (8 Hours)

React Core: Props, State, Event Handling, Lists and Keys, Styling, 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 Router and Navigation: Introduction to React Router, Setting up routing in a React application, Nested routes and route parameters, Programmatic navigation and redirecting, Handling 404 pages and route guards.

Learning Outcomes: Student will be able to

- Set up and configure React Router in a React application. (L2)
- Implement navigation using React Router. (L3)
- Create nested routes and handle route parameters. (L3)
- Implement programmatic navigation and redirects. (L3)
- Handle 404 pages and protect routes using route guards. (L3)

Unit 4 (12 Hours)

React Hooks: Introduction to Hooks, use State, use Effect, Run Effects, Fetching Data, use Context, use Reducer, use Call Back, use Memo, use Ref, 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, use State, use Reducer, State Immutability, Parent & Child, Memo, Context, use Call Back.

Learning Outcomes: Student will be able to

- Understand the working react rendering. (L2)
- Implement user Reducer and context for rendering react apps. (L3)

CONTEMPORARY TOPICS:

- React - Http client programming
- React - Form programming
- React - Routing
- React - Redux
- React - Animation

APPLICATIONS:

- Online Web Applications
- Financial, Banking Applications and Gateways etc
- Online and Social Media Applications

TEXT BOOKS:

1. "Learning React: Modern Patterns for Developing React Apps" by Alex Banks and Eve Porcello.
2. "React Up & Running: Building Web Applications" by Stoyan Stefanov.

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 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
C4117.1	3	2	2	1	3				1		1	1	2	3	3
C4117.2	3	2	2	1	3				1		1	1	2	3	3
C4117.3	3	3	3	2	3				1		1	2	3	3	3
C4117.4	3	3	3	2	3				1		1	2	3	3	3
C4117.5	2	2	2	2	2				1		1	1	2	2	2
C4117*	3	2	2	2	3				1		1	1	2	3	3

Subject Code	Subject Name	L	T	P	C
R23CSE-MT4104.2	Node Framework (Minors Course)	3	0	0	3

Course Objectives:

- To understand about the traditional web server model and applications
- To understand to setup a development environment in node js
- To understand different kinds of modules in node js
- To understand how to create node js web server and debugging
- To understand how to handle events and database connectivity

Course Outcomes:

1. Understand Node JS and REPL terminal. (L2) and
2. Experiment with Node JS Modules and Node Package Manager. (L3)
3. Develop applications to handle events in Node JS (L3)
4. Make use of Web Server to manage database. (L3)
5. Demonstrate Express Framework (L3)

Unit 1 (10 Hours)

Introduction: Overview of server-side development and the role of Node.js, Introduction to Node.js and its features, Setting up a Node.js development environment, Understanding the event-driven architecture, Working with Node.js modules and the Node Package Manager (npm), Building a simple HTTP server

Learning Outcomes: Student will be able to:

- Understand the basics of server-side development and Node.js.
- Set up a Node.js development environment.
- Understand the event-driven, non-blocking I/O model.
- Use Node.js modules and npm for dependency management.
- Build and run a simple HTTP server using Node.js.

Unit 2 (10 Hours)

Core Node.js Modules and File System: Understanding and using core Node.js modules (fs, path, os, etc.), Working with the file system: reading, writing, and manipulating files, Handling asynchronous operations with callbacks, Promises, and async/await, Streams and buffers in Node.js, Building a simple command-line tool

Learning Outcomes: Student will be able to:

- Utilize core Node.js modules for various tasks.
- Perform file system operations using Node.js.
- Handle asynchronous operations effectively.
- Understand and work with streams and buffers.
- Build simple command-line tools using Node.js.

Unit 3 (12 Hours)

Building Web Applications with Express.js: Introduction to Express.js and its features, Setting up an Express.js application, Middleware functions and their use, Routing and handling HTTP requests, Serving static files and templates, Working with forms and handling form submissions, Building a RESTful API with Express.js

Learning Outcomes: Student will be able to:

- Understand the basics of Express.js and its role in web development.
- Set up and configure an Express.js application.
- Use middleware functions to handle requests and responses.
- Implement routing and handle different types of HTTP requests.
- Serve static files and use templates in an Express.js application.
- Build a RESTful API using Express.js.

Unit 4 (8 Hours)

Databases and Authentication: Introduction to databases and their integration with Node.js, Working with MongoDB and Mongoose for data persistence, CRUD operations with MongoDB, User authentication and authorization, Implementing sessions and JWT (JSON Web Tokens), Securing APIs and handling security best practices.

Learning Outcomes: Student will be able to:

- Integrate databases with Node.js applications.
- Use MongoDB and Mongoose for data storage and retrieval.
- Perform CRUD operations using MongoDB.
- Implement user authentication and authorization mechanisms.
- Use sessions and JWT for secure authentication.
- Follow best practices for securing Node.js applications.

Unit 5 (8 Hours)

Advanced Topics and Deployment: Error handling and debugging in Node.js applications, Writing and running tests with Mocha and Chai, Performance optimization and best practices, Introduction to micro services with Node.js, Deploying Node.js applications (Heroku, AWS, DigitalOcean), Continuous Integration and Continuous Deployment (CI/CD), Real-time communication with WebSockets.

Learning Outcomes: Student will be able to:

- Handle errors and debug Node.js applications effectively.
- Write and run tests to ensure application reliability.
- Optimize performance and follow best practices in Node.js development.
- Understand the basics of micro services architecture.
- Deploy Node.js applications to various hosting platforms.
- Implement CI/CD pipelines for Node.js applications.
- Build real-time applications using Web Sockets.

CONTEMPORARY TOPICS:

- Working with Data Serialization
- Sending Emails
- Sending SMSs
- Communication using Web sockets

APPLICATIONS:

- Ecommerce Web Applications
- Financial, Banking applications and Payment gateways etc
- Social media applications

TEXT BOOKS:

- Dhruti Shah, “Node.JS Guidebook”, BPB Publications, 2018.

REFERENCE BOOKS:

- Basarat Ali Syed, Beginning Node.js, A press, 2014,

WEB REFERENCES :

- <https://nodejs.org/en/docs/>

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

R23_CSE (Honors)

Track- I (Web Framework)

S.No	Year & Semester	Course Code	Subject title	L	T	P	C
1	II-II	R23CSE-HN2201	Angular JS Framework	3	0	0	3
2	III-I	R23CSE-HN3101	Design Patterns	3	0	0	3
3	III-II	R23CSE-HN3201	UX and UI Design Framework	3	0	0	3
4	IV-I	R23CSE-HN4101	Scalable Angular and Architecture Patterns	3	0	0	3
5	II Year to IV Year	R23CSE-HM0001.1	Honors MOOCS-1	0	0	0	3
6	II Year to IV Year	R23CSE-HM0001.2	Honors MOOCS-2	0	0	0	3

Total

18

Track-II (Artificial Intelligence)

S.No	Year & Semester	Course Code	Subject title	L	T	P	C
1	II-II	R23CSE-HN2202	AI for Problem Solving.	3	0	0	3
2	III-I	R23CSE-HN3102	Social Network Analysis	3	0	0	3
3	III-II	R23CSE-HN3202	Deep Learning for Computer Vision	3	0	0	3
4	IV-I	R23CSE-HN4102	AI in Health Care	3	0	0	3
5	II Year to IV Year	R23CSE-HM0001.1	Honors MOOCS-1	0	0	0	3
6	II Year to IV Year	R23CSE-HM0001.2	Honors MOOCS-2	0	0	0	3

Total

18

Track III (Networks)

S.No	Year & Semester	Course Code	Subject title	L	T	P	C
1	II-II	R23CSE-HN2203	Introduction to Networks	3	0	0	3
2	III-I	R23CSE-HN3103	Switching, Routing, and Wireless Essentials	3	0	0	3
3	III-II	R23CSE-HN3203	Enterprise Networking, Security, and Automation	3	0	0	3
4	IV-I	R23CSE-HN4103	Wireless Sensor Networks	3	0	0	3
5	II Year to IV Year	R23CSE-HM0001.1	Honors MOOCS-1	0	0	0	3
6	II Year to IV Year	R23CSE-HM0001.2	Honors MOOCS-2	0	0	0	3

Total

18

Track IV (Security)

S.No	Year & Semester	Course Code	Subject title	L	T	P	C
1	II-II	R23CSE-HN2204	Cyber Security	3	0	0	3
2	III-I	R23CSE-HN3104	Secure Coding	3	0	0	3
3	III-II	R23CSE-HN3204	Vulnerability Assessment & Penetration Testing	3	0	0	3
4	IV-I	R23CSE-HN4104	Malware Analysis	3	0	0	3
5	II Year to IV Year	R23CSE-HM0001.1	Honors MOOCS-1	0	0	0	3
6	II Year to IV Year	R23CSE-HM0001.2	Honors MOOCS-2	0	0	0	3

Total

18

Subject Code	Subject Name	L	T	P	C
R23CSE-HN2201	Angular JS Framework	3	0	0	3

Course Objectives:

- To understand model view framework for building applications.
- To create modules for binding the application.
- To understand dependency injection for implementing services.
- To create and establish routes redirects and navigation.
- To validate forms for the submission of data.

