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

COMPUTER SCIENCE AND INFORMATION TECHNOLOGY

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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R23_ CSIT B.Tech III YEAR - COURSE STRUCTURE AND DETAILED SYLLABUS

III Year I Semester						
S. No	**Course Code**	**Course Name**	**L**	**T**	**P**	**Credits**
1.	R23CIT-PC3101	Computer Networks	3	0	0	3
2.	R23CIT-PC3102	Data warehousing & Data Mining	3	0	0	3
3.	R23CIT-PC3103	Automata Compiler Design	3	0	0	3
4.		**Professional Elective-I**				
	R23CIT-PE3101.1	1. Devops	3	0	0	3
	R23CIT-PE3101.2	2. Advanced Computer Architecture				
	R23CIT-PE3101.3	3. Artificial Intelligence and Neural Networks				
5.	R23CIT-OE3101	**Open Elective- I**	3	0	0	3
6.	R23CIT-PC3104	Computer Networks Lab	0	0	3	1.5
7.	R23CIT-PC3105	Data Mining Lab	0	0	3	1.5
8.	R23CIT-SC3101	Angular JS (Skill Oriented Course)	0	1	2	2
9.	R23CIT-ES3101	Prompt Engineering/ Tinkering Lab [AWS Cloud]	0	0	2	1
10.	R23BSH-MC3101	English and Soft Skills for Job Seekers (Mandatory Course)	0	1	2	0
11.	R23CIT-SI3101	Evaluation of Community Service Project Internship	0	0	0	2
Total			**15**	**2**	**14**	**23**
Honor Course-2/ Minor Course-2						

III Year II Semester						
S.No	**Course Code**	**Course Name**	**L**	**T**	**P**	**Credits**
1.	R23CIT-PC3201	Software Engineering & Object-Oriented Analysis and Design	3	0	0	3
2.	R23CIT-PC3202	Cryptography and Network Security	3	0	0	3
3.	R23CIT-PC3203	Machine Learning	3	0	0	3
4.		**Professional Elective-II**	3	0	0	3
	R23CIT-PE3201.1	1. Design and Analysis of Algorithms				
	R23CIT-PE3201.2	2. Mobile Computing				
	R23CIT-PE3201.3	3. E-Commerce				
5.		**Professional Elective-III**	3	0	0	3
	R23CIT-PE3202.1	1. Distributed Systems				
	R23CIT-PE3202.2	2. Advanced Computer Networks				
	R23CIT-PE3202.3	3. Cloud Computing				
6.	R23CIT-OE3201	**Open Elective - II**	3	0	0	3
7.	R23CIT-PC3204	Software Engineering & Object-Oriented Analysis and Design Lab	0	0	3	1.5
8.	R23CIT-PC3205	Machine Learning Lab	0	0	3	1.5
9.	R23CIT-SC3201	Node Express JS (Skill Oriented Course)	0	1	2	2
10.	R23CIT-MC3201	Technical Paper Writing & IPR (Mandatory Course)	2	0	0	0
Total			**20**	**1**	**8**	**23**
Honor Course-3/Minor Course-3						
Summer Internship (During the Summer Vacation after Third Year & Evaluated in IV-I Semester)						

R23_ CSIT (Honors)

Track-I(Data Science)							
S.No	**Year & Semester**	**Course Code**	**Subject title**	**L**	**T**	**P**	**C**
1	II-II	R23CIT-HN2201	Introduction to Data Science	3	0	0	3
2	III-I	R23CIT-HN3101	Data Analysis and Visualization	3	0	0	3
3	III-II	R23CIT-HN3201	Advanced Data Analysis Techniques	3	0	0	3
4	IV-I	R23CIT-HN4101	Applied Data Science Projects and Specializations	3	0	0	3
5	II Year to IV Year	R23CIT-HM0001	Honors MOOCS-1	0	0	0	3
6	II Year to IV Year	R23CIT-HM0002	Honors MOOCS-2	0	0	0	3
Total							**18**

Track-II (Ethical Hacking)							
S. No	**Year & Semester**	**Course Code**	**Subject title**	**L**	**T**	**P**	**C**
1	II-II	R23CIT-HN2202	Fundamentals of Ethical Hacking	3	0	0	3
2	III-I	R23CIT-HN3102	Network Penetration Testing	3	0	0	3
3	III-II	R23CIT-HN3202	Web Application Penetration Testing	3	0	0	3
4	IV-I	R23CIT-HN4102	Wireless Network Penetration Testing	3	0	0	3
5	II Year to IV Year	R23CIT-HM0001	Honors MOOCS-1	0	0	0	3
6	II Year to IV Year	R23CIT-HM0002	Honors MOOCS-2	0	0	0	3
Total							**18**

Track-III(Security)							
S.No	**Year & Semester**	**CourseCode**	**Subjecttitle**	**L**	**T**	**P**	**C**
1	II-II	R23CIT-HN2203	Cyber Security	3	0	0	3
2	III-I	R23CIT-HN3103	Secure Coding	3	0	0	3
3	III-II	R23CIT-HN3203	Vulnerability Assessment & Penetration Testing	3	0	0	3
4	IV-I	R23CIT-HN4103	Malware Analysis	3	0	0	3
5	II Year to IV Year	R23CIT-HM0001	Honors MOOCS-1	0	0	0	3
6	II Year to IV Year	R23CIT-HM0002	Honors MOOCS-2	0	0	0	3
Total							**18**

Track-IV(Networks)							
S.No	**Year&Semester**	**CourseCode**	**Subjecttitle**	**L**	**T**	**P**	**C**
1	II-II	R23CIT-HN2204	Introduction to Networks	3	0	0	3
2	III-I	R23CIT-HN3104	Switching, Routing, and Wireless Essentials	3	0	0	3
3	III-II	R23CIT-HN3204	Enterprise Networking, Security, and Automation	3	0	0	3
4	IV-I	R23CIT-HN4104	Wireless Sensor Networks	3	0	0	3
5	II Year to IV Year	R23CIT-HM0001	Honors MOOCS-1	0	0	0	3
6	II Year to IV Year	R23CIT-HM0002	Honors MOOCS-2	0	0	0	3
Total							**18**

R23_Open Electives Courses for CSIT

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

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

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

Offering Department: Computer Science and Engineering & Allied Branches						
S.No	**Course Code**	**Course Name**	**L**	**T**	**P**	**Credits**
1	R23CSE-OE0001	Python Programming	3	0	0	3
2	R23CSE-OE0002	Data Structures Using C	3	0	0	3
3	R23CSE-OE0003	Operating System Concepts	3	0	0	3
4	R23CSE-OE0004	Introduction to Java Programming	3	0	0	3
5	R23CSE-OE0005	Database Management Systems Concepts	3	0	0	3
6	R23CSE-OE0006	Unix & Shell Programming	3	0	0	3
7	R23CSE-OE0007	Software Engineering	3	0	0	3
8	R23CSE-OE0008	Introduction to Data mining	3	0	0	3
9	R23CSE-OE0009	Fundamentals of Web Technologies	3	0	0	3
10	R23CSE-OE0010	Fundamentals of Computer Networks	3	0	0	3
11	R23CSE-OE0011	Basics of Cloud Computing	3	0	0	3
12	R23CSE-OE0012	Introduction to Machine Learning	3	0	0	3
13	R23CSE-OE0013	Essentials of Cyber Security	3	0	0	3
14	R23CSE-OE0014	Introduction to React JS	3	0	0	3
15	R23CSE-OE0015	Deep Learning	3	0	0	3
16	R23CSE-OE0016	DevOps	3	0	0	3
17	R23CSE-OE0017	Mobile Computing	3	0	0	3
18	R23CSE-OE0018	Java Full Stack Development	3	0	0	3
19	R23CSE-OE0019	Human Computer Interface	3	0	0	3
20	R23CSE-OE0020	Cryptography and Network Security	3	0	0	3
21	R23CSE-OE0021	Quantum Computing	3	0	0	3
22	R23CSE-OE0022	Big data Analytics	3	0	0	3
23	R23CSE-OE0023	Block Chain Technology	3	0	0	3
24	R23CSE-OE0024	Multimedia Application Development	3	0	0	3
25	R23CSE-OE0025	Mobile Adhoc Networks	3	0	0	3
26	R23CSS-OE0001	Operating Systems	3	0	0	3
27	R23CSS-OE0002	Redhat Linux	3	0	0	3
28	R23CSS-OE0003	Cloud Computing	3	0	0	3
29	R23CSS-OE0004	Distributed Operating System	3	0	0	3
30	R23CSM-OE0001	An Introduction to Artificial Intelligence	3	0	0	3
31	R23CSM-OE0002	Introduction to Machine Learning with Python	3	0	0	3
32	R23CSM-OE0003	Foundation of Deep Learning for Engineering Applications	3	0	0	3
33	R23CSM-OE0004	Natural Language Processing- Frontiers Approach	3	0	0	3

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2.	R23CIT-PC3102	Data warehousing & Data Mining	3	0	0	3
3.	R23CIT-PC3103	Automata Compiler Design	3	0	0	3
4.		**Professional Elective-I**				
	R23CIT-PE3101.1	1. Devops	3	0	0	3
	R23CIT-PE3101.2	2. Advanced Computer Architecture				
	R23CIT-PE3101.3	3. Artificial Intelligence and Neural Networks				
5.	R23CIT-OE3101	**Open Elective- I**	3	0	0	3
6.	R23CIT-PC3104	Computer Networks Lab	0	0	3	1.5
7.	R23CIT-PC3105	Data Mining Lab	0	0	3	1.5
8.	R23CIT-SC3101	Angular JS (Skill Oriented Course)	0	1	2	2
9.	R23CIT-ES3101	Prompt Engineering/ Tinkering Lab [AWS Cloud]	0	0	2	1
10.	R23BSH-MC3101	English and Soft Skills for Job Seekers (Mandatory Course)	0	1	2	0
11.	R23CIT-SI3101	Evaluation of Community Service Project Internship	0	0	0	2
Total			**15**	**2**	**14**	**23**
Honor Course-2/ Minor Course-2						

B.Tech III Year - I Semester

Course code	Course Title	L	T	P	Credits
R23CIT-PC3101	Computer Networks	3	0	0	3

Course Objectives:

- Understand the contemporary technologies in network protocols and network architecture
- 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:

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 Internetworking Devices.

Applications:

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

UNIT 2:

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.

Applications:

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

UNIT 3:

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, point to point protocol (PPP): frame format, transition phase, multiplexing.

UNIT 4:

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, Hierarchical routing, Broad cast, Multi cast, distance vector routing, Link state routing Algorithms, IPv4 address, subnetting, Congestion Control Algorithms .

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

The Transport Layer: addressing, TCP establishing a connection, releasing connection, TCP Header format, End to end protocols: UDP,.

Application layer: File Transfer(FTP), WWW: architeture ,client / server ,uniform resource locator, cookies, web documents: static ,dynamic, active document, HTTP transaction: persistant, 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).

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 code	Course Title	L	T	P	Credits
R23CIT-PC3102	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]

UNIT –I:

Introduction: Why Data Mining? What Is Data Mining? What Kinds of Data Can Be Mined? What Kinds of Patterns Can Be Mined? Which Technologies Are Used? Which Kinds of Applications Are Targeted? Major Issues in Data Mining. Data Objects and Attribute Types, Basic Statistical Descriptions of Data, Data Visualization, Measuring Data Similarity and Dissimilarity

UNIT –II:

Data Pre-processing: Data Preprocessing: An Overview, Data Cleaning, Data Integration, Data Reduction, Data Transformation and Data Discretization.

UNIT –III:

Classification: Basic Concepts, General Approach to solving a classification problem, Decision Tree Induction: Working of Decision Tree, building a decision tree, methods for expressing an attribute test conditions, measures for selecting the best split, Algorithm for decision tree induction.

Classification: Alterative Techniques, Bayesian Classifier: Bayes theorem, using bayes theorem for classification, Native Bayes Classifier: Bayes error rate, Bayesian Belief Networks: Model representation, model building, (Tan)

UNIT –IV:

Association Analysis: Basic Concepts and Algorithms: Problem defination, 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)**

UNIT –V

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)**

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.
1. Data Mining and Analysis - Fundamental Concepts and Algorithms; Mohammed J. Zaki,Wagner Meira, Jr, Oxford
2. Data Warehousing Data Mining & OLAP, Alex Berson, Stephen Smith, TMH.

Course code	Course Title	L	T	P	Credits
R23CIT-PC3103	Automata Compiler Design	3	0	0	3

Course Objectives :

- To learn fundamentals of Regular and Context Free Grammars and Languages and The phases of a compiler
- To understand the relation between Regular Language and Finite Automata machines and Design of lexical analyzers
- To learn how to design Parse trees, problems encountered while parsing and Design of Syntax analyzers using bottom up parsing
- To understand the relation between Contexts free Languages and PDA, Design of Syntax analyzers using bottom up parsing

Course Outcomes :

1. Understand finite automata.
2. Design and develop lexical analyzers
3. Analyze the working process of top-down parser.
4. Analyze the working process of Bottom-up parser.
5. Design the optimized code by applying optimization techniques.

UNIT - 1

Introduction to Automata Theory: Central Concepts of Automata theory, Deterministic Finite Automata(DFA), Non- Deterministic Finite Automata(NFA) ,Epsilon- NFA, NFA to DFA Conversion, Minimization of DFA

Introduction to Compiler Design:

Language Processors, Phases of
Compilers Learning Outcomes:

UNIT - 2

Regular Expressions and Languages: Regular Expressions, Finite Automata and Regular Expressions, Inter Conversion, Equivalence between FA and RE.

Lexical Analysis Phase of compiler Design:
Role of Lexical Analyzer, Input Buffering , Specification of Token, Recognition of Token.

UNIT - 3

Context Free Grammars: Definition and designing CFGs, Derivations Using a Grammar, Parse Trees, Simplification of Context Free Grammars-Elimination of Useless Symbols, - Productions and Unit Productions, Normal Forms-Chomsky Normal Form and Greibach Normal Form, Syntax Analysis Phase of Compilers:

Part-1: Role of Parser, Ambiguity and Elimination of Ambiguity, Elimination of Left Recursion, Left Factoring, Top-Down Parsing techniques

UNIT - 4

Push Down Automata:
Definition of the Pushdown Automata, Design of Pushdown Automata, The Language acceptance of PDA.

Syntax Analysis Phase of Compilers:

Part-2: Bottom-up Parsing, Introduction to LR Parsing: SLR, More Powerful LR parsers

UNIT - 5

Syntax Directed Translation- Syntax-Directed Definitions, Evaluation Orders for SDD's. Intermediate-Code Generation-Three-Address Code. Code Optimization techniques-Common sub expression elimination, constant folding, copy propagation, dead code elimination, strength reduction, loop optimization, Machine dependent code optimization: Peephole optimization, code generation, register allocation

Text Books:

1. Introduction to Automata Theory, Languages and Computation, J. E. Hopcroft, R. Motwani and J. D. Ullman, 3rd Edition, Pearson, 2008
2. Theory of Computer Science-Automata, Languages and Computation, K. L. P. Mishra and N. Chandrasekharan, 3rd Edition, PHI, 2007
3. Compilers: Principles, Techniques and Tools, Second Edition, Alfred VAho, Monica S. Lam, Ravi Sethi, Jeffry D. Ullman, Pearson.
4. Compiler Construction-Principles and Practice, Kenneth C Louden, Cengage Learning.

References:

1. Elements of Theory of Computation, Lewis H.P. & Papadimition C.H., Pearson /PHI
2. Theory of Computation, V. Kulkarni, Oxford University Press, 2013
3. Theory of Automata, Languages and Computation, Rajendra Kumar, McGraw Hill, 2014
4. Modern Compiler Implementation in C, Andrew W Appel, Revised edition, Cambridge University Press.
5. The Theory and Practice of Compiler writing, J. P. Tremblay and P. G. Sorenson, TMH Lex &yacc, 2nd Edition by John Levine, Doug Brown, Tony Mason

e-Resources:

1. https://nptel.ac.in/courses/106/104/106104028
2. https://www.edx.org/course/compilers
3. https://nptel.ac.in/courses/106/108/106108113/

Course code	Course Title	L	T	P	Credits
R23CIT-PE3101.1	DevOps (**Professional Elective - I)**	3	0	0	3

Course Objectives:

- Understand the principles and practices of DevOps.
- Understand the tools and techniques used in automation, CI/CD, configuration management, and containerization.
- Develop, test, and deploy software efficiently using DevOps practices.
- Foster collaboration between software development and operations.
- Understand monitoring & security in DevOps

Course Outcomes:

1. Compare the traditional IT practices with DevOps practices.
2. Apply CI/CD practices by designing and evaluating pipelines using tools such as Jenkins and GitLab CI.
3. Deploy and manage applications using Docker containers and orchestrate them with Kubernetes.
4. Analyze and implement configuration management and Infrastructure as Code automation using Ansible and Terraform.
5. Understand the Integration of monitoring and security tools in DevOps

Unit 1: Introduction to DevOps

Topics:

Introduction to Software Development life cycle and agile software development, DevOps Definition and Benefits and it Goals, differentiate between Traditional vs. DevOps IT Infrastructure, Cloud Platforms (AWS, GCP, Azure, IBM), DevOps Principles (CI, CD, CT, CM), DevOps Tools (Git, Jenkins, Docker, Kubernetes, Ansible, Terraform), DevOps Lifecycle (Development → Monitoring), Version Control (SVN, Git, GitHub, GitLab)

Course Outcomes (COs):

CO1.1: Explain different phases of the software development life cycle and Agile methodology. (Understand)

CO1.2: Compare traditional IT infrastructure with DevOps practices. (Analyze)

CO1.3: Demonstrate version control operations using Git, GitHub, GitLab, and SVN. (Apply)

CO1.4: Identify key services of cloud platforms (AWS, GCP, Azure, IBM) for DevOps practices. (Understand)

CO1.5: Illustrate the DevOps lifecycle and role of tools (Git, Jenkins, Docker, Kubernetes, Ansible, Terraform) in automation. (Apply/Analyze)

Unit 2: Continuous Integration & Delivery (CI/CD)

Topics:

Introduction to CI/CD Concepts (Build, Test, Deploy Automation), CI/CD Tools (Jenkins, GitLab CI, CircleCI)

Course Outcomes (COs):

CO2.1: Explain the principles of Continuous Integration and Continuous Delivery. *(Understand)*

CO2.2: Design and implement CI/CD pipelines using Jenkins/GitLab CI. *(Apply)*

CO2.3: Evaluate the benefits and challenges of CI/CD in Agile development teams. *(Evaluate)*

Unit 3: Containerization & Orchestration

Topics:

Introduction to Containers: Difference between Containers and Virtual Machines, Benefits **Docker Basics**: Docker Images, Containers, Dockerfile, **Container Orchestration with Kubernetes**: Basic Components (Pods, Services, Deployments), Kubernetes Architecture, Scaling Applications, Kubernetes on Cloud (GKE, EKS, AKS)

Course Outcomes (COs):

CO3.1: Differentiate between containers and virtual machines with respect to resource utilization. (Analyze)

CO3.2: Deploy and manage applications using Docker containers. (Apply)

CO3.3: Configure Kubernetes clusters and manage orchestration components (Pods, Services, Deployments). (Apply/Analyze)

CO3.4: Demonstrate application deployment using Kubernetes on cloud platforms (GKE, EKS, AKS). (Apply)

Unit 4: Configuration Management & IaC

Topics:

Introduction to Configuration Management: Why Configuration Management is Important Tools: Ansible, Puppet, Chef, **Infrastructure as Code**: Definition, Benefits, Tools like Terraform and CloudFormation

Course Outcomes (COs):

CO4.1: Explain the role of configuration management in DevOps automation. (Understand)

CO4.2: Automate server provisioning and configuration using Ansible. (Apply)

CO4.3: Implement Infrastructure as Code (IaC) using Terraform or CloudFormation. (Apply)

Unit 5: Monitoring & Security in DevOps

Topics:

Introduction to DevOps Monitoring: Importance and Overview, **Monitoring Tools**: Nagios, Prometheus, Grafana, **Log Management**: Centralized logging with ELK (Elasticsearch, Logstash, Kibana), **Security Tools**: Using tools like SonarQube for code analysis.

Course Outcomes (COs**):**

CO5.1: Explain the importance of monitoring and log management in DevOps. (Understand)

CO5.2: Set up dashboards and alerts using monitoring tools like Prometheus and Grafana. (Apply)

CO5.3: Implement centralized logging with ELK stack for system monitoring. (Apply/Analyze)

CO5.4: Integrate security checks into DevOps pipelines using SonarQube. (Apply/Analyze)

Text Books:

1. Learning DevOps: Continuously Deliver Better Software – Mikael Krief, Stéphane Jourdan, Ralf Schlotter, Packt Publishing, 2021.
2. Mastering DevOps with Docker, Kubernetes, Terraform, Ansible, and Monitoring & Security Tools – Sagar Rahalkar, Yashavant Chandak, 1st Edition, Packt Publishing, March 2023, ISBN: 9781803247495.
3. DevOps Tools for Beginners: Docker, Kubernetes, Terraform, Ansible, Jenkins and Azure DevOps – Mitesh Soni, BPB Publications, 2022.
4. Practical DevOps: Harnessing the Power of DevOps, Docker, Kubernetes, Terraform & Ansible – Joakim Verona, Mikael Krief, Packt Publishing, 2022.

Reference Books:

1. The DevOps Handbook – Gene Kim, Jez Humble, Patrick Debois, John Willis, 2nd Edition, IT Revolution, 2021.
2. Cloud Native DevOps with Kubernetes – John Arundel, Justin Domingus, 2nd Edition, O'Reilly Media, 2023.
3. Docker and Kubernetes for Java Developers – Jaroslaw Krochmalski, Packt Publishing, 2021.

Web References:

1. DevOps Roadmap (Visual Guide): **https://roadmap.sh/devops**
2. DevOps Roadmap GitHub Repository: **https://github.com/milanm/DevOps-Roadmap**
3. Scrum Guide (Official Scrum Framework): **https://scrumguides.org/**
4. Agile 101 – Agile Alliance: **https://www.agilealliance.org/agile101/**
5. AWS – What is DevOps?: **https://aws.amazon.com/devops/what-is-devops/**
6. Microsoft Azure DevOps Documentation: **https://learn.microsoft.com/en-us/azure/devops**/
7. Kubernetes Official Documentation: **https://kubernetes.io/docs/**
8. Docker Official Documentation: **https://docs.docker.com/**
9. Terraform Official Documentation: **https://developer.hashicorp.com/terraform/docs**
10. Jenkins Official Documentation: **https://www.jenkins.io/doc/**

Course code	Course Title	L	T	P	Credits
R23CIT-PE3101.2	Advanced Computer Architecture **(Professional Elective-I)**	3	0	0	3

Course Objectives:

- To make students know about the Evolution of Computer architecture.
- To give the students an elaborate idea about the different memory systems and buses.
- To introduce the advanced processor architectures to the students.
- To make the students learn about Memory hierarchy concepts.
- To study about data flow computer architectures.

Course Outcomes:

1. Understand concepts of Evolution of Computer architecture.
2. Apply memory organization and mapping techniques.
3. Understand architectural features of advanced processors.
4. Analyze the Memory hierarchy concepts
5. Development of software to solve computationally intensive problems.

UNIT– I

Parallel Computer Models:
Evolution of Computer architecture, system attributes to performance, Multi processors and multi computers, Multi-vector and SIMD computers, PRAM and VLSI models-Parallelism in Programming, conditions for Parallelism-Program Partitioning and Scheduling-program flow Mechanisms-Speed up performance laws-Amdahl‘s law, Gustafson‘s law-Memory bounded speedup Model.

UNIT– II

Instruction set architecture design: Instruction set design, implementation and performance Perspectives, relative advantages of RISC and CISC instruction set, Data Path Design

UNIT – III

Instruction-level parallelism (ILP): Pipeline data-path, data-dependence. Challenges in ILP realization. Pipeline hazards and their solutions, out-of-order execution, branch prediction, and dynamic scheduling. VLIW and superscalar processors.

UNIT– IV

Memory Systems and Buses: Memory hierarchy-cache and shared memory concepts-Cache memory organization-cache addressing models, Aliasing problem in cache, cache memory mapping techniques-Shared memory organization-Inter leaved memory organization, Lower order inter leaving, Higher order interleaving. Back plane bus systems-Bus addressing, arbitration and transaction.

UNIT - V

Memory hierarchy design- cache performance- reducing cache misses penalty and miss rate– virtual memory-protection and examples of VM. Flynn Processor classification.