Course Outcomes:

1. Understand the fundamentals of Angular JS and its architecture.
2. Apply data binding objects for implementing modules.
3. Implement service and retrieve rest call data.
4. Understand routes and their configuration in angular.
5. Implement form handling with event driven apps.

Unit 1 (8 Hours)

Angular JS – Introduction to Angular JS, Java Script vs Angular, MVC Framework, Component Based Model, Setting Up the Environment, Installation of Node and NPM, Angular CLI, Creating and Running Project, Add Dependencies, The Anatomy of an AngularJS app, First Application. What is a Component, Create and Start Component.

Learning Outcomes: Student will be able to

- Understand MVC framework for building applications. (L2)
- Understand the installations of Node, NPM and angular. (L2)
- Implement Components using angular dependencies. (L3)

Unit 2 (10 Hours)

Data Binding: Introduction to Data Binding, Types of Binding, Binding Data from Component, Async, Template Interpolation, Looping with ngFor, Condition with ngIf, Passing inputs and variables to Components, ngModel for 2-way binding, ngOnInit, Styling with components, Creating multiple modules. Combine Forms with Data binding.

Learning Outcomes: Student will be able to

- Understand data binding for components. (L2)
- Implement looping and decision making for components. (L3)
- Implement components and modules for binding data from the applications. (L3)

Unit 3 (10 Hours)

Dependency Injection: Understanding Dependency Injection(DI), Services, Creating a Service, Service Injection Context, Rest Calls with HttpClient, Building Angular Project.

Learning Outcomes: Student will be able to

- Understand the dependency injection and its types. (L2)
- Implement rest based calls from client using HttpClient. (L3)
- Implement Angular project by building angular services. (L3)

Unit 4 (12 Hours)

Routing & Wrap Up: Introduction to Routing, Angular Project with routing, Creating routes, Route redirects and wild cards, Route Configuration, Static Data in Route, Nested Routing, Navigation Controlling.

Learning Outcomes: Student will be able to

- Understand routing with angular. (L2)
- Implement and redirect routes for navigation. (L3)
- Implement wild cards and wrap up for building angular project. (L3)

Unit 5 (8 Hours)

Form Handling : Introduction to Form Handling, Template Driven, Form Validation, ng-minlength, ngmaxlength, ng-pattern, ng-required, Submitting Forms, Event Handling with Forms.

Learning Outcomes: Student will be able to

- Understand the working of forms and its validations. (L2)
- Implement event handling methods for form submissions. (L3)

CONTEMPORARY TOPICS:

- Pipes
- HTTP Requests
- Authentication
- Angular Modules
- Animations

APPLICATIONS:

- Online Web Applications
- Financial, Banking Applications and Gateways etc
- Online and Social Media Applications

TEXT BOOKS:

1. Angular 6 by Example: Get up and running with Angular by building modern realworld web apps, 3rd Edition, by Chandermani Arora.
2. Pro Angular 6, Apress, by Adam Freeman

REFERENCE BOOKS:

1. Angular JS by Green, Orielly
2. Professional AngularJS (WROX), by Valeri Karpov

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	1	3				1		1	1	2	3	3
	3	2	2	1	3				1		1	1	2	3	3
	3	3	3	2	3				1		1	2	3	3	3
	3	3	3	2	3				1		1	2	3	3	3
	2	2	2	2	2				1		1	1	2	2	2
	3	2	2	2	3				1		1	1	2	3	3

Subject Code	Subject Name	L	T	P	C
R23CSE-HN3101	Design Patterns	3	0	0	3

Course Objectives:

- To understand the purpose and application of software design patterns in building scalable web applications.
- To explore how common web frameworks implement design patterns.
- To apply design patterns in real-world web development projects.
- To analyze the benefits and trade-offs of using patterns in modern web architectures.

Course Outcomes:

1. Understand the fundamental concepts of design patterns and web frameworks,
2. Apply creational design patterns such as Singleton, Factory Method, Abstract Factory, Builder, and Prototype in the context of web application development.
3. Analyze the use of structural design patterns like Adapter, Decorator, Composite, Proxy, and Facade in real-world web framework scenarios.
4. Implement behavioral design patterns including Observer, Strategy, Command, Chain of Responsibility.
5. Evaluate and demonstrate the application of design patterns in advanced web architecture.

Unit 1 (8 Hours)

Unit I: Introduction to Design Patterns and Web Frameworks

Overview of Design Patterns: GoF (Gang of Four) Patterns, Classification: Creational, Structural, Behavioral, Introduction to Web Frameworks (MVC/MVT architecture), Importance of design patterns in web application development, Case study: MVC in Django, Flask, or ASP.NET

Unit 2 (10 Hours)

Unit II: Creational Patterns in Web Development

Singleton Pattern: Database connections, configuration handling, Factory Method: Creating views and controllers dynamically. Abstract Factory: Theming and UI component management, Builder Pattern: Building complex forms or queries, Prototype Pattern: Cloning and session objects

Unit 3 (10 Hours)

Unit III: Structural Patterns in Web Frameworks

Adapter Pattern: API integration, third-party services, Decorator Pattern: Middleware implementation, Composite Pattern: Nested forms and templates, Proxy Pattern: Caching, authentication, and authorization, Facade Pattern: Simplified interface for complex subsystems

Unit 4 (12 Hours)

Unit IV: Behavioral Patterns in Web Applications

Observer Pattern: Event handling, pub-sub systems, Strategy Pattern: Routing and request handling strategies, Command Pattern: Encapsulating web requests, Chain of Responsibility: Middleware chains, Template Method: Template rendering engines

Unit 5 (8 Hours)

Unit V: Advanced Topics and Case Studies

REST and MVC: Applying design principles in RESTful APIs, ORM and Active Record Pattern: Django

ORM, SQLAlchemy, Dependency Injection in frameworks like ASP.NET Core

Case Study: Design pattern analysis in a real-world open-source project

TEXT BOOKS:

- Design Patterns: Elements of Reusable Object-Oriented Software by Gamma et al, 1994
- Patterns of Enterprise Application Architecture by Martin Fowler, 2002

REFERENCE BOOKS:

- Flask Web Development by Miguel Grinberg, 2014
- Design Patterns in C# by Vaskaran Sarcar, 2018
- Official Documentation of Chosen Framework, 2023

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	1	3				1		1	1	2	3	3
	3	2	2	1	3				1		1	1	2	3	3
	3	3	3	2	3				1		1	2	3	3	3
	3	3	3	2	3				1		1	2	3	3	3
	2	2	2	2	2				1		1	1	2	2	2
	3	2	2	2	3				1		1	1	2	3	3

Subject Code	Subject Name	L	T	P	C
R23CSE-HN3201	UX and UI Design Framework	3	0	0	3

Course Objectives:

- To understand the principles and processes involved in UX and UI design.
- To explore frameworks and tools used for designing user-centered digital interfaces.
- To develop skills in designing interactive prototypes and conducting usability testing.
- To integrate design thinking into web and mobile application development.

Course Outcomes:

1. Understand the fundamental concepts of UX and UI design
2. Apply UX research techniques such as user interviews, persona creation, and journey mapping to define user goals and structure content effectively.
3. Design user interfaces using visual design principles, responsive frameworks, and accessibility standards to ensure inclusivity and usability.
4. Develop wireframes and interactive prototypes using industry-standard tools while incorporating navigation strategies and design heuristics.
5. Evaluate and validate UX/UI designs through usability testing, metric analysis, and iterative refinement based on real-world feedback and case studies.