Text Books:

1. KaiHwang, Advanced Computer architecture Parallelism, scalablity, Programmablity, McGrawHill, N.Y,2003
2. Computer Architecture A quantitative approach 3rd edition JohnL. Hennessy & David, A Patterson Morgan Kufmann (An Imprint of Elsevier)
3. Kai Hwang and F.A.Briggs, Computer architecture and parallel processor 'McGraw Hill, N.Y,1999

References:

1. "Computer Architecture and parallel Processing" Kai Hwang and A.Briggs International Edition McGraw-Hill. Advanced Computer Architectures, Dezso Sima, Terence Fountain, Peter Kacsuk, Pearson.
2. David A. Patterson and JohnL. Hennessey,—Computer organization and design Elsevier, Fifthedition,2014

Course code	Course Title	L	T	P	Credits
R23CIT-PE3101.3	Artificial Intelligence and Neural Networks **(Professional Elective-I)**	3	0	0	3

Course Objectives:

- To provide a strong foundation of fundamental concepts in Artificial Intelligence.
- To provide a basic exposition to the goals and methods of Artificial Intelligence.
- To apply the techniques in applications which involve perception, reasoning and learning.
- To learn various types of Artificial Neural Networks

Course Outcomes:

1. Understand basics of Artificial Intelligence
2. Apply the basic principles of AI in problem solving
3. Understand the basics of Artificial Neural Networks
4. Understand unsupervised learning approaches
5. Apply knowledge representation in AI approaches

UNIT I

Introduction: The Foundations of Artificial Intelligence, The History of Artificial Intelligence, The State of the Art, Agents and Environments, Good Behavior: The Concept of Rationality, The Nature of Environments, The Structure of Agents.

UNIT II

Problem Solving: Problem-Solving Agents, Example Problems, Searching for Solutions, Uninformed Search Strategies, Informed (Heuristic) Search Strategies, Local Search Algorithms and Optimization Problems, Searching with Nondeterministic Actions.

UNIT III

Artificial Neural Networks Introduction, Basic models of ANN, important terminologies, Supervised Learning Networks, Perceptron Networks, Adaptive Linear Neuron, Back- propagation Network.

Associative Memory Networks. Training Algorithms for pattern association, BAM and Hopfield Networks.

UNIT IV

Unsupervised Learning Network- Introduction, Fixed Weight Competitive Nets, Maxnet, Hamming Network, Kohonen Self-Organizing Feature Maps, Learning Vector Quantization, Counter Propagation Networks, Adaptive Resonance Theory Networks. Special Networks- Introduction to various networks.

UNIT V

Knowledge Representation: Knowledge-Based Agents, Logic, And Propositional Logic: A Very Simple Logic, Ontological Engineering, Categories and Objects, Events, Mental Events and Mental Objects, Reasoning Systems for Categories, The Internet Shopping World.

Text Books:

1. Stuart Russell and Peter Norvig, "Artificial Intelligence: A Modern Approach" , 3rd Edition, Pearson.
2. Elaine Rich and Kevin Knight, "Artificial Intelligence", Tata McGraw Hill
3. Neural Networks and Learning Machines, Simon Haykin, 3rd Edition, Pearson Prentic Hall.

Reference Books:

1. SarojKaushik, "Artificial Intelligence", Cengage Learning India, 2011
2. David Poole and Alan Mackworth, "Artificial Intelligence: Foundations for Computational Agents", Cambridge University Press 2010.
3. Trivedi, M.C., "A Classical Approach to Artifical Intelligence", Khanna Publishing House, Delhi.

Course code	Course Title	L	T	P	Credits
R23CIT-PC3104	Computer Networks Lab	3	0	0	3

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
- Undesrstand 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

Week 4

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.

Week 5

A).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.

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**):**

COs	**PO 1**	**PO 2**	**PO3**	**PO4**	**PO5**	**PO 6**	**PO 7**	**PO 8**	**PO9**	**PO10**	**PO11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO3**
CO1	3	3	3	3	3				3					3	3
CO2	3	3	3	3	3				3					3	3
CO3	3	3	3	2	2				3					3	3
CO4	3	3	3	2	3				3					3	3
CO5	3	3	3	2	3				3					3	3
CO*	3	3	3	2	3				3					3	3

** For Entire Course, PO & PSO Mapping*

Course code	Course Title	L	T	P	Credits
R23CIT-PC3105	Data Mining Lab	3	0	0	3

Course Objective:

- 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 dimensions.

(b).Write a Program to perform the various operations on matrices.

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.

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.

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.

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.

WEEK-7 : **Implement linear regression using**
python 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

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.

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

WEEK-11 : Partition based Clustering Libraries: Pandas, NumPy, Sklearn, Seaborn, Matplotlib Implement K-means clustering using algorithm On any dataset .

WEEK-12 : Implement DBSCAN Clustering Algorithm using Python libraries.
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 code	Course Title	L	T	P	Credits
R23CIT-SC3101	Angular JS **(Skill Oriented 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

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.

UNIT 2

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.

UNIT 3

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

UNIT 4

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.

UNIT 5

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

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 Ka

Course code	Course Title	L	T	P	Credits
R23CIT-ES3101	Tinkering Lab	3	0	0	3

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 Door lock System
- Hand gesture recognition
- Text to speech
- Smart City
- Private chatroom
- Android app controlled robotic arm
- Smart Traffic System
- Vehicle Accident Alam 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.

Unit I:

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, **Proofreading 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.

Unit II:

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 formal 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.

Unit III:

Mastering Interview Skills
Purpose of Interviews: Understand recruiter expectations, align personal goals, skills, and achievements.
Interview Preparation: Pre-interview research, behaviour, 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.

Unit IV:

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 workplace 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, workplace 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.

Unit V:

English for Abroad Education

Introduction to Studying Abroad: Overview of global education systems and Admission Process, Research and University Selection:H ow 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 SkillsTypes 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.

III Year II Semester						
S.No	**Course Code**	**Course Name**	**L**	**T**	**P**	**Credits**
1.	R23CIT-PC3201	Software Engineering & Object-Oriented Analysis and Design	3	0	0	3
2.	R23CIT-PC3202	Cryptography and Network Security	3	0	0	3
3.	R23CIT-PC3203	Machine Learning	3	0	0	3
4.		**Professional Elective-II**	3	0	0	3
	R23CIT-PE3201.1	1. Design and Analysis of Algorithms				
	R23CIT-PE3201.2	2. Mobile Computing				
	R23CIT-PE3201.3	3. E-Commerce				
5.		**Professional Elective-III**	3	0	0	3
	R23CIT-PE3202.1	1. Distributed Systems				
	R23CIT-PE3202.2	2. Advanced Computer Networks				
	R23CIT-PE3202.3	3. Cloud Computing				
6.	R23CIT-OE3201	**Open Elective - II**	3	0	0	3
7.	R23CIT-PC3204	Software Engineering & Object-Oriented Analysis and Design Lab	0	0	3	1.5
8.	R23CIT-PC3205	Machine Learning Lab	0	0	3	1.5
9.	R23CIT-SC3201	Node Express JS (Skill Oriented Course)	0	1	2	2
10.	R23CIT-MC3201	Technical Paper Writing & IPR (Mandatory Course)	2	0	0	0
Total			**20**	**1**	**8**	**23**
Honor Course-3/Minor Course-3						
Summer Internship (During the Summer Vacation after Third Year & Evaluated in IV-I Semester)						

B.Tech III Year - II Semester

Course code	Course Title	L	T	P	Credits
R23CIT-PC3201	Software Engineering & Object Oriented Analysis Design	3	0	0	3

Course Objectives:

- Explain the phases of Software Development.
- Teach the customer requirement gathering techniques.
- Demonstrate coding standards
- Introducing the Unified Process and showing how UML can be used within the process.
- Case study experience with architecture, analysis and design.
- Programmatic interactions using UML diagrams.
- Analyze and design solutions to problems using object-oriented approach

Course outcomes: Students will be able to:

1. Understand the need of Software Life Cycle Models (L1)
2. Demonstrate the Requirements of the Software Systems process (L2)
3. Analyze various testing techniques, Risk management and Software quality of the software products(L4)
4. Create class diagrams that model both the domain model and design model of a software system.
5. Analyzed the conceptual model of UML.
6. Create interaction diagrams and other diagrams that model the dynamic aspects of a software system.
7. Detailed case study experience with architecture, analysis and design.

UNIT-1

Introduction: Introduction to Software Engineering, Evolving role of Software, Software Crisis, Changing Nature of Software, Software myths, Process Models for Software Development, Waterfall, Prototyping Evolutionary models: Incremental model, Spiral model, Agile developmental process.

UNIT-2

Software Requirements Engineering: Requirements Gathering and Requirements Analysis, Functional & Non-functional requirements, Feasibility studies, Requirements Elicitation and Analysis, Requirements Verification, Requirements validation, Software Requirements Specification(SRS), Golden rules.

UNIT-3

Coding & Testing: Coding standards, Code Review and Verification, Testing levels: Unit testing, integration testing, System testing – alpha and beta testing, Black box and White box testing, Risk Types, Software Quality –McCall Quality factors, Software Maintenance.

UNIT-4

Introduction to UML: Why we model, Conceptual Model of UML, Architecture, Introduction to Iterative Development, & Unified Model Process, Case Study of RUP Next Gen POS System, The FURPS model.

Basic Behavioral Modeling: Use Case Diagram, Relationships among Use-Cases, Class Diagram, Sequence Diagram, Interaction diagrams, Activity Diagrams.

UNIT-5

Advanced Behavioral Modeling: Events and signals, state machines, Processes and Threads, State Chart diagrams, Understanding the Use Case Models, Use Cases types and formats and writing use cases.

Architectural Modeling: Component, Deployment, Component diagrams and Deployment diagrams.

Case Study: The NEXT GEN POS SYSTEM.

Text books:

1. Roger S. Pressman, Software Engineering, A practitioner's Approach, 7thEdition, McGraw- Hill International Edition, 2009.
2. Rajib Mal, Fundamentals of software Engineering, 3rdEdition, Eastern Economy Edition, 2009.
3. "Object- Oriented Analysis And Design with Applications", Grady BOOCH, Robert A. Maksimchuk, Michael W. ENGLE, Bobbi J. Young, Jim Conallen, Kellia Houston, 3rd edition, 2013, PEARSON.
4. "The Unified Modeling Language User Guide", Grady Booch, James Rumbaugh, Ivar Jacobson, 12th Impression, 2012, PEARSON.
5. Applying UML and Patterns by Craig Larman , Pearson.

Reference books:

1. Sommerville, Software Engineering, 7thEdition, Pearson education, 2004
2. K KAggarwal and Yogeshsingh, Software engineering,3rd Edition,New age International publication,2008
3. "Object-oriented analysis and design using UML", Mahesh P. Matha, PHI
4. "Head first object-oriented analysis and design", Brett D. McLaughlin, Gary Pollice, Dave West, OReilly .
5. "Object-oriented analysis and design with the Unified process", John W. Satzinger, Robert B. Jackson, Stephen D. Burd, Cengage Learning.

B.Tech III Year - II Semester

Subject Code	Subject Name	L	T	P	C
R23CIT-PC3202	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

UNIT- II

Symmetric Encryption Mathematics of Symmetric Key Cryptography, Introduction to Modern Symmetric Key Ciphers, Data Encryption Standard, Advanced Encryption Standard.

UNIT- III

Asymmetric Encryption Mathematics of Asymmetric Key Cryptography, Asymmetric Key Cryptography

UNIT- IV

Data Integrity, Digital Signature Schemes & Key Management Message Integrity and Message Authentication, Cryptographic Hash Functions, Digital Signature, Key Management.

UNIT -V

Network Security: Security at application layer: PGP and S/MIME, Security at the Transport Layer: SSL and TLS, IPSec, System Security.

Text Books:

1. Cryptography and Network Security, Behrouz A Forouzan, Debdeep Mukhopadhyay, (3e) Mc Graw Hill.
2. Cryptography and Network Security, William Stallings, (6e) Pearson.
3. Everyday Cryptography, Keith M.Martin, Oxford.

Reference Books:

1. Network Security and Cryptography, Bernard Meneges, Cengage Learning

B.Tech III Year - II Semester

Course code	Course Title	L	T	P	Credits
R23CIT-PC3203	Machine Learning	3	0	0	3

Course Objectives: The objectives of the course is to

- Define machine learning and its different types (supervised and unsupervised) and understand their applications.
- Apply supervised learning algorithms including decision trees and k-nearest neighbours (k-NN).
- Implement unsupervised learning techniques, such as K-means clustering.

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

1. Understand different types of machine learning algorithms.
2. Apply classification algorithms and regression algorithms.
3. Apply decision tree algorithms for classification and regression algorithms.
4. Apply supervised machine learning algorithms.
5. Apply Unsupervised machine learning algorithms.

UNIT-I

Introduction to Machine Learning: Evolution of Machine Learning, Paradigms for ML, Learning by Rote, Learning by Induction, Reinforcement Learning, Types of Data, Matching, Stages in Machine Learning, Data Acquisition, Feature Engineering, Data Representation, Model Selection, Model Learning, Model Evaluation, Model Prediction, Search and Learning, Data Sets.

UNIT-II

Nearest Neighbour-Based Models: Introduction to Proximity Measures, Distance Measures, Non-Metric Similarity Functions, Proximity Between Binary Patterns, Different Classification Algorithms Based on the Distance Measures, K-Nearest Neighbour Classifier, Radius Distance Nearest Neighbour Algorithm, KNN Regression, Performance of Classifiers, Performance of Regression Algorithms.