Unit I: Introduction to UX/UI Design- Fundamentals of UX and UI, Difference between UX and UI, Human-Centered Design (HCD) process, Design Thinking: Empathize, Define, Ideate, Prototype, Test, Importance of UX in product success, Psychology and cognitive principles in design

Unit II: UX Research and Analysis- User research methods: Interviews, surveys, observation, Creating user personas, Journey mapping and empathy maps, Information architecture and content strategy, Competitive analysis, Defining user needs and goals

Unit III: UI Design Principles and Frameworks- Visual design elements: Layouts, color theory, typography, iconography, UI design principles: Consistency, feedback, visibility, affordance, Introduction to UI frameworks: Material Design, Bootstrap, Ant Design, Fluent UI, Designing responsive interfaces (mobile-first approach), Accessibility standards (WCAG) and inclusive design

Unit IV: Prototyping and Interaction Design- Wireframing tools: Figma, Adobe XD, Sketch, Balsamiq, Low-fidelity vs high-fidelity prototypes, Interactive design and microinteractions, Design patterns and UI components, Navigation and layout design strategies, Heuristic evaluation

Unit V: Usability Testing and Design Validation- Types of usability testing: Moderated, unmoderated, A/B testing, Conducting usability tests and recording feedback, Analyzing test data and iteration, Metrics for usability (SUS, NPS, Task success rate), Final project: End-to-end UX/UI case study, Real-world examples and current trends in UX/UI

TEXT BOOKS:

- *Don't Make Me Think* by Steve Krug (Latest Edition), 2014
- *The Design of Everyday Things* by Don Norman, 2013

REFERENCE BOOKS:

- *About Face: The Essentials of Interaction Design* by Alan Cooper, 2014
- *Lean UX* by Jeff Gothelf, *Lean UX: Designing Great Products with Agile Teams*, 3rd Edition, 2012
- *A Project Guide to UX Design* by Russ Unger and Carolyn Chandler, 2012

Subject Code	Subject Name	L	T	P	C
R23CSE-HN4101	Scalable Angular and Architecture Patterns	3	0	0	3

Course Objectives:

- Understand the architectural principles of building scalable Angular applications.
- Apply advanced design patterns and state management techniques.
- Optimize application performance using Angular-specific strategies.
- Develop testable and maintainable enterprise-grade applications.
- Leverage monorepo tools like Nx for large-scale Angular development.

Course Outcomes: After successful completion, students will be able to:

- Architect and structure Angular applications for scalability and maintainability.
- Implement efficient state management using RxJS, NgRx, or Signals.
- Apply modular and layered architecture using Domain-Driven Design and Clean Architecture.
- Integrate performance and security best practices into Angular projects.
- Manage large codebases using Nx and build CI/CD-ready applications.

Unit 1: Angular Architecture Essentials

Angular Module System: Core, Shared, and Feature Modules, Dependency Injection Hierarchy, Component Design: Smart vs. Dumb Components, Routing Patterns: Lazy Loading, Guards, and Preloading Strategies, Change Detection and Signals API Overview

Unit 2: Scalable Design Patterns and Principles

Component Design Patterns (Presenter, Container), Services and Facade Pattern, SOLID Principles in Angular, Domain-Driven Design (DDD) in Angular, Feature Slicing and Clean Architecture

Unit 3: Advanced State Management

RxJS in Practice: Observables, Subjects, BehaviorSubject, Global State with NgRx / Akita / NGXS, Angular Signals: Reactive Component Design, Data Normalization and Entity Management, State Lifecycle Management

Unit 4: Performance, Testing & Security

Ahead-of-Time Compilation, Lazy Loading, Code Splitting, OnPush Strategy and Change Detection Optimization, XSS, CSRF and API Security in Angular, Unit Testing with Jasmine / Jest, E2E Testing with Cypress / Playwright

Unit 5: Scalable Monorepo Development with Nx

Introduction to Nx Workspace, Modularization with Libraries (Feature, UI, Util, Data), Linting, Formatting, and Project Boundaries, Dependency Graph and Affected Commands, Integration into CI/CD pipelines

TEXT BOOKS:

- “Architecting Angular Applications with Redux, RxJS, and NgRx” – Christoffer Noring, Packt Publishing, 2018.
- “Enterprise Angular Applications” – Manfred Steyer, 3rd Edition, Leanpub, 2020.

REFERENCE BOOKS:

- “Design Patterns: Elements of Reusable Object-Oriented Software” – Erich Gamma et al, Addison-Wesley Professional, 1994
- “Domain-Driven Design: Tackling Complexity in the Heart of Software” – Eric Evans, Addison-Wesley Professional, 2003

WEB REFERENCES:

- Angular.io Documentation: <https://angular.io/docs>
- RxJS Docs: <https://rxjs.dev/>
- NgRx Documentation: <https://ngrx.io/>
- Nx.dev Documentation: <https://nx.dev/>

Course Code	Subject Name	L	T	P	C
R23CSE-HN2202	Artificial Intelligence for Problem Solving	3	0	0	3

Course Objectives :

This course deals with

- Autonomous agent behaviour in solving problems intelligently.
- Imagining the consequence of AI decision making system to identify the wide variety of search methods that agents can employ for problem solving.

Course Outcomes :

Students will be able to

- Understand the philosophy of AI and State Space Search for problem solving.
- Explore the operations of Heuristic Search and Population Based Methods.
- Apply various optimal search techniques and Space Saving Algorithms
- Develop Game Playing Algorithms using planning and decomposition problems.
- Develop systems using Rule Based Systems and Constraint Satisfaction.

Unit-I (10 Hours)

AI Philosophy: Introduction: History, Can Machines think? Winograd Schema Challenge, Language and Thought, Wheels & Gears, **Philosophy:** Mind, Reasoning, Computation, Dartmouth Conference, The Chess Saga, Epiphenomena **State Space Search:** Depth First Iterative Deepening.

Unit-II (08 Hours)

Heuristic Search: Best First Search, Hill Climbing, Solution Space, TSP, Escaping Local Optima, Stochastic Local Search. **Population Based Methods:** Genetic Algorithms, SAT, TSP, emergent Systems, Ant Colony Optimization

Unit-III(10 Hours)

Finding Optimal Paths: Branch & Bound, A*, Admissibility of A*, Informed Heuristic Functions. **Space Saving Versions of A*:** Weighted A*, IDA*, RBFS, Monotone Condition, Sequence Alignment, DCFS, SMGS, Beam Stack Search

Unit-IV(10Hours)

Game Playing: Game Theory, Board Games and Game Trees, Algorithm Minimax, AlphaBeta and SSS*. **Automated Planning:** Domain Independent Planning, Blocks World, Forward & Backward Search, Goal Stack Planning, Plan Space Planning. **Problem Decomposition:** Means Ends Analysis, Algorithm Graphplan, Algorithm AO*

Unit-V(10Hours)

Rule Based Expert Systems: Production Systems, Inference Engine, Match-Resolve-Execute, Rete Net. **Deduction as Search:** Logic, Soundness, Completeness, First Order Logic, Forward Chaining, Backward Chaining. **Constraint Processing:** CSPs, Consistency Based Diagnosis, Algorithm Backtracking, Arc Consistency, Algorithm Forward Checking

Books and references

Text Book:

1. Deepak Khemani. A First Course in Artificial Intelligence, McGraw Hill Education (India), 2013.

Reference Books:

1. Stefan Edelkamp and Stefan Schroedl. Heuristic Search: Theory and Applications, Morgan Kaufmann, 2011.
2. John Haugeland, Artificial Intelligence: The Very Idea, A Bradford Book, The MIT Press, 1985.
3. Pamela McCorduck, Machines Who Think: A Personal Inquiry into the History and Prospects of Artificial Intelligence, A K Peters/CRC Press; 2 edition, 2004.
4. Zbigniew Michalewicz and David B. Fogel. How to Solve It: Modern Heuristics. Springer; 2nd edition, 2004.
5. Judea Pearl. Heuristics: Intelligent Search Strategies for Computer Problem Solving, Addison-Wesley, 1984.
6. Elaine Rich and Kevin Knight. Artificial Intelligence, Tata McGraw Hill, 1991.
7. Stuart Russell and Peter Norvig. Artificial Intelligence: A Modern Approach, 3rd Edition, Prentice Hall, 2009.
8. Eugene Charniak, Drew McDermott. Introduction to Artificial Intelligence, Addison-Wesley, 1985.
9. Patrick Henry Winston. Artificial Intelligence, Addison-Wesley, 1992.

Link:

1. https://onlinecourses.nptel.ac.in/noc21_cs79/preview

Course Code	Subject Name	L	T	P	C
R23CSE-HN3102	Social Network Analysis	3	0	0	3

Course Objective:

- Social network analysis is to understand a community by mapping the relationships that connect them as a network, and then trying to draw out key individuals, groups within the network and/or associations between the individuals.

Course Outcomes:

- Understand the importance of social network analysis and various network measures.
- Summarize network growth models and applications of link analysis
- Apply different graph visualization tools on community detection and link predictions.
- Development of models using cascading behavior with promising network effects.
- Development of Recommendation Systems

Unit-1: (10 Hours)

Introduction to Social Network Analysis- Introduction to Colab, Introduction to NetworkX, **Network Measures-** Basics, Node Centrality, Transitive and Reciprocity, Similarity and Degeneracy.

Unit-2: (10 Hours)

Network Growth Models- Properties of real world network, Random Network Model, Ring Lattice, Network Model, Watts Strogatz Model, Link **Analysis-** Applications, Signal Networks, Strong and Weak Ties.

Unit 3: (10 Hours)

Graph Visualization Tools- Community Detection - Applications, Types of communities, Detection Methods, Overlapping, Community Detection Vs Community v's Search. **Link Prediction-**Applications, Temporal changes in network, Prediction Networks and Heuristic Models.