UNIT-III

Models Based on Decision Trees: Decision Trees for Classification, Impurity Measures, Properties, Regression Based on Decision Trees, Bias–Variance Trade-off, Random Forests for Classification and Regression.

The Bayes Classifier: Introduction to the Bayes Classifier, Bayes' Rule and Inference, The Bayes Classifier and its Optimality, Multi-Class Classification | Class Conditional Independence and Naive Bayes Classifier (NBC)

UNIT-IV

Linear Discriminants for Machine Learning: Introduction to Linear Discriminants, Linear Discriminants for Classification, Perceptron Classifier, Perceptron Learning Algorithm, Support Vector Machines, Linearly Non-Separable Case, Non-linear SVM, Kernel Trick, Logistic Regression, Linear Regression, Multi-Layer Perceptron's (MLPs), Backpropagation for Training an MLP.

UNIT-V

Clustering: Introduction to Clustering, Partitioning of Data, Matrix Factorization | Clustering of Patterns, Divisive Clustering, Agglomerative Clustering, Partitional Clustering, K-Means Clustering, Soft Partitioning, Soft Clustering, Fuzzy C-Means Clustering, Rough Clustering, Rough K-Means Clustering Algorithm, Expectation Maximization-Based Clustering, Spectral Clustering.

Text Books:

1. "Machine Learning Theory and Practice", M N Murthy, V S Ananthanarayana, Universities Press (India), 2024

Reference Books:

2. "Machine Learning", Tom M. Mitchell, McGraw-Hill Publication, 2017
3. "Machine Learning in Action",Peter Harrington, DreamTech
4. "Introduction to Data Mining", Pang-Ning Tan, Michel Stenbach, Vipin Kumar, 7th Edition, 2019.

B.Tech III Year - II Semester

Course code	Course Title	L	T	P	Credits
R23CIT-PE3201.1	Design and Analysis of Algorithms **(Professional Elective Courses-II)**	3	0	0	3

Course Objectives:

- Understand how the algorithm performance is measured.
- Familiarize with different algorithm design techniques like divide and conquer.
- Understand the applications of greedy method.
- Explain algorithm design techniques like dynamic programming, backtracking and branch & bound.
- Analyze the back tracking and branch and bound technique.

Course Outcomes:

1. Understand the fundamentals of algorithms.
2. Analyze the algorithms by applying the divide and conquer.
3. Analyze the algorithm using greedy method.
4. Apply and analyze different applications using dynamic programming.
5. Apply and analyze the algorithm using back tracking with branch and bound method.

UNIT I :

Introduction: Algorithm, Algorithm specification, Performance analysis, Space Complexity, Time Complexity, Asymptotic Notations, Practical Complexities

UNIT II:

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

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, The traveling salesperson problem, Reliability Design. Basic Traversal and Search Techniques: Bi-connected components and DFS

UNIT IV :

Back tracking: General Method, 8 – queens problem, Sum of subsets problem, Graph coloring and Hamiltonian cycles, Knapsack Problem

UNIT V:

Branch and Bound:The method, 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.

Text Books:

1. Ellis Horowitz, Sartaj Sahni and Rajasekaran, Fundamentals ofComputer Algorithms,2nd Edition, 2012, University Press.
2. Parag Himanshu Dave and Himanshu Bhalchandra Dave, Design and Analysis ofAlgorithms, 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 andAlgorithms”, 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.

B.Tech III Year - II Semester

Course code	Course Title	L	T	P	Credits
R23CIT-PE3201.2	Mobile Computing **(Professional Elective Courses-II)**	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.

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.

UNIT III

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

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.

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.

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. Siva Ram Murthy, B. S. Manoj, “Adhoc Wireless Networks: Architectures and Protocols”, Second Edition, Pearson Education, 2008.

B.Tech III Year - II Semester

Course code	Course Title	L	T	P	Credits
R23CIT-PE3201.3	E-Commerce **(Professional Elective Courses-II)**	**3**	**0**	**0**	**3**

Course Objectives:

- Discuss fundamentals of e-commerce, types and applications.
- Evaluate the role of the major types of information systems in a business environment and their relationship to each other.
- Assess the impact of the Internet and Internet technology on business electronic commerce and electronic business.
- Identify the major management challenges for building and using information systems and learn how to find appropriate solutions to those challenges.

Course Outcomes:

1. Understand the basic concepts and technologies used in the field of management information systems
2. Understand the processes of developing and implementing information systems
3. Understand the ethical, social, and security issues of information systems and
4. Understand the working functionalities of different gateways
5. Understand the role of information systems in organizations, the strategic management processes, and the implications for the management and learn about the importance of managing organizational change associated with information systems implementation

UNIT I

Introduction: Definition of Electronic Commerce, E-Commerce: technology and prospects, incentives for engaging in electronic commerce, needs of E-Commerce, advantages and disadvantages, framework, Impact of E-commerce on business, E-Commerce Models.

UNIT II

Approaches to Safe Electronic Commerce

Secure Transport Protocols, Secure Transactions, Secure Electronic Payment Protocol (SEPP), Secure Electronic Transaction (SET), Certificates for authentication Security on web Servers and Enterprise Networks.

UNIT III

WEB SECURITY: Security Issues on web, Importance of Firewall, components of Firewall, Transaction security, Security Threats, Network Security, Factors to consider in Firewall design, Limitation of Firewalls.

UNIT IV

ELECTRONIC PAYMENTS: Overview, The SET protocol, Payment Gateway, certificate, digital Tokens, Smart card, credit card, magnetic strip card, E-Checks, Credit/Debit card based EPS, online Banking. EDI Application in business

UNIT V

E-Mail and Secure E-mail Technologies for Electronic Commerce: The Means of Distribution, A model for Message Handling, Email working, Multipurpose Internet Mail Extensions, Message Object Security Services.

Text Books:

1. Ravi Kalakota, Andrew Winston, “Frontiers of Electronic Commerce”, Addison Wesley.

Reference Books:

1. Pete Lohsin , John Vacca “Electronic Commerce”, New Age International
2. Goel, Ritendra “E-commerce”, New Age International
3. Laudon, “E-Commerce: Business, Technology, Society”, Pearson Education
4. Bajaj and Nag, “E-Commerce the cutting edge of Business”, TMH
5. Turban, “Electronic Commerce 2004: A Managerial Perspective”, Pearson Education

B.Tech III Year - II Semester

Course code	Course Title	L	T	P	Credits
R23CIT-PE3202.1	Distributed Systems **(Professional Elective Courses-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:

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**.**

Unit 2:

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 Communication- IP Multicast- an implementation of group communication, Reliability and Ordering of Multicast.

Unit 3:

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.

Unit 4:

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

Unit 5:

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

Application:

- Internet and Web Services
- Cloud Computing
- Social Media Platforms
- Financial Systems
- Online Marketplaces

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

Textbooks:

1. Ajay D Kshemkalyani, MukeshSighal, "*Distributed Computing, Principles, Algorithms and Systems*", Cambridge.
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 & Fransis 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.

B.Tech III Year - II Semester

Course code	Course Title	L	T	P	Credits
R23CIT-PE3202.2	Advanced Computer Network **(Professional Elective Courses-III)**	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

IPv4 Addresses: Introduction - Classfull 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

Unit – II

Next Generation IP

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

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

Unit – III Unicast and Multicast Routing Protocols

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

Unit – IV:

Transport Layer Protocols

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

Unit – V

Application Layer

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 **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

B.Tech III Year - II Semester

Course code	Course Title	L	T	P	Credits
R23CIT-PE3202.3	Cloud Computing **(Professional Elective Courses-III)**	3	0	0	3

Course Objectives:

- Cloud Computing is a large-scale distributed computing paradigm which has become a driving force for information technology over the past several years.
- This course introduces cloud computing technology to undergraduate engineering students, so they can learn, apply and use this technology in their future careers.

Course Outcomes

1. Understand different computing paradigms
2. Understand the basics of cloud computing and different cloud deployment models.
3. Understand different cloud implementation and management strategies.
4. Understand different cloud service models.
5. Analyze and use different cloud services/applications/tools available from key cloud providers.

UNIT-I

Computing Paradigms: High-Performance Computing, Parallel Computing, Distributed Computing, Cluster Computing, Grid Computing, Cloud Computing, Bio computing, Mobile Computing, Quantum Computing, Optical Computing, Nano computing.

UNIT-II

Cloud Computing Fundamentals: Motivation for Cloud Computing, The Need for Cloud Computing, Defining Cloud Computing, Definition of Cloud Computing, Cloud Computing is a Service, Cloud Computing is a Platform, Principles of Cloud computing, Five Essential Characteristics, Four Cloud Deployment Models

UNIT-III

Cloud Computing Architecture and Management: Cloud architecture, Layer, Anatomy of the Cloud, Network Connectivity in Cloud Computing, Applications on the Cloud, Managing the Cloud, Managing the Cloud Infrastructure, Managing the Cloud Application, Migrating Application to Cloud, Phases of Cloud Migration Approaches for Cloud Migration.

UNIT-IV

Cloud Service Models: Infrastructure as a Service, Characteristics of IaaS. Suitability of IaaS, Pros and Cons of IaaS, Platform as a Service, Characteristics of PaaS, Suitability of PaaS, Pros and Cons of PaaS, Software as a Service, Characteristics of SaaS, Suitability of SaaS, Pros and Cons of SaaS, Other Cloud Service Models.

UNIT-V

Cloud Providers and Applications: EMC, EMC IT, Captiva Cloud Toolkit, Google Cloud Platform, Cloud Storage, Google Cloud Connect, Google Cloud Print, Google App Engine, Amazon Web Services, Amazon Elastic Compute Cloud, Amazon Simple Storage Service, Amazon Simple Queue service, Microsoft, Windows Azure**.**

Text Book:

1. Essentials of Cloud Computing, K. Chandrasekhran, CRC press.

Reference Books:

1. Cloud Computing: Principles and Paradigms, Rajkumar Buyya, James Broberg and Andrzej M. Goscinski, Wiley.
2. Distributed and Cloud Computing, Kai Hwang, Geoffery C. Fox, Jack J. Dongarra, Elsevier.
3. Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance, Tim Mather, SubraKumaraswamy, ShahedLatif, O'Reilly.

B.Tech III Year - II Semester

Course code	Course Title	L	T	P	Credits
R23CIT-PC3204	Software Engineering & Object Oriented Analysis & Design Lab	0	0	3	1.5

Course Objectives:

- To have hands on experience in developing a software project by using various software engineering principles and methods in each of the phases of software development.

Course Outcomes:

1. Design SRS documents for the software projects.
2. Design classes diagrams for the software projects
3. Design use case diagrams for the software projects
4. Design flow diagrams for the software projects
5. Design test for the software projects.

List of Experiments

Do the following 8 exercises for any two projects given in the list of sample projects or any other projects:

1. Development of problem statement.
2. Preparation of Software Requirement Specification Document.
3. Develop test cases for unit testing and integration testing.
4. Identify and analyze events& domain cases.
5. Identify Use-Cases.
6. Develop Use-Case Diagram, Class Diagram, Sequence Diagram, State Chart Diagram, Activity Diagram.

Sample Projects:

1. Passport automation System
2. Book Bank
3. Online Exam Registration
4. Stock Maintenance System
5. ATM
6. E-ticketing
7. Software Personnel Management System
8. Credit Card Processing
9. Point of Sale
10. Library Management System.

Text Books:

1. Software Engineering, A practitioner.s Approach- Roger S. Pressman, 6th edition, Mc Graw Hill International Edition.
2. Software Engineering- Sommerville, 7th edition, Pearson Education.
3. The unified modeling language user guide Grady Booch, James Rambaugh, Ivar Jacobson, Pearson Education.
4. Applying UML and Patterns by Craig Larman Pearson.
5. ”Object Oriented analysis and design with the Unified Process by Satzinger, Jackson&Burd Cengage Learning.

B.Tech III Year - II Semester

Course Code	Course Name	L	T	P	Credits
R23CIT-PC3205	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. Attribute selection, Handling Missing Values, Discretization, 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

B.Tech III Year - II Semester

Course code	Course Title	L	T	P	Credits
R23CIT-SC3201	Node Express JS **(Skill Oriented Course)**	0	1	2	2

Course Objectives:

- To understand the Node's Web Server Development.
- To understand npm and Node JS Modules.
- To create Node JS applications using Express.JS.
- Toc deploy Node JS applications.

Course Outcomes:

1. Understand the Node's unique approach to asynchronous development.
2. Understand the Node Package Manager (npm) and Modules.
3. Implement Node JS applications with the Express framework and Connect Middleware.
4. Learn in-depth practices for debugging and testing Node JS applications.
5. Deploy Node JS applications in the cloud or on your own system.

UNIT 1

Node JS – Introduction, What is Node JS? Advantages of Node JS, Traditional Web Server Model, Node.js Process Model.

Setup Dev Environment: Install Node.json Windows/Linux, Working in REPL, Node JS Console.

UNIT 2

Node JS Modules: Functions, Buffer, Module, Module Types, Core Modules, Local Modules, Module. Exports, **Node Package Manager:** What is NPM? Installing Packages Locally. Adding the dependency in package.json, Installing packages globally, Updating packages. **Web server:** Creating web server, Handling HTTP requests, Sending requests

UNIT 3

File System: Synchronous vs Asynchronous, Open a File, Get File Information, Writing a File, Reading a File, Closing a File, Delete a File, Other IO Operations. **Callbacks:** What is Callback? Blocking Code Example, Non-Blocking Code. **Events:** Event Emitter Class, Methods, Events, Returning event emitter,
Inhering events.

UNIT 4

Express.JS: Configuring routes, Working with express, **Serving Static Resources:** Serving static files, Working with middleware. **Debugging Node JS Application:** Core Node JS debugger. Debugging with Visual Studio.

UNIT 5

Database Connectivity: Introduction to MongoDb, Connecting Node.Js to Database, Connection string, Configuring, working with the select command, updating records, deleting records, Creating Rest APIs.

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:

1. Node JS Book: Learning Node by Shelley Powers, O'Reilly.
2. Learning Node.js Development: Learn the fundamentals of Node.js, and deploy and test Node.js applications on the web By Andrew Mead, Packt

Reference Books:

1. Mastering Node.js: Build robust and scalable real-time server-side web applications efficiently, Second Edition, Packt

B.Tech III Year - II Semester

Course code	Course Title	L	T	P	Credits
R23CIT-MC3201	Technical Paper Writing & IPR (Mandatory Course)	2	0	0	0

Course Objectives:

- Build the knowledge on principles and characteristic soft technical writing, including clarity, conciseness, and precision. (L2)
- Formulate clear and focused research objectives and research proposal(L2)
- Outline the significance of Intellectual Properity Rights(L2)
- Provide knowledge of Copy right and patent law, registration process and grants, protects in India and abroad.(L3)
- Assessandmaintaintheprotectionoftrademarkandtradesecretintheorganisation and also emerging trends in cyber security (L2)

Course Outcomes:

- Develop the technical writing skills, evaluate sources and properly cite references using appropriate citation styles.(L3)
- Constructclearandfocusedresearchproposalthataddressaspecificgapintheadvance mento fknowledge in their field of study.(L3)
- Assess needful elements, agencies responsible for Registration of IPR elements(L3)
- Analyze Copy right subject matters, Patent requirements, Infringement and Litigation.(L3)
- Outline the registration Processes of Trade Mark and Legal procedure stop revent cyber crimes.(L2)

UNIT-I:

Introduction To Technica Lpaper 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

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

UNIT-II:

Information and Communication of Technical paper writing: 7C'soft technicall writing- Difference between technical writer and technical editor-Lega land ethical communication and its description in technical paper-Usage of contemporary technologies in technical paper writing

Application: Analyse accurate in formation forehical decision making process.

UNIT-III:

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

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

UNIT-IV:

Copyrights and Patents: Introduction to Copyrights– Principles of Copyright 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.

Application:

- Practice of copyrights case and Identification of the in fringement.
- Checking the eligibility for several patents and suggest remedies for problems through case study.

UNIT-V:

Trademarks, Trade secrets and Cybercrimes: Introduction to Trade marks– 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.

Application:

- Compare and contrast different trademarks and know how to register trade mark
- Identify the physical protection of trade secret.
- Detect various cyber crimes protection in the society.

Contemporary Practices:

- E-filing Applications
- Digital Piracy

Text Books:

1. Fundamentals of IPR for Engineers- Kompal Bansal & ParishitBansal, B.S.Publications, first edition. 2013
2. Research Methodology-C.R.Kothari, GauravGarg, NEWAGE International Publishers, 4th edition, 2019.
3. Developing Research Proposals (Paperback-2023), PamDenicolo, Sage Publications, first edition, 2023
4. Intellectual Property- DeborahE.Bouchoux, Cengage Learning, New Delhi., 4th edition, 2012
5. V.Scople Vinod, Managing Intellectual Property ,Prentice Hall of India pv tLtd, 2nd edition, 2012
6. Essentials of Technical Communication- Elizabeth Tableaux SamDragga, Oxford University Press, 4th edition, 2017.

References Books:

1. Intellectual property rights- PrabuddhaGanuli. TataMcgrawhill, 2012.
2. Intellectual property rights M.Ashok kumar and Mohd.IqbalAli:,Serials Publications,2015
3. Developing Research Proposals- English, Paper back, DenicoloPam, Sage South Asia edition,2012
4. Intellectual Property Rights (Patents&CyberLaw), 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, EssEss

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/

R23_ CSIT (Honors)

Track-I(Data Science)							
S.No	**Year & Semester**	**Course Code**	**Subject title**	**L**	**T**	**P**	**C**
1	II-II	R23CIT-HN2201	Introduction to Data Science	3	0	0	3
2	**III-I**	**R23CIT-HN3101**	**Data Analysis and Visualization**	**3**	**0**	**0**	**3**
3	**III-II**	**R23CIT-HN3201**	**Advanced Data Analysis Techniques**	**3**	**0**	**0**	**3**
4	IV-I	R23CIT-HN4101	Applied Data Science Projects and Specializations	3	0	0	3
5	II Year to IV Year	R23CIT-HM0001	Honors MOOCS-1	0	0	0	3
6	II Year to IV Year	R23CIT-HM0002	Honors MOOCS-2	0	0	0	3
Total							**18**

Track-II (Ethical Hacking)							
S. No	**Year & Semester**	**Course Code**	**Subject title**	**L**	**T**	**P**	**C**
1	II-II	R23CIT-HN2202	Fundamentals of Ethical Hacking	3	0	0	3
2	**III-I**	**R23CIT-HN3102**	**Network Penetration Testing**	**3**	**0**	**0**	**3**
3	**III-II**	**R23CIT-HN3202**	**Web Application Penetration Testing**	**3**	**0**	**0**	**3**
4	IV-I	R23CIT-HN4102	Wireless Network Penetration Testing	3	0	0	3
5	II Year to IV Year	R23CIT-HM0001	Honors MOOCS-1	0	0	0	3
6	II Year to IV Year	R23CIT-HM0002	Honors MOOCS-2	0	0	0	3
Total							**18**

Track-III(Security)							
S.No	**Year & Semester**	**Course Code**	**Subject title**	**L**	**T**	**P**	**C**
1	II-II	R23CIT-HN2203	Cyber Security	3	0	0	3
2	**III-I**	**R23CIT-HN3103**	**Secure Coding**	**3**	**0**	**0**	**3**
3	**III-II**	**R23CIT-HN3203**	**Vulnerability Assessment & Penetration Testing**	**3**	**0**	**0**	**3**
4	IV-I	R23CIT-HN4103	Malware Analysis	3	0	0	3
5	II Year to IV Year	R23CIT-HM0001	Honors MOOCS-1	0	0	0	3
6	II Year to IV Year	R23CIT-HM0002	Honors MOOCS-2	0	0	0	3
Total							**18**

Track-IV(Networks)							
S.No	**Year & Semester**	**Course Code**	**Subject title**	**L**	**T**	**P**	**C**
1	II-II	R23CIT-HN2204	Introduction to Networks	3	0	0	3
2	**III-I**	**R23CIT-HN3104**	**Switching, Routing, and Wireless Essentials**	**3**	**0**	**0**	**3**
3	**III-II**	**R23CIT-HN3204**	**Enterprise Networking, Security, and Automation**	**3**	**0**	**0**	**3**
4	IV-I	R23CIT-HN4104	Wireless Sensor Networks	3	0	0	3
5	II Year to IV Year	R23CIT-HM0001	Honors MOOCS-1	0	0	0	3
6	II Year to IV Year	R23CIT-HM0002	Honors MOOCS-2	0	0	0	3
Total							**18**

B.Tech III Year -HONORS Courses

Course code	Course Title	L	T	P	Credits
R23CIT-HN3101	Data Analysis and Visualization Honors Course(Track-1)	3	0	0	3

Course Objectives: Understand the network architecture and applications.

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

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

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

Unit I

Introduction to Data and Pre-processing:

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

Learning Outcomes: Student will be able to

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

Lab 1: Data Cleaning using Pandas

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

Lab 2: Data Transformation Techniques

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

Unit II

Exploratory Data Analysis (EDA)

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

Learning Outcomes: Student will be able to

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

Lab 1: Statistical Summary and Correlation Matrix

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

Lab 2: Outlier Detection using Boxplots

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

Unit III

Data Visualization Techniques:

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

Learning Outcomes: Student will be able to

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

Lab 1: Creating Basic Charts

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

Lab 2: Advanced Plots and Plot Customization

- **Question**:
  Create scatter plots and heatmaps to show relationships between variables. Customize the plots with labels, grids, and color palettes.
- **Tool**: Python (Seaborn)

- **Expected Outcome**: Students will gain skills in producing attractive and informative visualizations.

UNIT-IV

Dashboard Design and Interactive Visualization:

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

Learning Outcomes: Student will be able to

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

Lab 1: Interactive Dashboard with Tableau Public

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

Lab 2: Dashboard in Power BI Desktop

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

UNIT-V

Real-World Data Analysis and Project:

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

Learning Outcomes: Student will be able to

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

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

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

Lab 2: Presentation and Insight Communication

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

Text Books:

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

References:

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

COURSE 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
CO1	3	3	2	1	1			1					1	2	
CO2	3	3	2	2	1			1					1	2	
CO3	3	3	2	1	1			1					2	2	
CO4	3	3	2	1	1			1					1	2	
CO5	3	3	2	2	1			1					1	2	
CO*	3	3	2	1	1			1					1	2	

Course code	Course Title	L	T	P	Credits
R23CIT-HN3201	Advanced Data Analysis Techniques Honors Course (Track-1)	3	0	0	3

Course Objectives:

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

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

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

UNIT I

Advanced Statistical Analysis and Data Preparation

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

Learning Outcome:

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

Lab Programs

Lab 1: *Multivariate Data Exploration and Outlier Detection*

Tool: Python (Pandas, Seaborn, SciPy)

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

Lab 2: *Feature Transformation and Selection*

Tool: Python (Scikit-learn)

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

UNIT II

Dimensionality Reduction and Clustering Techniques

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

Learning Outcome:

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

Lab Programs

Lab 1: *Dimensionality Reduction with PCA and t-SNE*
Tool: Python (Scikit-learn, Matplotlib)
Task: Reduce dimensions of a high-dimensional dataset and visualize using PCA and t-SNE.
Lab 2: *Clustering with K-means and Evaluation*
Tool: Python or Orange Data Mining
Task: Apply K-means and hierarchical clustering and evaluate using silhouette score and inertia.

UNIT III

Predictive Modeling and Regression Techniques

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

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

Lab Programs

Lab 1: *Regularized Regression (Lasso and Ridge)*
Tool: Python (Scikit-learn)
Task: Fit Lasso and Ridge regression models and compare their performance on multicollinear data.

Lab 2: *Random Forest for Classification*
Tool: R (randomForest package) or Python
Task: Train a random forest classifier and interpret feature importance

UNIT IV

Time Series and Text Data Analysis

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

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

Lab Programs

Lab 1: *Time Series Forecasting with ARIMA*
Tool: Python (statsmodels, Pand as)
Task: Perform trend and seasonality analysis and build a forecasting model using ARIMA.
Lab 2: *Sentiment Analysis using TF-IDF and Logistic Regression*
Tool: Python (NLTK, Scikit-learn)
Task: Preprocess text, vectorize with TF-IDF, and classify sentiments using logistic regression.

UNIT V

Model Evaluation, Interpretation, and Applications

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

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

Lab Programs

Lab 1: *Model Evaluation using Cross-validation and ROC Curves*
Tool: Python (Scikit-learn, Matplotlib)
Task: Apply k-fold cross-validation and plot ROC-AUC for multiple classifiers.

Lab 2: *Explainable Machine Learning with SHAP or LIME*
Tool: SHAP or LIME libraries in Python
Task: Use SHAP or LIME to interpret a black-box classifier's predictions on a real dataset.

Textbooks:

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

Reference Books:

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

COURSE 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
CO1	3	3	2	1	1			1					1	2	
CO2	3	3	2	1	2			1					1	2	
CO3	3	3	2	1	1			1					1	2	
CO4	3	3	2	1	2			1					1	2	
CO5	3	3	2	1	1			1					1	2	
CO*	3	3	2	1	1			1					1	2	

Course code	Course Title	L	T	P	Credits
R23CIT-HN3102	Network Penetration Testing Honors Course(Track-2)	3	0	0	3

Course Objectives: Understand the network architecture and applications.