Unit 4: (10 Hours)

Cascade Behaviour- Models, Probabilistic Cascades, Epidemic Models, Independent Models, Cascade Prediction. **Network Effects & Anomaly Detection-** Outliers and Network Based Anomalies, Challenges Anomaly detection in static and dynamic models.,

Unit-5: (08 Hours)

Graph Representation Learning, Coding on Graph Representation Learning- Criteria on GRL, Representation Learning Methods, **Applications and Case Studies**- Malicious activities on OSNs and Recommendation Systems.

Books and references:

1. Social Network Analysis, Tanmoy Chakraborty, Wiley, 2021
2. Network Science, Albert-Lazzlo Barabasi
3. Social Network Analysis: Methods and Applications, Stanley Wasserman, Katherine Faus

Link: https://onlinecourses.nptel.ac.in/noc22_cs117/preview

Course Code	Subject Name	L	T	P	C
R23CSE-HN3202	Deep Learning for Computer Vision	3	0	0	3

Course Objective:

- Recognise and describe how mathematical and scientific concepts are applied in computer vision.
- Identify and interpret appropriate sources of information relating to computer vision.
- Apply knowledge of computer vision to real life scenarios.

Course Outcomes:

- Describe how mathematical and scientific concepts are applied in computer vision through images.
- Identify appropriate sources of information and architecture relating to computer vision.
- Understand the concept of visualization using CNN.
- Apply the concepts of advanced CNN and RNN techniques for computer vision problems.
- Apply knowledge of computer vision to real life scenarios.

Unit-1: (10 Hours)

Introduction and Overview: Introduction to Image Formation: Capture and Representation; Linear Filtering, Correlation and Convolution. **Visual Features and Representations:** Edge, Blobs, Corner Detection; Scale Space and Scale Selection; SIFT, SURF; HoG, LBP, etc.

Unit-II:(10 Hours)

Visual Matching: Bag-of-words, VLAD; RANSAC, Hough transform; Pyramid Matching; Optical Flow. **Deep Learning Review-** Review of Deep Learning, Multi-layer Perceptrons, Backpropagation. **Convolutional Neural Networks (CNNs)-** Introduction to CNNs; Evolution of CNN Architectures: AlexNet, ZFNet, VGG, InceptionNets, ResNets, DenseNets

Unit-III:(10 Hours)

Visualization and Understanding CNNs: Visualization of Kernels; Backprop-to-image/Deconvolution Methods; Deep Dream, Hallucination, Neural Style Transfer; CAM, Grad-CAM, Grad-CAM++; Recent Methods (IG, Segment-IG, SmoothGrad)

Unit-IV(10 Hours)

CNNs for Recognition and Verification (Siamese Networks, Triplet Loss, Contrastive Loss, Ranking Loss); CNNs for Detection: Background of Object Detection, R-CNN, Fast R-CNN, Faster R-CNN, YOLO, SSD, RetinaNet; CNNs for Segmentation: FCN, SegNet, U-Net, Mask-RCNN. **Recurrent Neural Networks (RNNs):** Review of RNNs; CNN + RNN Models for Video Understanding: Spatio-temporal Models, Action/Activity Recognition

Unit-V:(08 Hours)

Attention Models:Introduction to Attention Models in Vision; Vision and Language: Image Captioning, Visual QA, Visual Dialog; Spatial Transformers; Transformer Networks.

Deep Generative Models:Deep Generative Models: GANs, VAEs; Other Generative Models: PixelRNNs, NADE, Normalizing Flows. Applications.

Books and references :

- Ian Goodfellow, Yoshua Bengio, Aaron Courville, Deep Learning, 2016
- Michael Nielsen, Neural Networks and Deep Learning, 2016
- Yoshua Bengio, Learning Deep Architectures for AI, 2009
- Richard Szeliski, Computer Vision: Algorithms and Applications, 2010.
- Simon Prince, Computer Vision: Models, Learning, and Inference, 2012.
- David Forsyth, Jean Ponce, Computer Vision: A Modern Approach, 2002.

Link:

- https://onlinecourses.nptel.ac.in/noc20_cs88/preview

Course Code	Subject Name	L	T	P	C
R23CSE-HN4102	AI in Health Care	3	0	0	3

Course Objective:

- The students should be able to understand how AI is transforming the practice of medicine.
- The students should learn the practical experience in applying machine learning to concrete problems in medicine

Course Outcomes:

After completion of course, students would be able to:

- Apply tree-based machine learning to estimate patient survival rates.
- Analyse convolutional neural network image classification and segmentation models to make diagnoses of lung and brain disorders.
- Apply natural language processing to extract information from unstructured medical data.
- Apply survival models to build realistic applications.
- Understand different types of prognosis models related to different diseases.

Unit-I: (10 Hours)

Disease detection with computer vision- Medical Image Diagnosis, Eye Disease and Cancer Diagnosis, Building and Training a Model for Medical Diagnosis, Training, prediction, and loss, Image Classification and Class Imbalance, Generating More Samples, Model Testing

Unit-II: (10 Hours)

Evaluating models- Sensitivity, Specificity, and Evaluation Metrics, Accuracy in terms of conditional probability, Confusion matrix, ROC curve and Threshold. **Image segmentation on MRI images-** Medical Image Segmentation, MRI Data and Image Registration, Segmentation, 2D U-Net and 3D U-Net Data augmentation and loss function for segmentation, Different Populations and Diagnostic Technology, External validation

Unit-III: (10 Hours)

Linear prognostic models- Medical Prognosis, Atrial fibrillation, Liver Disease Mortality, Risk of heart disease, Evaluating Prognostic Models, Concordant Pairs, Risk Ties, Permissible Pairs. **Prognosis with Tree-based models-** Decision trees for prognosis, fix overfitting, Different distributions, Missing Data example, Imputation

Unit-IV: (10 Hours)

Survival Models and Time- Survival Model, Survival function, collecting time data, Estimating the survival function. Build a risk model using linear and tree-based models. Hazard Functions, Relative risk, Individual vs. baseline hazard, Survival Trees, Nelson Aalen estimator.

Unit-V: (08 Hours)

Medical Treatment Effect Estimation- Analyze data from a randomized control trial, Average treatment effect, Conditional average treatment effect, T-Learner, S-Learner, C-for-benefit.

Books and References:

- Deep Medicine: How Artificial Intelligence Can Make Healthcare Human Again, Eric Topol, Basic Books, 1st edition 2019.
- Machine Learning and AI for Healthcare: Big Data for Improved Health Outcomes, Arjun Panesar, Apress, 1st ed. Edition, 2019.
- Artificial Intelligence in Healthcare, 2020, ISBN 978-0-12-818438-7, Elsevier Inc.

Links:

1. <https://www.coursera.org/learn/ai-for-medical-diagnosis>
2. <https://www.coursera.org/learn/ai-for-medical-prognosis#syllabus>
3. <https://www.coursera.org/learn/ai-for-medical-treatment/#syllabus>

Course Code	Subject Name	L	T	P	C
R23CSE-HN2203	Introduction to Networks (ITN)	3	0	0	3

Course Objectives

- Understand the core components that make up a network, such as devices, protocols, and media.
- Learn how to work with IPv4 addresses, understand subnet masks, and perform subnet calculations to divide networks into smaller logical segments.
- Identify the different cable types and connectors used to connect devices in a local area network.
- Gain hands-on experience setting up basic network connections and performing troubleshooting checks on different operating systems (Windows, Linux, macOS, Android, and iOS)
- Learn about network switches and their role in connecting devices within a network segment and forwarding data packets.
- Learn systematic approaches to identify and resolve network issues.

Course Outcomes:

- Understand Key network terminology like bandwidth, throughput, and various network types
- Apply IPv4 addressing and subnet mask concepts to identify network and host information
- Identify and differentiate between various cables and connectors used in local area networks.
- Understand with the fundamental knowledge and hands-on skills necessary to identify and troubleshoot network connectivity problems.
- Implement effective troubleshooting strategies for resolving network connectivity issues.

Unit-I – Standards and Concepts (10 Hours)

Identify the fundamental conceptual building blocks of networks - Differentiate between bandwidth and throughput - Differentiate between LAN, WAN, MAN, CAN, PAN, and WLAN - Compare and contrast cloud and on-premises applications and services - Describe common network applications and protocols.

Learning Outcomes:

- Identify and explain the fundamental concepts that form the foundation of computer networks. This includes understanding how devices communicate and share resources over a network.
- Differentiate between various network types based on their scope and functionality over PAN, LAN, MAN, WAN.
- Identify and explain the role of fundamental network protocols in facilitating communication between devices.

Unit – II: Addressing and Subnet Formats (10 Hours)

Compare and contrast private addresses and public addresses - Identify IPv4 addresses and subnet formats - Identify IPv6 addresses and prefix formats.