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

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

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

Unit I

Introduction to Penetration Testing:

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

Learning Outcomes: Student will be able to

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

Lab 1: Setting Up a Penetration Testing Lab

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

Lab 2: Foot printing and Target Profiling

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

Unit II

Scanning and Enumeration:

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

Learning Outcomes: Student will be able to

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

Lab 1: Port Scanning with Nmap

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

Lab 2: Service Enumeration and OS Fingerprinting

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

Unit III

Vulnerability Analysis and Exploitation**:**

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

Learning Outcomes: Student will be able to

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

Lab 1: Vulnerability Scanning using OpenVAS or Nessus

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

Lab 2: Exploitation using Metasploit Framework

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

UNIT-IV

Web Application Penetration Testing**:**

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

Learning Outcomes: Student will be able to

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

Lab 1: Testing SQL Injection and XSS in DVWA

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

Lab 2: Intercepting Web Requests with Burp Suite

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

UNIT-V

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

Learning Outcomes: Student will be able to

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

Lab 1: Writing a Penetration Test Report

- **Question**:
  Prepare a detailed penetration testing report for one of your lab activities. Include executive summary, findings, impact, and recommendations.
- **Tool**: Report Template (Word/PDF)
- **Outcome**: Students will learn professional reporting and risk communication.

Lab 2: Applying Security Controls and Patching

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

Text Books:

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

References:

4. *Metasploit: The Penetration Tester's Guide – David Kennedy*
5. *Web Application Hacker's Handbook – Dafydd Stuttard, Marcus Pinto*
6. *Hacking: The Art of Exploitation – Jon Erickson*

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

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

** For Entire Course, PO & PSO Mapping*

Course code	Course Title	L	T	P	Credits
R23CIT-HN3202	Web Application Penetration Testing Honors Course(Track-2)	3	0	0	3

Course Objectives:

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

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

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

UNIT I

Introduction to Web Security and Testing Setup

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

Learning Outcome:

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

Lab Programs

Lab 1: *Set Up a Web Penetration Testing Lab Using DVWA*
Tool: DVWA (Damn Vulnerable Web Application)
Task: Install DVWA on a local server and configure security settings for different levels.
Lab 2: *Intercept and Analyze HTTP Requests*
Tool: Burp Suite Community Edition
Task: Use Burp Suite to capture and analyze web traffic between client and server.

UNIT II

Input Validation and Injection Vulnerabilities

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

Learning Outcome:

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

Lab Programs

Lab 1: *Test for SQL Injection in DVWA*
Tool: SQLMap or Burp Suite
Task: Exploit SQL injection to bypass login or extract data from the database.
Lab 2: *Perform Stored and Reflected XSS Attacks*
Tool: DVWA, Burp Suite
Task: Inject scripts in input fields to demonstrate stored and reflected XSS.

UNIT III

Authentication and Session Management Attacks

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

Learning Outcome:

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

Lab Programs

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

Tool: Hydra or Burp Suite Intruder

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

Lab 2: *Session Hijacking through Cookie Theft*

Tool: DVWA, Browser DevTools

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

UNIT IV

File Handling, Upload, and Security Misconfigurations

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

Learning Outcome:

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

Lab Programs

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

Tool: DVWA or bWAPP

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

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

Tool: bWAPP or OWASP Juice Shop

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

UNIT V

Reporting, Secure Coding, and Remediation Strategies

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

Learning Outcome:

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

Lab Programs

Lab 1: *Write a Professional Penetration Test Report*

Tool: Markdown editors or LibreOffice

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

Lab 2: *Review and Patch Insecure Code Snippets*

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

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

Textbooks:

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

Reference Books:

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

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

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

** For Entire Course, PO & PSO Mapping*

Course code	Course Title	L	T	P	Credits
R23CIT-HN3103	Secure Coding Honors Course (Track-3)	3	0	0	3

Course Objectives:

- To understand the security development process.
- Knowledge of outline of the techniques for developing a secure application.
- To handling dynamic memory management effectively.
- Knowledge on stored procedures and XSS attacks.
- 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).
- Analyze 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 Books:

1. Michael Howard, David LeBlanc, "Writing Secure Code", Microsoft Press, 2nd Edition, 2003.

Reference Books:

2. Robert C. Seacord, "Secure Coding in C and C++", Pearson Education, 2nd edition, 2013.
3. 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	**PO 1**	**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	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*

Course code	Course Title	L	T	P	Credits
R23CIT-HN3203	Vulnerability Assessment & Penetration Testing Honors Course(Track-3)	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 , 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)

Textbooks:

1. Kali Linux 2: Windows Penetration Testing, By Wolf Halton, Bo Weaver , June 2016 PacktPublishing

Reference Books:

1. Mastering Modern Web Penetration Testing By Prakhar Prasad,October 2016 PacktPublishing.
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	Course Title	L	T	P	Credits
R23CIT-HN3104	Switching, Routing and Wireless Essentials Honors Course(Track-4)	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:

1. Configuring basic VLANs on a network switch using appropriate methods (port-based, MAC-based, etc.)
2. Understanding the concepts and functionalities of Spanning Tree Protocol (STP) in preventing loops on switched networks
3. Configuring a basic DHCPv4 server to automatically assign IP addresses to network devices
4. Applying security measures to mitigate network vulnerabilities and protect sensitive data
5. 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:

1. https://itexamanswers.net/ccna-2-v7-exam-answers-switching-routing-and-wireless-essentials-v7-0- srwe.html
2. 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**):**

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
CO1	3	3	3	1	2									2	
CO2	3	3	3	1	2									2	
CO3	3	3	3	1	2									2	
CO4	3	3	3	1	2									2	
CO5	3	3	3	1	2									2	

Course code	Course Title	L	T	P	Credits
R23CIT-HN3204	Enterprise Networking, Security, and Automation Honors Course (Track-4)	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:

1. Apply the different OSPFv2 components like areas, routers, neighbors, and LSAs
2. Understand the fundamental concepts of network security, including threats, vulnerabilities, and security controls.
3. Apply the various technologies used to connect geographically dispersed locations in a WAN
4. Apply network design principles to optimize WAN performance, scalability, and security
5. 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:

Enterprise Networking, Security, and Automation Companion Guide (CCNAv7) Cisco Networking Academy ISBN-13: 978-0-13-663432-4

ISBN-10: 0-13-663432-X

References Books:

A Practical Introduction To Enterprise Network And Security Management. [2 ed.] CRC Press.

ISBN: 978-0-367-64251-8 (hbk), ISBN: 978-1-032-04802-4 (pbk), ISBN: 978-1-003-12369-9 (ebk)

Web links:

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	

R23_Open Electives Courses for CSIT

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

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

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

Offering Department: Computer Science and Engineering & Allied Branches						
S.No	**Course Code**	**Course Name**	**L**	**T**	**P**	**Credits**
1	R23CSE-OE0001	Python Programming	3	0	0	3
2	R23CSE-OE0002	Data Structures Using C	3	0	0	3
3	R23CSE-OE0003	Operating System Concepts	3	0	0	3
4	R23CSE-OE0004	Introduction to Java Programming	3	0	0	3
5	R23CSE-OE0005	Database Management Systems Concepts	3	0	0	3
6	R23CSE-OE0006	Unix & Shell Programming	3	0	0	3
7	R23CSE-OE0007	Software Engineering	3	0	0	3
8	R23CSE-OE0008	Introduction to Data mining	3	0	0	3
9	R23CSE-OE0009	Fundamentals of Web Technologies	3	0	0	3
10	R23CSE-OE0010	Fundamentals of Computer Networks	3	0	0	3
11	R23CSE-OE0011	Basics of Cloud Computing	3	0	0	3
12	R23CSE-OE0012	Introduction to Machine Learning	3	0	0	3
13	R23CSE-OE0013	Essentials of Cyber Security	3	0	0	3
14	R23CSE-OE0014	Introduction to React JS	3	0	0	3
15	R23CSE-OE0015	Deep Learning	3	0	0	3
16	R23CSE-OE0016	DevOps	3	0	0	3
17	R23CSE-OE0017	Mobile Computing	3	0	0	3
18	R23CSE-OE0018	Java Full Stack Development	3	0	0	3
19	R23CSE-OE0019	Human Computer Interface	3	0	0	3
20	R23CSE-OE0020	Cryptography and Network Security	3	0	0	3
21	R23CSE-OE0021	Quantum Computing	3	0	0	3
22	R23CSE-OE0022	Big data Analytics	3	0	0	3
23	R23CSE-OE0023	Block Chain Technology	3	0	0	3
24	R23CSE-OE0024	Multimedia Application Development	3	0	0	3
25	R23CSE-OE0025	Mobile Adhoc Networks	3	0	0	3
26	R23CSS-OE0001	Operating Systems	3	0	0	3
27	R23CSS-OE0002	Redhat Linux	3	0	0	3
28	R23CSS-OE0003	Cloud Computing	3	0	0	3
29	R23CSS-OE0004	Distributed Operating System	3	0	0	3
30	R23CSM-OE0001	An Introduction to Artificial Intelligence	3	0	0	3
31	R23CSM-OE0002	Introduction to Machine Learning with Python	3	0	0	3
32	R23CSM-OE0003	Foundation of Deep Learning for Engineering Applications	3	0	0	3
33	R23CSM-OE0004	Natural Language Processing- Frontiers Approach	3	0	0	3

OPEN ELECTIVES

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

Course Objectives:

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

Course Outcomes:

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

UNIT – I

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

UNIT – II

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

UNIT – III

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

UNIT – IV

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

UNIT – V

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

Textbooks

1. Simon Haykin, Communication Systems, Wiley.
2. B.P. Lathi, Modern Digital and Analog Communication Systems, Oxford University Press.
3. Sanjay Sharma, Communication Systems, S.K. Kataria & Sons. (Indian Author)

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. Desing 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 serverintroduction, 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. OvidiuVermesan,PeterFriess, IoT-From Research and Innovation to Market deployment, River Publishers

Reference Books:

1. Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand, StamatisKarnouskos, 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. Inference 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 acquifer – 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 coasting 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
2. Management", Khanna Publishers, 1988.
3. 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

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 [2x n] and [mx2] 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

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 RapidTooling, D.T. Pham, S.S. Dimov, Springer.
3. Rapid Prototyping: Principles and Applications in Manufacturing, Rafiq Noorani, John Wiley &Sons.

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

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/- Inspection and Quality controlmanufacturing.
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

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 of 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/

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

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 (FEM), 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

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.

Course Code	Subject Name	L	T	P	C
R23CSE-OE0001	**PYTHON PROGRAMMING**	3	0	0	3

Course Objectives:

- Understand the structure and data types of Python script.
- Implement iterations and functions in Python.
- Implement modules and understand packages.
- Implement data structures using mutable & immutable objects.
- Understand object-oriented concepts and Exception handling.

Course Outcomes:

- Implement Basic Python programming Fundamentals for Computation of Expression [L3]
- Apply Iterators and functions in data processing.[L3]
- Understand modules and packages to leverage powerful libraries for data science tasks.[L2]
- Implement sequences and data structures for data organization.[L3]
- Implement object-oriented principles in Python, handling run-time errors.[L3]

Unit I: **Hours:10**

Introduction: History of Python, Features of Python, Applications, Python Using the REPL (Shell), Running Python Scripts, Variables, Assignment forms, Keywords, Input-Output, Indentation.

Operators and Type Conversion: Data Types: Numeric, Booleans, Sequence, Strings, Type Conversions, Operators, Operator Precedence, Evaluation of Expressions.

Learning Outcomes: After completing this chapter, students will be able to

- Understand the environment of Python. (L2)
- Write and run simple scripts in Python. (L3)
- Implement Type conversion techniques. (L3)

Unit II: **Hours:10**

Control Flow: Conditional statements (if, else, elif), Looping structures (for, while, for-else, while-else)Transfer Control Statements**:** break, continue, pass.

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

Learning Outcomes: After completing this chapter, students will be able to

- Understand the iterations using looping structures.(L2)
- Implement Python functions.(L3)

Unit III: **Hours:9**

Modules: Creating modules, import statement, from import statement, namespace, built-in modules- OS, random, Math, JSON, request, date, RegEx, itertools

Packages: Introduction to PIP**,** Installing packages using PIP.

Exploring Data Science Libraries: NumPy, Pandas,Data visualization: Matplotlib

Learning Outcomes: After completing this chapter, student will be able to

- Understand modules (L2)
- Understand data science libraries.(L2)

Unit IV: **Hours:10**

Strings & Data Structures: String**,** String Formatting**,** List, String and List Slicing, Tuple, Sets, Frozen Sets, Dictionaries, Comprehensions, Built-in methods of all sequences, File Handling: Reading and writing files,File modes and file objects

Learning Outcomes: After completing this chapter, student will be able to

- Implement different data structures in Python.(L3)
- Understand different file handling Operations.(L2)

Unit V: **Hours:09**

Object Oriented Programming OOP in Python: Classes, 'self- variable', Methods, Constructor, Inheritance, Polymorphism, and Data Abstraction.