Learning Outcomes:

- Understand the purpose and limitations of each type of IP address and how they are used in network configurations
- Perform basic calculations to determine the network address, subnet ID, broadcast address, and usable host range within a subnet based on the provided IP address and subnet mask
- Understand how prefix lengths are used in IPv6 to specify the network portion of the address

Unit – III: Endpoints and Media Types (10 Hours)

Identify cables and connectors commonly used in local area network - Differentiate between Wi-Fi, cellular, and wired network technologies - Describe endpoint devices - Demonstrate how to set up and check network connectivity on Windows, Linux, Mac OS, Android, and Apple iOS.

Learning Outcomes:

- Identify and differentiate between common cables and connectors used in local area networks (LANs)
- Understand the characteristics and functionalities of these cables and connectors, including their suitability for different network applications based on factors like speed, distance, and cost
- Demonstrate the basic steps involved in setting up network connectivity on various operating systems

Unit – IV: Infrastructure (10 Hours)

Identify the status lights on a Cisco device when given instruction by an engineer - Use a network diagram provided by an engineer to attach the appropriate cables - . Identify the various ports on network devices - Explain basic routing concepts - Explain basic switching concepts.

Learning Outcomes:

- Analyze and apply network knowledge to connect devices based on a provided network diagram
- Identify and differentiate between the various ports commonly found on network devices (e.g., console, Ethernet, serial, USB) and understand their typical uses.
- The fundamental concepts of network switching

Unit – V: Diagnosing Problems (8 Hours)

Demonstrate effective troubleshooting methodologies and help desk best practices, including ticketing, documentation, and information gathering - Perform a packet capture with Wireshark and save it to a file - Run basic diagnostic commands and interpret the results - Differentiate between different ways to access and collect data about network devices - Run basic show commands on a Cisco network device.

Learning Outcomes:

- Utilize Wireshark, a network protocol analyzer, to capture network traffic data

- Distinguish between different methods for accessing and collecting data about network devices, understanding their advantages and limitations
- Execute basic show commands on Cisco network devices to retrieve specific information

Contemporary Topics need to mention (Compulsory)

Security: Describe how firewalls operate to filter traffic - Describe foundational security concepts - Configure basic wireless security on a home router (WPAx).

Text Books:

Introduction to Networks Companion Guide (CCNAv7) Cisco Networking Academy,
ISBN-13: 978-0-13-663366-2 ISBN-10: 0-13-663366-8

References Books:

CCNA : Cisco Certified Network Associate study guide / Todd Lammle. — 7th ed. Wiley Publishing, Inc.
ISBN 978-0-470-90107-6

Weblinks:

- https://www.ccri.edu/faculty_staff/comp/jmowry/CSCO-1850-PP.html
- <https://examscisco.com/ccna-v7-0/ccna-1-v7-introduction-to-networks-v7-02-itn-exam-answers/>

COURSE OUTCOMES VS POs MAPPING (DETAILED; HIGH: 3; MEDIUM: 2; LOW: 1):

[illegible]

Course Code	Subject Name	L	T	P	C
R23CSE-HN3103	Switching, Routing and Wireless Essentials	3	0	0	3

Course Objectives:

- Understand the concept of Layer 2 switching and how it operates within the OSI model, Configure basic VLANs on a network switch
- Understanding and configuring redundancy mechanisms in networks, specifically using Spanning Tree Protocol (STP) and EtherChannel technology.
- Student able to configure basic DHCPv4 servers and explain the functionalities of SLAAC, DHCPv6, and FHRPs in promoting network availability and reliability
- Students able to configure basic security features on switches and set up secure WLANs
- Students will gain a solid foundation in routing principles and be able to configure basic static routes on network routers

Course Outcomes:

- Configuring basic VLANs on a network switch using appropriate methods (port-based, MAC-based, etc.)
- Understanding the concepts and functionalities of Spanning Tree Protocol (STP) in preventing loops on switched networks
- Configuring a basic DHCPv4 server to automatically assign IP addresses to network devices
- Applying security measures to mitigate network vulnerabilities and protect sensitive data
- Applying static routes to connect different networks and ensure proper traffic flow

Unit-I – (8 Hours)

Switching Concepts and VLANs : Basic Device Configuration - Switching Concepts – VLANs - Inter-VLAN Routing

Learning Outcomes:

- Identify the process of frame forwarding based on MAC addresses
- Verify VLAN configuration and membership using switch commands
- Comprehend the need for inter-VLAN routing to enable communication across VLANs

Unit – II: (10 Hours)

Redundant Networks : STP - Etherchannel

Learning Outcomes:

- Explain the purpose and functionalities of Spanning Tree Protocol(STP)
- Configure basic EtherChannel
- Compare and contrast STP with other loop prevention technologies

Unit – III: (12 Hours)

Available and Reliable Networks : DHCPv4 - SLAAC and DHCPv6 Concepts - FHRP Concepts

Learning Outcomes:

- Verify DHCP server configuration and functionality to ensure successful IP address assignment to clients
- Compare and contrast DHCPv4 and DHCPv6 functionalities for IP address management.
- Understand the functionalities of FHRP as a high availability routing protocol.

Unit – IV: (8 Hours)

L2 Security and WLANs : LAN Security Concepts - Switch Security Configuration - WLAN Concepts - WLAN Configuration

Learning Outcomes:

- Understand the importance of network segmentation
- Configure basic security features on network switches
- Analyze the challenges associated with wireless security

Unit – V: (10 Hours)

Routing Concepts and Configuration: Routing Concepts - IP Static Routing - Troubleshoot Static and Default Routes

Learning Outcomes:

- Understand the concept of routing tables and how they direct network traffic
- Configure basic static routes for specific destinations or networks.
- Understand the role of the default route and troubleshoot issues related to missing or incorrect default routes

Contemporary Topics need to mention (Compulsory)

Text Books:

Switching, Routing, and Wireless Essentials Companion Guide, Cisco Networking Academy

Published by : Cisco Press Hoboken, New Jersey.

ISBN-13: 978-0-13-672935-8 ISBN-10: 0-13-672935-5

References Books :

CCNA : Cisco Certified Network Associate study guide / Todd Lammle. — 7th ed. Wiley Publishing, Inc.

ISBN 978-0-470-90107-6

Web links :

- <https://itexamanswers.net/ccna-2-v7-exam-answers-switching-routing-and-wireless-essentials-v7-0-srwe.html>
- https://examscisco.com/ccna-v7-0/ccna-2-v7-switching-routing-and-wireless-essentials-v7-02-srwe-exam-answers/#google_vignette

COURSE OUTCOMES VS POs MAPPING (DETAILED; HIGH: 3; MEDIUM: 2; LOW: 1):

[illegible]

Course Code	Subject Name	L	T	P	C
R23CSE-HN3203	Enterprise Networking, Security, and Automation	3	0	0	3

Course Objectives

- Configure a single-area OSPFv2 network using a network simulator or real equipment.
- Understand the principles of Network Address Translation (NAT) for IPv4 and its role in network security and addressing.
- Analyze different VPN technologies like PPTP, L2TP/IPsec, and OpenVPN
- Apply network troubleshooting methodologies to identify and resolve common network issues.
- Understand the principles of network automation and its role in automating network configuration and management tasks.

Course Outcomes:

- Apply the different OSPFv2 components like areas, routers, neighbors, and LSAs
- Understand the fundamental concepts of network security, including threats, vulnerabilities, and security controls.
- Apply the various technologies used to connect geographically dispersed locations in a WAN
- Apply network design principles to optimize WAN performance, scalability, and security
- Apply the knowledge to design, implement, and manage automated network solutions.

Unit-I – (09 Hours)

OSPF Concepts and Configuration: Single-Area OSPFv2 Concepts - Single-Area OSPFv2 Configuration

Learning Outcomes:

- Analyze how link state advertisements and Dijkstra's algorithm work within OSPF.
- Configure a single OSPFv2 network for basic routing functionality.
- Verify OSPF routing table entries and troubleshoot basic configuration issues.

Unit – II: (09 Hours)

Network Security: Network Security Concepts - ACLs Concepts - ACLS for IPv4 Configuration - NAT for IPv4

Learning Outcomes:

- Configure basic IPv4 ACLs to control traffic flow through the network.
- Understand the benefits and applications of Network Address Translation (NAT) for IPv4 networks.
- Configure static NAT to translate private network addresses for internet access.

Unit – III: (10 Hours)

WAN: WAN Concepts - VPN and IPsec Concepts

Learning Outcomes:

- Understand the principles of IPsec (Internet Protocol Security) used to secure VPN tunnels.
- Analyze the functionalities of different VPN technologies (e.g., PPTP, L2TP/IPsec, OpenVPN)
- Configure basic VPN tunnels for secure remote network access

Unit – IV: (10 Hours)

Optimize, Monitor, and Troubleshoot Networks: QoS Concepts - Network Management - Network Design - Network Troubleshooting

Learning Outcomes:

- Implement basic QoS mechanisms like prioritization and shaping to optimize network traffic flow.
- Utilize network management tools and techniques to monitor network health and performance.
- Analyze network design principles and their impact on network efficiency and scalability.