Errors and Exceptions: Syntax Errors, Exceptions, Exception Handlers, Raising Exceptions, User-defined Exceptions.

Learning Outcomes: After completing this chapter, student will be able to

- Understand Object oriented concepts with real world scenarios.(L2)
- Implement exceptions in Python.(L3)

TEXT BOOKS:

1. Let Us Python by Yashavant Kanetkar ,Aditya Kanetkar ,6th edition, BPB Publication
2. Python Programming: Using Problem Solving Approach by Reema Theraja, 2nd edition, Oxford publications.

REFERENCE BOOKS:

1. Python Programming: A Modern Approach, Vamsi Kurama, Pearson.
2. Learning Python, Mark Lutz, Orielly.
3. Python Programming, S Sridhar, J Indumathi, V M Hariharan, 2nd Edition, Pearson, 2024

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

COs	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO11	PO12	PSO1	PSO2	PSO3
	3	2	2	2	3				3			1	2	3	3
	3	3	2	2	3				3			1	2	3	3
	3	3	2	2	3				3			1	2	3	3
	3	3	3	2	3				3			1	2	3	3
	3	3	3	3	3				3			1	2	2	3
	3	3	3	2	3				3			1	2	3	3

** For Entire Course, PO & PSO Mapping*

Course Code	Subject Name	L	T	P	C
R23CSE-OE0002	**DATA STRUCTURES USING C**	3	0	0	3

Course Objectives:

1. To teach efficient storage mechanisms of data for an easy access.
2. To develop application using data structures.
3. To improve the logical ability

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

1. Compare the performances of various Searching and Sorting techniques in terms of time and space complexities.
2. Illustrate the applications of Stacks.
3. Implement various types of Queues and their efficient operations.
4. Demonstrate the advantages of dynamic memory allocation via linked lists.
5. Implement the basic operations, search and traversals on Trees.

UNIT-I

Time and space complexity, Data Structures – Introduction to Data Structures, abstract data types, Searching and Sorting – Sorting- selection sort, bubble sort, insertion sort, quick sort, merge sort, shell sort, radix sort, Searching-linear and binary search methods, comparison of sorting and searching methods.

UNIT –II

Linear list – singly linked list implementation, insertion, deletion and searching operations on linear list, circular linked list implementation, Double linked list implementation, insertion, deletion and searching operations. Applications of linked lists.

UNIT-III

Stacks-Operations, array and linked representations of stacks, stack applications -infix to postfix conversion, postfix expression evaluation, recursion implementation.

UNIT-IV

Queues-operations, array, and linked representations. Circular Queue operations, Dequeues, applications of queues.

UNIT-V

Trees – Definitions, tree representation, properties of trees, Binary tree, Binary tree representation, binary tree properties, binary tree traversals, binary tree implementation, applications of trees.

Text Books:

1. Fundamentals of Data structures in C, 2nd Edition, E.Horowitz, S.Sahniand Susan Anderson-Freed, Universities Press, 2008.
2. Data structures A Programming Approach with C, 2nd Edition D.S.Kushwaha and A.K.Misra, PHI, 2007.

References:

1. Data structures: A Pseudocode Approach with C, 2nd edition, R.F.GilbergAndB.A.Forouzan, CengageLearning.
2. Data structures and Algorithm Analysis in C, 2nd edition, M.A.Weiss, Pearson.
3. Data Structures using C& C ++,2nd Edition A.M.Tanenbaum,Y. Langsam, M.J.Augenstein, Pearson.
4. Data structures and Program Design in C, 2nd edition, R.Kruse, C.L.TondoandB.Leung,Pearson

Course Code	Subject Name	L	T	P	C
R23CSE-OE0003	**OPERATING SYSTEM CONCEPTS**	3	0	0	3

Course Objectives

1. Provide knowledge about the services rendered by operating systems.
2. Present detail discussion on processes, threads and scheduling algorithms.
3. Discuss various file-system implementation issues and memory management techniques.

Course Outcomes:

1. Understand the importance of operating systems and different types of system calls.
2. Analyze the communication between processes and various process scheduling algorithms.
3. Understand the process synchronization, different ways for deadlocks handling.
4. Analyze various memory mapping techniques and different page replacement methods.
5. Evaluate various file allocation and disk scheduling algorithms.

UNIT-I: **Operating Systems Overview:**

Introduction: what is an operating system, Types of operating systems, operating systems concepts, operating systems services, Introduction to System call, System call types, Operating System Generation.

UNIT–II: Process Management:

Process concept: Process Concept, Process Scheduling, Operations on Processes, Inter process Communication.

Multithreaded Programming: Overview, Multithreading models, Threading Issues.

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

UNIT-III: Synchronization:

Process Synchronization: The Critical-Section Problem, Synchronization Hardware, Semaphores, Classic Problems of Synchronization, Monitors, Synchronization examples.

Principles of deadlock – System Model, Deadlock Characterization, Deadlock Prevention, Detection and Avoidance, Recovery from Deadlock.

UNIT-IV: Memory Management:

Memory Management strategies: Swapping, Contiguous Memory Allocation, Segmentation, Paging, Structure of the Page Table.

Virtual Memory Management: Virtual Memory, Demand Paging, Page-Replacement Algorithms, Thrashing.

UNIT-V: File system Interface- The concept of a file, Access Methods, Directory and Disk structure, File system mounting.

File System implementation: File system structure, allocation methods, free-space management.

Mass-storage structure: Overview of Mass-storage structure, Disk scheduling, Device drivers.

Text Books:

1. Silberschatz A, Galvin P B, and Gagne G, Operating System Concepts, 10 th edition, Wiley, 2013.
2. Tanenbaum A S, Modern Operating Systems, 4th edition, Pearson Education, 2008. (forInterprocess Communication and File systems).

References:

i. Tanenbaum A S, Woodhull A S, Operating Systems Design and Implementation, 3rd edition, PHI, 2006.

ii. Dhamdhere D M, Operating Systems A Concept Based Approach, 3rd edition, Tata McGraw-Hill, 2012.

iii. Stallings W, Operating Systems -Internals and Design Principles, 6th edition, Pearson Education, 2009.

iv. Nutt G, Operating Systems, 3rd edition, Pearson Education, 2004.

Course Code	Subject Name	L	T	P	C
R23CSE-OE0004	**INTRODUCTION TO JAVA PROGRAMMING**	3	0	0	3

Course Objectives

1. Understand the structure and environment of Java.
2. Implement the relationship between objects.
3. Understand the Strings and Organize data using different data
4. Implement text processes and error handling.
5. Understand to create multi threading applications and GUI applications.

Course Outcomes:

1. Understand the environment of JRE and Control Statements. (L2)
2. Implement real world objects using class Hierarchy (L3)
3. Implement generic data structures for iterating distinct objects (L3)
4. Implement error handling through exceptions and file handling through streams. (L3)
5. Design thread-safe GUI applications for data communication between objects (L4)

Unit I: Java Environment and Program Structure (10 Hours)

History of Java, Features, Applications, Java Installation - JDK and JRE, JVM Architecture, OOPS Principles, Class and Object, Naming Convention, Data Types, Type Casting, Type Conversion, Wrapper classes, Operators, instance of operator, Command Line Arguments, Decision making, Arrays, and Looping statements.

Learning Outcomes: Student will be able to

1. Understand architecture of Java Virtual Machine. (L2)
2. Understand the structure of java program and its environment. (L2)

Unit II: Class Hierarchy & Data Hiding (10 Hours)

Property, Method, Constructor, Inheritance (IS-A) , Aggregation and Composition (HAS-A), this and super, static and initialize blocks, Method overloading and overriding, static and final keywords, Types of Inheritance, Compile time and Runtime Polymorphism, Access Specifiers and scope, packages and access modifiers, Abstract class, Interface, Interface Inheritance, Achieving Multiple Inheritance, Class casting, Object Cloning, Inner Classes.

Learning Outcomes: Student will be able to

1. Understand the class hierarchy and their scope. (L2)
2. Implement relationship between objects. (L3)
3. Understand data hiding and nested classes. (L2)
4. Implement data type casting and cloning of objects. (L3)

Unit III: Strings and Collections (10 Hours)

String: Methods, StringBuffer and StringBuilder, StringTokenizer

Collections: Exploring java.util.*, Scanner, Iterable, Collection Hierarchy, Set, List, Queue and Map, Comparable and Comparator, Iterators: foreach, Enumeration, Iterator and ListIterator.

Learning Outcomes: Student will be able to

1. Understand the usage of String and its properties and methods.(L2)
2. Understand data structures and Iterators. (L2)
3. Create the data structures and implement different utility classes. (L3)

Unit IV: IO and Error Handling (10 Hours)

IO Streams: Exploring java.io.*, Character and Byte Streams, Reading and Writing, Serialization and De-serialization, Error Handling: Error vs Exception, Exception hierarchy, Types of Exception, Exception handlers, User defined exception, Exception propagation.

Learning Outcomes: Student will be able to

1. Understand character and byte streams. (L2)
2. Understand the hierarchy of errors and exceptions. (L2)
3. Implement data streams and exception handlers. (L3)

Unit V: Threads and GUI (8 Hours)

Multi-Threading: Process vs Thread, Thread Life Cycle, Thread class and Runnable Interface, Thread synchronization and communication.

GUI: Component, Container, Applet, Applet Life Cycle, Event delegation model, Layouts, Menu, MenuBar, MenuItem.

Learning Outcomes: Student will be able to

1. Understand the Thread Life Cycle and its scheduling.(L2)
2. Implement the synchronization of threads. (L2)

TEXT BOOKS:

1. The complete Reference Java, 8th edition, Herbert Schildt, TMH.
2. Programming in JAVA, Sachin Malhotra, SaurabhChoudary, Oxford.
3. Introduction to java programming, 7th edition by Y Daniel Liang, Pearson.
4. Java: How to Program, 9th Edition (Deitel) 9th Edition.
5. Core Java: An Integrated Approach, Java 8 by R. Nageswara Rao.

REFERENCE BOOKS:

1. Swing: Introduction, JFrame, JApplet, JPanel, Componets in Swings, Layout Managers
2. Swings, JList and JScrollPane, Split Pane, JTabbedPane, JTree, JTable, Dialog Box.

Weblinks:

1. https://www.javapoint.com/
2. https://www.sitesbay.com/java/index
3. https://www.tutorialspoint.com/java/index.htm
4. https://www.w3schools.com/java/
5. https://www.programiz.com/java-programming

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

SNO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	3	3	2	1	2				1			1	3	1	2
CO2	3	3	2	2	2				2			1	3	1	2
CO3	3	3	2	1	2				2			1	3	1	2
CO4	3	3	2	1	2				2			1	3	1	2
CO5	3	3	2	1	2				2			1	3	1	2

Subject Code	Subject Name	L	T	P	C
R23CSE-OE0005	**DATA BASE MANAGEMENT SYSTEMS CONCEPTS**	**3**	**0**	**0**	**3**

Course Objectives:

1. Train in the fundamental concepts of database management systems, database modeling and design, SQL, PL/SQL, and System implementation techniques.
2. Enable students to model ER diagram for any customized applications.
3. To learn the principles of systematically designing and using large scale Database Management Systems for various applications.

Course Outcomes:

1. Understand the usage of Key Constraints on Database.
2. Describe ER model and normalization for database design.
3. Create, maintain, and manipulate a relational database using SQL.
4. Understand efficient data storage and retrieval mechanism, recovery techniques.
5. Design and build database system for a given real world problem.

UNIT-I:

An Overview of Database Management: Introduction- Importance of Database System, Data Independence- Relation Systems and Others- Summary, Database system architecture, Introduction-The Three Levels of Architecture-The External Level- the Conceptual Level- the Internal Level-Mapping- the Database Administrator-The Database Management Systems- Client/Server Architecture.

UNIT-II:

The E/R Models: The Relational Model, Relational Calculus, Introduction to Database Design, Database Design and ER Diagrams-Entities Attributes, Entity Sets-Relationship and Relationship Sets-Conceptual Design with the ER Models.

The Relational Model: Integrity Constraints Over Relations- Key Constraints –Foreign Key Constraints-General Constraints, Relational Algebra and Calculus, Relational Algebra- Selection and Projection- Set Operation, Renaming – Joins- Division- More Examples of Queries, Relational Calculus - Tuple Relational Calculus, Domain Relational Calculus.

UNIT-III:

Queries, Constraints, Triggers: The Form of Basic SQL Query, Union, Intersect, and Except, Nested Queries, Aggregate Operators, Null Values, Complex Integrity Constraints in SQL, Triggers and ActiveDatabase.