Unit – V: (10 Hours)

Network Virtualization and Automation: Network Virtualization - Network Automation

Learning Outcomes:

- Understand the principles and benefits of network automation for managing network tasks efficiently.
- Identify common network automation tools and platforms
- Analyze the advantages and challenges of implementing network automation solutions.

Contemporary Topics need to mention (Compulsory)

- Software-Defined Networking (SDN) , IPv6 Security, Cloud-based VPNs, Cloud-based Network Architectures

Text Books:

1. Enterprise Networking, Security, and Automation Companion Guide (CCNAV7) Cisco Networking Academy ISBN-13: 978-0-13-663432-4
2. ISBN-10: 0-13-663432-X

References Books:

1. A Practical Introduction To Enterprise Network And Security Management. [2 ed.] CRC Press.
2. ISBN: 978-0-367-64251-8 (hbk), ISBN: 978-1-032-04802-4 (pbk), ISBN: 978-1-003-12369-9 (ebk)

Weblinks

1. https://ptgmedia.pearsoncmg.com/images/9780136634324/samplepages/9780136634324_Sample.pdf
2. <https://www.oreilly.com/library/view/enterprise-networking-security/9780136634171/>

COURSE OUTCOMES VS POs MAPPING (DETAILED; HIGH: 3; MEDIUM: 2; LOW: 1):

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
HC32.1	3	3	1	2	1								1	2	
HC32.2	3	3	1	2	1								1	2	
HC32.3	3	3	1	2	1								1	2	
HC32.4	3	3	1	2	1								1	2	
HC32.5	3	3	1	2	1								1	2	

Course Code	Subject Name	L	T	P	C
R23CSE-HN4103	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:

- Understand the basics, characteristics and challenges of Wireless Sensor Network
- Apply the knowledge to identify appropriate physical and MAC layer protocol
- Apply the knowledge to identify the suitable routing algorithm based on the network and user requirement
- Analysis of OS used in Wireless Sensor Networks and build basic modules
- 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

Contemporary Topics need to mention (Compulsory)

Text Books:

1. Wireless Sensor Networks Technology, Protocols, and Applications, Kazem S. Oshrahy, Daniel Minoli and Taieb Znati, John Wiley & Sons, 2007
2. Protocols and Architectures for Wireless Sensor Network, Holger Karl and Andreas Willig John Wiley & Sons, Ltd, 2005

References Books:

Title of the Reference book, Author Name, publisher Name, year of publication, Edition

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

Web links:

COURSE OUTCOMES VS POs MAPPING (DETAILED; HIGH: 3; MEDIUM: 2; LOW: 1):

[illegible]

Course Code	Subject Name	L	T	P	C
R23CSE-HN2204	CYBER SECURITY	3	0	0	3

Course Objectives:

1. Understand the fundamental concepts and principles of cybersecurity.
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 Cybersecurity: 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 Cybersecurity(L4)
- Outline the Ethical considerations in cyber security practices(L2)
- Understand the functionality of cyber security tools(L2)

Application:

- Web Firewall
- Antivirus and Antimalware
- Bots

- Threat management systems
- Network Security Surveillance

Contemporary Topics:

Critical infrastructure security, Endpoint security, Application security, Cloud security, Diverse Attack Vectors, Supply Chain Attacks.

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, Sunit Belapure, 1st Edition Publication Wiley, 2011.
3. William Stallings, Effective Cybersecurity: 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, 2018.

Weblinks:

1. <https://www.cybrary.it/course/entry-level-cybersecurity-training>
2. <https://www.professormesser.com/security-plus/sy0-601/sy0-601-video/sy0-601-comptia-security-plus-course/>
3. <https://www.cto.int/strategic-goals/cybersecurity/web-links/>

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
	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

Course Code	Subject Name	L	T	P	C
R23CSE-HN3104	SECURE CODING	3	0	0	3

Course Objectives:

1. To understand the security development process.
2. Knowledge of outline of the techniques for developing a secure application.
3. To handling dynamic memory management effectively.
4. Knowledge on stored procedures and XSS attacks.
5. Acquire knowledge on software architecture and design.

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

1. Analyze secure systems and various security principles.
2. Understand the development of process of software leads to secure coding practices
3. Apply Secure programs and various risk in the dynamic memory management.
4. Understand XSS related attacks and remedies
5. Understand various software architecture models.

UNIT-I:

Introduction-Need for secure systems, Proactive security development process, Security principles to live by and threat modeling.

Learning Outcomes: student will be able to

- Understand the need of secure system (L2).
- Analyzes security development process (L4).
- Analyze various threats in secure systems (L4).

UNIT-II:

Secure Coding in C-Character strings- String manipulation errors, String Vulnerabilities and exploits Mitigation strategies for strings, Pointers, Mitigation strategies in pointer based vulnerabilities Buffer Overflow based vulnerabilities.

Learning Outcomes: Student will be able to

- Describe the string manipulation errors (L2).
- Analyze the string buffer overflow Vulnerabilities (L4).
- Analyze mitigation strategies for strings (L4).

UNIT-III:

Secure Coding in C++ and Java-Dynamic memory management, Common errors in dynamic memory management, Memory managers, Double –free vulnerabilities, Integer security, Mitigation strategies.

Learning Outcomes: Student will be able to

- Analyze errors in dynamic memory management (L4).
- Analyze double free vulnerabilities (L4).
- Apply integer security to various applications (3).

UNIT-IV:

Database and Web Specific Input Issues-Quoting the Input, Use of stored procedures, Building SQL statements securely, XSS related attacks and remedies.

Learning Outcomes: student will be able to

- Understand the stored procedures (L2).
- Implement SQL statements related to security (L5).
- Analyze XSS attacks and remedies (L4).

UNIT-V:

Software Security Engineering-Requirements engineering for secure software: Misuse and abuse cases, SQUARE process model Software security practices and knowledge for architecture and design.

Learning Outcomes: Student will be able to

- Describe Misuse and abuse cases in requirements engineering (L2).
- Understand software security practices (L2).
- Understand software architecture and design (L2).

Text Book:

1. Michael Howard, David LeBlanc, “Writing Secure Code”, Microsoft Press, 2nd Edition, 2003.

Reference Books:

1. Robert C. Seacord, “Secure Coding in C and C++”, Pearson Education, 2nd edition, 2013.
2. Julia H. Allen, Sean J. Barnum, Robert J. Ellison, Gary McGraw, Nancy R. Mead, “Software Security Engineering: A guide for Project Managers”, Addison-Wesley Professional, 2008.

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	PS O1	PS O2	PS O3
CO1	3	2										2	2	2	2
CO2	3	2	2		1							2	2	2	2
CO3	3	2	2		1							2	2	2	2
CO4	3	2	2		1							2	2	2	2
CO5	3	2			1							2	1	2	2
C0.*	3	2	2		1							2	2	2	2

** For Entire Course, PO & PSO Mapping*

Subject Code	Subject Name	L	T	P	C
R23CSE-HN3204	Vulnerability Assessment & Penetration	3	0	0	3

Course Objectives:

1. To identify penetration testing process.
2. To identify the various information gathering and scanning procedures of security systems.
3. To identify various system hacking procedures.
4. To understand the impact of hacking in real time machines.
5. To understand the impact of hacking in wireless networks.

Course Outcomes:

1. Understand Penetration testing process.
2. Understand information gathering methodologies.
3. Analyze various Vulnerabilities assessments.
4. Apply System Hacking Techniques in real time applications.
5. Understand Bypassing WLAN Authentication

UNIT-I: Introduction: Penetration Testing phases/Testing Process, types and Techniques, Blue/Red Teaming, Strategies of Testing, Non Disclosure Agreement Checklist, Phases of hacking, Open-source/proprietary Pentest Methodologies.

Learning outcomes: Student should be able to

1. Understand penetration testing phases. (L2)
2. Understand penetration testing types and strategies. (L2)
3. Understand hacking phases. (L2)

UNIT –II: Information Gathering and Scanning : Information gathering methodologies- Foot printing, Competitive Intelligence- DNS Enumerations- Social Engineering attacks, Port Scanning-Network Scanning- Vulnerability Scanning- NMAP scanning tool- OS Fingerprinting- Enumeration.

Learning outcomes: Student should be able to

1. Understand various information gathering methodologies. (L2)
2. Analyze various social engineering attacks. (L4)
3. Analyze Vulnerability Scanning approach. (L4)
4. Analyze operating system based Vulnerabilities. (L4)

UNIT-III: System Hacking: Password cracking techniques- Key loggers- Escalating privileges- Hiding Files, Double Encoding, Steganography technologies and its Countermeasures. Active and passive sniffing- ARP Poisoning, MAC Flooding- SQL Injection - Error- based, Union-based, Time-based, Blind SQL, Out-of-band, Injection Prevention Techniques.

Learning outcomes: Student should be able to

1. Understand various password cracking techniques. (L2)
2. Analyze various double encoding algorithms. (L4)
3. Analyze various security attacks. (L4)

UNIT-IV: Advanced System Hacking: Broken Authentication, Sensitive Data Exposure, XML External Entities, Broken Access Code, XSS - Stored, Reflected, DOM Based.

Learning outcomes: Student should be able to

1. Analyze broken authentication techniques. (L4)
2. Analyze various XML entities. (L4)
3. Develop XML scripts for hacking . (L5)

UNIT-V: Wireless Pentest: Wi-Fi Authentication Modes, Bypassing WLAN Authentication, Types of Wireless Encryption, WLAN Encryption Flaws, AP Attack, Attacks on the WLAN Infrastructure, DoS-Layer1, Layer2, Layer 3, DDoS Attack, Client Disassociation, Wireless Hacking Methodology, Wireless Traffic Analysis.

Learning outcomes: Student should be able to

1. Understand bypassing authentication in WLAN. (L2)
2. Analyze DDoS attacks. (L4)
3. Understand how clients are disassociated. (L2)
4. Analyze data patterns in wireless network. (L4)

Text books:

1. Kali Linux 2: Windows Penetration Testing, By Wolf Halton, Bo Weaver , June 2016
Packt Publishing

Reference Books:

1. Mastering Modern Web Penetration Testing By Prakhar Prasad, October 2016
Packt Publishing.
2. SQL Injection Attacks and Defense 1st Edition, by Justin Clarke-Salt, Syngress
Publication

COURSE OUTCOMES VS POs MAPPING (DETAILED; HIGH: 3; MEDIUM: 2; LOW: 1):

Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	2			2					2	2	2	2	2
CO2	3	2	2			2					2	2	2	2	2
CO3	3	2				2					2	2	2	2	2
CO4	3	2				2					2	2	2	2	2
CO5	3	2				2					2	2	2	2	2
CO.*	3	2	2			2					2	2	2	2	2

** For Entire Course, PO & PSO Mapping*

Course Code	Subject Name	L	T	P	C
R23CSE-HN4104	Malware Analysis	3	0	0	3

Course Objectives:

- To understand the purpose of computer infection program.
- To implement the covert channel and mechanisms.
- To test and exploit various malware in open source environment.
- To analyze and design the famous virus and worms.
- Understand the Reverse Engineering (RE) Methodology
- Disassemble products and specify the interactions between its subsystems and their functionality

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

1. Explain the characteristics of Malware and its effects on Computing systems.
2. Predict the given system scenario using the appropriate tools to Identify the vulnerabilities and to perform Malware analysis.
3. Analyze the given Portable Executable and Non-Portable Executable files using Static and dynamic analysis techniques.
4. Demonstrate the Malware functionalities.
5. Apply anti-reverse engineering in different Applications

UNIT-I:

Malware Basics- General Aspect of Computer infection program, Non Self Reproducing Malware, How does Virus Operate, Virus Nomenclature, Worm Nomenclature, Recent Malware Case Studies.

UNIT-II:

Basic Analysis- Antivirus Scanning, x86 Disassembly, Hashing, Finding Strings, Packed Malware, PE File Format, Linked Libraries & Functions, PE Header File & Section.

UNIT-III:

Advanced Static & Dynamic Analysis-IDA Pro, Recognizing C code constructs, Analyzing malicious windows program, Debugging, OllyDbg, Kernel Debugging with WinDbg, Malware Focused Network Signatures.

UNIT-IV:

Malware Functionalities-Malware Behavior, Covert Malware Launch, Data Encoding, Shell code Analysis.

UNIT-V:

Reverse Engineering Malware (REM): REM Methodology, Resources for Reverse-Engineering Malware (REM) Understanding Malware Threats, Malware indicators, Malware Classification, Examining Clam AV-Signatures.

Text books:

1. Michael Sikorski, Andrew Honig "Practical Malware Analysis: The Hands-On Guide to Dissecting Malicious Software" publisher Williampollcock

Reference Books:

1. ErciFiliol, "Computer Viruses: from theory to applications", Springer, 1st edition, 2005.

R23_Open Electives Courses for CSE

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	R23CSS-OE0001	Operating Systems	3	0	0	3
2	R23CSS-OE0002	Redhat Linux	3	0	0	3
3	R23CSS-OE0003	Cloud Computing	3	0	0	3
4	R23CSS-OE0004	Distributed Operating System	3	0	0	3
5	R23CIT-OE0001	Basics of Computer Networks	3	0	0	3
6	R23CIT-OE0002	Cryptography and Network Security	3	0	0	3
7	R23CIT-OE0003	Mobile Computing	3	0	0	3
8	R23CIT-OE0004	Wireless sensor networks	3	0	0	3
9	R23CSM-OE0001	An Introduction to Artificial Intelligence	3	0	0	3
10	R23CSM-OE0002	Introduction to Machine Learning with Python	3	0	0	3
11	R23CSM-OE0003	Foundation of Deep Learning for Engineering Applications	3	0	0	3
12	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)
-

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)

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>
-

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
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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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Subject Code	Subject Name	L	T	P	C
R23CSS-OE0001	Operating Systems	3	0	0	3

Course Objectives:

- Provide knowledge about the services rendered by operating systems.
- Present detail discussion on processes, threads and scheduling algorithms.
- Expose the student with different techniques of handling deadlocks.
- Discuss various file-system implementation issues and memory management techniques.
- Learn the basics of Linux system and Android Software Platform.

Course Outcomes:

1. Understand the importance of operating systems and different types of system calls
2. Analyze process scheduling algorithms and various IPC mechanisms.
3. Understand the process synchronization, different ways for dead locks handling.
4. Analyze different page replacement methods, various File management techniques
5. Understand Linux and Android environment and behavior

Unit: 1: Operating Systems Overview: Introduction: What Operating systems Do, Types of Operating systems, Computer system Architecture, Computer system organization, Operating system functions, Operating systems operations, Protection and Security.

Virtualization: Types of Virtualizations, Benefits, and Challenges.

System structure: Operating System Services, User and Operating - System Interface, System calls, Types of System Calls, Operating system debugging, System Boot.

Learning Outcomes: Student will be able to

- Understand operating system structure and functions.
- Understand operating system services and system calls
- Comprehend the basics of virtualization

Unit: 2: Process Management: 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.

Learning Outcomes: Student will be able to

- Identify various message sharing mechanisms used in IPC.
- Understand how to handling multiple threads.
- Differentiate between preemptive, non-preemptive and real time CPU scheduling

Unit: 3: 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 form Deadlock, Concurrency in Distributed Systems, Consistency, and Replication.

Learning Outcomes: Student will be able to

- Analyze various solutions for process synchronization.
- Analyze the reasons for deadlocks and proposed solutions to detect, avoid, recovery from deadlocks.
- Understand concurrency issues in distributed systems

Unit: 4: 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.

File system Interface and Introduction to Network Programming: - the concept of a file, Access Methods, OSI model, Unix standards, TCP and UDP & TCP connection establishment and Format, Buffer sizes and limitation, standard internet services, Protocol usage by common internet application.

Learning Outcomes: Student will be able to

- Demonstrate the ability to implement various memory management techniques
- Illustrate various demand paging techniques.
- Identify various file management and optimization techniques.

Unit: 5: Network Programming and OS Security:

Sockets: Address structures, value – result arguments, Byte ordering and manipulation function and related functions.

Elementary TCP sockets – Socket, connect, bind, listen, accept, fork and exec function, concurrent servers. Close function and related function.

Elementary UDP sockets: Introduction UDP Echo server function, lost datagram, summary of UDP example, Lack of flow control with UDP, determining outgoing interface with UDP.

OS Security - Security Policies, Intrusion Detection, and Prevention.

Learning Outcomes: Student will be able to

- Understand socket programming.
- Understand basics of UDP (L2), Comprehend OS security concepts

Text Books:

1. Silberschatz A, Galvin PB, and Gagne G, Operating System Concepts, 9th edition, Wiley, 2013
2. Tanenbaum AS, Modern Operating Systems, 3rd edition, Pearson Education, 2008. (for Inter process Communication and File systems).

References:

1. Tanenbaum AS, Woodhull AS, Operating Systems Design and Implementation, 3rd edition, PHI, 2006.
2. Dhamdhere D M, Operating Systems A Concept Based Approach, 3rd edition, Tata Mc Graw-Hill, 2012.
3. Stallings W, Operating Systems –Internals and Design Principles, 6th edition, Pearson Education, 2009
4. Nutt G, Operating Systems, 3rd edition, Pearson Education, 2004.

Subject Code	Subject Name	L	T	P	C
R23CSS-OE0002	Red Hat Linux	3	0	0	3

Course Objectives:

- Master essential command-line tools for file manipulation, system access, and documentation in a RHEL environment.
- Implement core system administration tasks, including booting, process control, service control (systemd), and managing user/group accounts.
- Configure and manage local storage using partitions, filesystems (XFS/Ext4), and Logical Volume Management (LVM).
- Secure the system by configuring the firewall (firewalld), managing file permissions, and enforcing SELinux policies.
- Perform network configuration, package management, and write basic Bash shell scripts for task automation.

Course Outcomes:

1. Navigate and operate a Red Hat Enterprise Linux system entirely from the command line.
2. Manage local security policies, including users, groups, and file permissions.
3. Diagnose and troubleshoot boot process failures and service issues.
4. Apply proper file system management techniques, including creating and extending LVM.
5. Automate routine administrative tasks using shell scripting and scheduled utilities.

Unit 1: Essentials and System Access

Introduction to RHEL: Command Line Interface (CLI), Shell basics, using grep and regular expressions.

Getting Help: Utilizing man pages and system documentation.

File Management: Standard commands (ls, cp, mv), hard and soft links.

Text Editing and Remote Access: Using vim/nano for configuration; Secure Shell (ssh) usage.

Unit 2: Running Systems and Management

System Boot and Processes: Boot procedure, run levels, interrupting boot for recovery.

Process Control: Identifying, managing, and adjusting process priority (top, kill, nice).

Service Control: Managing system services and daemons using systemctl (systemd).

Package Management: Installing, updating, and removing software using dnf / yum (RPM).

User and Group Administration: Creating, modifying, and managing local users, groups, and password policies.

Unit 3: Storage Administration

Disk Partitioning: Understanding MBR/GPT and creating partitions.

Filesystems: Creating, mounting and managing XFS/Ext4 filesystems, and configuring /etc/fstab.

Logical Volume Management (LVM): PVs, VGs, LVs, creating, resizing, and extending logical volumes.

Network Storage: Basics of mounting NFS and SMB/CIFS shares.

Unit 4: Networking and Security

Basic Networking Configuration: Configuring IPv4/IPv6 addresses and network interfaces.

Firewall Management: Configuring network access restrictions using firewalld.

Security Contexts: Managing Access Control Lists (ACLs) for granular permissions.

SELinux: Introduction to SELinux modes, contexts, and troubleshooting access issues.

System Logging: Locating and interpreting system logs using journalctl.

Unit 5: Automation and Advanced Topics

Archiving and Scheduling: Using tar and compression utilities; scheduling tasks with cron and at.

Bash Shell Scripting: Introduction, variables, conditional execution (if), loops, and processing script inputs/outputs.

Kernel and Updates: Managing kernel modules and performing system maintenance/updates.

Virtualization / Containers: Overview of enterprise virtualization and container concepts (e.g., Podman).

Text Books:

1. Red Hat RHCSA [RHEL Version] Cert Guide (Exam EX200), Sander van Vugt
2. UNIX and Linux System Administration Handbook, Evi Nemeth, Garth Snyder

Subject Code	Subject Name	L	T	P	C
R23CSS-OE0003	Cloud Computing	3	0	0	3

Course Objectives:

- To implement Virtualization
- To implement Task Scheduling algorithms
- Apply Map-Reduce concept to applications
- To build Private Cloud
- Broadly educate to know the impact of engineering on legal and societal issues involved

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

1. Interpret the key dimensions of the challenge of Cloud Computing
2. Examine the economics, financial, and technological implications for selecting cloud computing for own organization
3. Assessing the financial, technological, and organizational capacity of employers for actively initiating and installing cloud-based applications
4. Evaluate own organizations. needs for capacity building and training in cloud computing-related IT areas
5. Illustrate Virtualization for Data-Center Automation

UNIT I

Introduction: Network centric computing, Network centric content, peer-to .peer systems, cloud computing delivery models and services, Ethical issues, Vulnerabilities, Major challenges for cloud computing. Parallel and Distributed Systems: introduction, architecture, distributed systems, communication protocols, logical clocks, message delivery rules, concurrency, and model concurrency with Petri Nets.

UNIT II

Cloud Infrastructure: At Amazon, The Google Perspective, Microsoft Windows Azure, Open Source Software Platforms, Cloud storage diversity, Inter cloud, energy use and ecological impact, responsibility sharing, user experience, Software licensing, Cloud Computing : Applications and Paradigms: Challenges for cloud, existing cloud applications and new opportunities, architectural styles, workflows, The Zookeeper, HPC on cloud.

UNIT III

Cloud Resource virtualization: Virtualization, layering and virtualization, virtual machine monitors, virtual machines, virtualization- full and para, performance and security isolation, hardware support for virtualization, Case Study: Xen, vBlades, Cloud Resource Management and Scheduling: Policies and Mechanisms, Applications of control theory to task scheduling, Stability of a two-level resource allocation architecture, feedback control based on dynamic thresholds, coordination, resource bundling, scheduling algorithms, fair queuing, start time fair queuing, cloud scheduling subject to deadlines, Scheduling Map Reduce applications, Resource management and dynamic application scaling.

UNIT IV

Storage Systems: Evolution of storage technology, storage models, file systems and database, distributed file systems, general parallel file systems. Google file system. Apache Hadoop, Big Table, Megastore (text book 1), Amazon Simple Storage Service(S3) (Text book 2), Cloud Security: Cloud security risks, security . a top concern for cloud users, privacy and

privacy impact assessment, trust, OS security, Virtual machine security, Security risks.

UNIT V

Cloud Application Development: Amazon Web Services : EC2 – instances, connecting clients, security rules, launching, usage of S3 in Java, Cloud based simulation of a Distributed trust algorithm, Cloud service for adaptive data streaming (Text Book 1), Google: Google App Engine, Google Web Toolkit (Text Book 2), Microsoft: Azure Services Platform, Windows live, Exchange Online, Share Point Services, Microsoft Dynamics CRM (Text Book 2)

Text Books:

1. Cloud Computing, Theory and Practice, 1st Edition, Dan C Marinescu, MK Elsevier publisher ,2013
2. Cloud Computing, A Practical Approach, 1st Edition, Anthony T Velte, Toby J Velte, Robert Elsenpeter, TMH,2017

Reference Books:

1. Mastering Cloud Computing, Foundations and Application Programming, 1st Edition, Raj Kumar Buyya, Christen vecctiola, S Tammaraiselvi, TMH,2013
2. Essential of Cloud Computing, 1st Edition, K Chandrasekharan, CRC Press, 2014.
3. Cloud Computing, A Hands on Approach, ArshdeepBahga, Vijay Madisetti, Universities Press, 2014.

Subject Code	Subject Name	L	T	P	C
R23CSS-OE0004	Distributed Operating Systems	3	0	0	3

Course Objectives:

- To study the concepts and design principles of Distributed Operating Systems,
- To understand clock synchronization protocols and distributed file system implementation,
- To gain knowledge on communication, synchronization, and consistency models in distributed systems.

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

- Explain the architecture and components of distributed systems,
- Understand various synchronization and coordination mechanisms,
- Analyze consistency and fault tolerance issues,
- Describe distributed file systems and object-based distributed environments,
- Apply concepts of distributed systems in real-time applications.

Detailed Syllabus:

Unit I – Fundamentals of Distributed Systems

Introduction to distributed systems, Goals of distributed systems, Hardware and software concepts, Design issues, Network operating systems, Comparison between time-sharing, multiprocessor, and true distributed systems, System architectures for distributed systems.

Unit II – Communication in Distributed Systems

Basics of communication systems, Layered protocols, ATM models, Client–Server model, Blocking and non-blocking primitives, Buffered and unbuffered communication, Reliable and unreliable primitives, Message passing, Remote Procedure Call (RPC).

Unit III – Synchronization and Processes

Clock synchronization, Mutual exclusion in distributed systems, Election algorithms, Atomic transactions, Deadlock handling, Processes and threads in distributed systems, System models, Processor allocation, Process scheduling in distributed systems.

Unit IV – Consistency, Replication, and Fault Tolerance

Data-centric and client-centric consistency models, Replica management, Consistency protocols, Fault tolerance in distributed systems, Process resilience, Distributed commit protocols, Reliable client–server communication.

Unit V – Distributed Object-Based Systems and File Systems

Distributed object-based systems, Object-oriented architecture, Processes and communication in object-based systems, Synchronization in object environments, Consistency and replication in object-based systems, Distributed file system design and implementation.

Reference Books:

- Andrew S. Tanenbaum, *Distributed Operating Systems*, Pearson Education, Reprint, 2011,
- Andrew S. Tanenbaum and Maarten Van Steen, *Distributed Systems – Principles and Paradigms*, 2nd Edition, PHI, 2007,
- Pradeep K. Sinha, *Distributed Operating Systems – Concepts and Design*, PHI, 2007.

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 Cookbook, 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.