Schema Refinement (Normalization) : Purpose of Normalization or Schema Refinement, Concept of Functional Dependency, Normal Forms Based on Functional Dependency(1NF, 2NF and3 NF), Concept of Surrogate Key, Boyce-Codd Normal Form(BCNF), Lossless Join and Dependency Preserving Decomposition, Fourth NormalForm(4NF).

UNIT-IV:

Transaction Management and Concurrency Control:

Transaction, Properties of Transactions, Transaction Log, Transaction Management with SQL using Commit Rollback and Save Point, Concurrency Control for Lost Updates, Uncommitted Data, Inconsistent Retrievals, and the Scheduler.

Concurrency Control with Locking Methods: Lock Granularity, Lock Types, Two Phase Locking For Ensuring Serializability, Deadlocks, Concurrency Control with Time Stamp Ordering: Wait/Die and Wound/Wait Schemes, Database Recovery Management : Transaction Recovery.

UNIT-V:

Overview of Storages and Indexing: Data on External Storage- File Organization and Indexing – Clustered Indexing – Primary and Secondary Indexes, Index Data Structures, Hash-Based

Indexing – Tree- Based Indexing, Comparison of File Organization.

Text Books:

1. Introduction to Database Systems, 8th Edition CJ Date, Pearson, 2004.
2. Data base Management Systems, Raghurama Krishnan, Johannes Gehrke, TATAMcGraw Hill 3rd Edition.

References Books:

1. Data base Systems design, Implementation, and Management, Peter Rob & Carlos Coronel13th Edition.
2. Fundamentals of Database Systems, 7 th Edition ElmasriNavrate Pearson Education.
3. Database Systems - The Complete Book, 2nd edition H G Molina, J D Ullman, J WidomPearson.
4. Data base System Concepts, 7thedition ,Silberschatz, Korth,Mcgraw Hill (TMH).

Subject Code	Subject Name	L	T	P	C
R23CSE-OE0006	**UNIX and Shell Programming**	3	0	0	3

Course Objectives:

- To provide an overview of the history, development, and significance of UNIX/Linux in computing.
- To provide skills in diagnosing common problems, log analysis, and troubleshooting techniques in a UNIX/Linux environment.
- To provide an overview of system administration tasks such as user management, backup and restore, system monitoring, and software installation.
- To explain file systems, mounting, disk usage, file permissions (chmod), and file attributes (chown).

Course Outcomes:

- Understand the architecture and features of UNIX. (L2)
- Apply the commands for implementation of the File System. (L3)
- Understand the Streams, Pipes and Filters. (L2)
- Apply the pattern reorganization commands and scripting concepts. (L3)
- Implementation of system calls for file system. (L3)

Unit 1 (10 Hours)

Introduction to Unix:

Introduction to Unix-Brief History-What is Unix-Unix Components-Using Unix-Commands in Unix-Some Basic Commands-Command Substitution-Giving MultipleCommands.

Learning Outcomes: Student will be able to

- Understand the origins and development of Unix. (L2)
- Learn the key milestones in the evolution of Unix (L3)
- Learn how to use command substitution to streamline tasks. (L3)

Unit 2 (8 Hours)

Unix Utilities:

Introduction to Unix file system, vi editor, file handling utilities, security by file permissions, process utilities, disk utilities, networking commands, unlink, du, df, mount, unmount, find, unmask, ulimit, ps, w, finger, Arp, ftp, telnet, rlogin. Text processing utilities and backup utilities , detailed commands to be covered are tail, head , sort, nl, uniq, grep, egrep, fgrep, cut, paste, join, tee, pg, comm, cmp, diff, tr, awk, cpio

Learning Outcomes: Student will be able to

1. Learn the organization and layout of the Unix directory hierarchy. (L2)

2. File Attributes and Permissions: Understand the various file attributes and how permissions work. (L2)

Unit 3 (10 Hours)

Introduction to Shells:

Using the Shell-Command Line Structure-Met characters- Creating New Commands-Command Arguments and Parameters-Program Output as Arguments-Shell Variables- -More on I/O Redirection-Looping in Shell Programs.

Filters:

Filters and Pipes, Concatenating files, Display Beginning and End of files, Cut and Paste, Sorting, Translating Characters, Files with Duplicate Lines, Count characters, Words or Lines, Comparing Files.

Learning Outcomes: Student will be able to

1. Understand the role and management of variables in the Unix shell. (L2)
2. Gain advanced knowledge of input/output redirection in Unix. (L3)
3. Learn how to implement loops in shell scripts. (L3)

Unit 4 (12 Hours)

Grep: Operation, grep Family, Searching for File Content.

Sed: Scripts, Operation, Addresses, commands, Applications, grep and sed.

Shell Programming:

Basic Script concepts, Expressions, Decisions: Making Selections, Repetition, special Parameters and Variables, changing Positional Parameters, Argument Validation, Debugging Scripts, Script Examples.

Learning Outcomes: Student will be able to

1. Understand the basics of awk for pattern scanning and text processing (L2)
2. Learn best practices for creating and using effective filters and well-structured files in Unix. (L3)

Unit 5 (8 Hours)

File Management:

File Structures, System Calls for File Management – create, open, close, read, write, lseek, link, symlink, unlink, stat, fstat, lstat, chmod, chown, Directory API – opendir, readdir, closedir, mkdir, rmdir, umask.

Learning Outcomes: Student will be able to

1. Learn how to change file ownership using the chown command.(L2)
2. Understand how to change the group ownership of a file using the chgrp command.(L2)

TEXT BOOKS:

1. Unix and shell Programming Behrouz A. Forouzan, Richard F. Gilberg.Thomson
2. Your Unix the ultimate guide, Sumitabha Das, TMH. 2nd Edition.

REFERENCE BOOKS:

- Unix for programmers and users, 3rd edition, Graham Glass, King Ables, Pearson Education.
- Unix programming environment, Kernighan and Pike, PHI. / Pearson Education.
- The CompleteReference Unix, Rosen, Host, Klee, Farber, Rosinski, Second Edition, TMH.

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

Cos	**PO1**	**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	2	2	1	3				1		1	1	2	3	3
CO2	3	2	2	1	3				1		1	1	2	3	3
CO3	3	3	3	2	3				1		1	2	3	3	3
CO4	3	3	3	2	3				2		1	2	3	3	3
CO5	2	2	2	2	2				2		1	1	2	2	2

Subject Code	Subject Name	L	T	P	C
R23CSE-OE0007	**SOFTWARE ENGINEERING**	3	0	0	3

Course Objectives:
1. Explain the phases of Software Development.
2. Teach the customer requirement gathering techniques.
3. Teach Software Design techniques
4. Demonstrate coding standards
5. Apply the testing techniques on software

Course Outcomes:
Students will be able to:
1. Understand the need of Software Life Cycle Models (L1)
2. Demonstrate the Requirements of the Software Systems process (L2)
3. Summarize the system models of software engineering (L2)
4. Choose appropriate software architecture style for real-time software projects (L3)
5. Analyze various testing techniques, Risk management and Software quality of the software products(L4)

UNIT-1
Introduction: Introduction to Software Engineering, Evolving role of Software, Software Crisis,Changing Nature of Software, Software myths, Process Models for Software Development, Waterfall, prototyping Evolutionary models: Incremental model, Spiral model, Agile developmental process.
Learning Outcomes:
At the end of the module, students will be able to:
1. List the steps involved in software development. (L1)
2. Explain myths of software. (L2)
3. Apply various software process models (L3)

UNIT-2
Software Requirements Engineering: Functional & Non-functional requirements, Feasibility studies, Requirements Elicitation and Analysis, requirements validation, Software Requirements Specification, Process and System Models, context models, behavioural model, Data model.
Learning Outcomes:
At the end of the module, students will be able to:
1. Explain software development model (L2)
2. Define functional and non-functional requirements for software development (L1)
3. Analyse user requirementsfor a software(L4)

UNIT-3
Design Engineering: Design concepts, data design, software architecture, Architectural styles and patterns, User interface design - Golden rules, User interface analysis and design, Effective Modular Design.
Learning Outcomes:
At the end of the module, students will be able to:
1. List the software architecture style for the given problem. (L1)
2. BuildGoldenrulesfor the given problem (L3)
3. User Interface Analysis and Design (L5)

UNIT-4

Coding&Testing: Coding standards, code review and verification, Testing levels: Unit testing, integration testing, system testing . alpha and beta testing, black box and white box testing, debugging.

Learning Outcomes:

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

1. Implementation of coding standards(L6)
2. Apply different Testing concepts (L3)

UNIT-5

Risk Management: Risk types, strategies, Estimation and Planning. Software Quality .McCall Quality factors, Six Sigma for Software Quality, Quality Assurance and its techniques.

Applications: analyze the risks in any software project

Learning Outcomes:

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

1. Evaluate different Risk management techniques. (L5)

Text books:

1. Roger S. Pressman, Software Engineering, A practitioner.s Approach, 7thEdition, McGraw-Hill International Edition, 2009
2. Rajib Mal, Fundamentals of software Engineering, 3rdEdition, Eastern Economy Edition, 2009

Reference books:

1. Sommerville, Software Engineering, 7thEdition, Pearson education, 2004
2. K KAggarwal and Yogeshsingh, Software engineering,3rd Edition,New age International publication,2008

Subject Code	Subject Name	L	T	P	C
R23CSE-OE0008	**Introduction to Data Mining**	3	0	0	3

COURSE OBJECTIVES:

- Students will be enabled to understand and implement classical models and algorithms in data warehousing and data mining.
- They will learn how to analyze the data, identify the problems, and choose the relevant models and algorithms to apply.
- They will further be able to assess the strengths and weaknesses of various methods and algorithms and to analyze their behavior.

COURSE OUTCOMES:

- Understand the process of knowledge discovery from data.
- Analyze the Data Pre-processing techniques.
- Apply classification techniques to various data sets.
- Apply the association rule mining to real time applications
- Apply the clustering algorithms to various data sets.

UNIT –I:

Introduction: Why Data Mining? What Is Data Mining? What Kinds of Data Can Be Mined? What Kinds of Patterns Can Be Mined? Which Technologies Are Used? Which Kinds of Applications Are Targeted? Major Issues in Data Mining. Data Objects and Attribute Types, Basic Statistical Descriptions of Data, Data Visualization, Measuring Data Similarity and Dissimilarity

Learning Outcomes: Student should be able to

1. Summarize the process of Data mining.(L2)
2. Classify various kinds of Data Mining techniques.(L2)
3. Memorize different visualization techniques.(L1)
4. Differentiate a data warehouse with data mining(L4)

UNIT –II:

Data Pre-processing: Data Preprocessing: An Overview, Data Cleaning, Data Integration, Data Reduction, Data Transformation and Data Discretization

Learning Outcomes: Student should be able to

1. Recognize various steps in Data Preprocessing.(L1)
2. Identify the process of handling noisy data.(L1)

UNIT –III:

Classification: Basic Concepts, General Approach to solving a classification problem, Decision Tree Induction: Working of Decision Tree, building a decision tree, methods for expressing an attribute test conditions, measures for selecting the best split, Algorithm for decision tree induction.

Classification: Alterative Techniques, Bayesian Classifier: Bayes theorem, using bayes theorem for classification, Native Bayes Classifier: Bayes error rate, Bayesian Belief Networks: Model representation, model building (Tan)

Learning Outcomes: Student should be able to

1. Summarize the process of classification.(L2)
2. Apply the process of classification on sample data.(L3)
3. Construct a decision tree for any sample data.(L3)
4. Calculate Bayes probability for any given data(L3)
5. Calculate Naïve Bayes probability.(L3)

UNIT –IV:

Association Analysis: Basic Concepts and Algorithms: Problem defination, Frequent Item Set generation, Rule generation, compact representation of frequent item sets, FP-Growth Algorithm. **(Tan &Vipin)**

Learning Outcomes: Student should be able to

1. Apply the Apriori algorithm on any sample data.(L3)
2. Construct an FP tree for any sample data. (L3)

UNIT –V

Cluster Analysis: Basic Concepts and Algorithms: Overview: What Is Cluster Analysis? Different Types of Clustering, Different Types of Clusters; K-means: The Basic K-means Algorithm, K-means Additional Issues, Bisecting K-means, Strengths and Weaknesses; Agglomerative Hierarchical Clustering: Basic Agglomerative Hierarchical Clustering Algorithm DBSCAN: Traditional Density Center-Based Approach, DBSCAN Algorithm, Strengths and Weaknesses. **(Tan &Vipin)**

Learning Outcomes: Student should be able to

1. Identify the data objects and partition them into different clusters.(L2)
2. Apply the different clustering techniques on sample data.(L3)
3. Acquire the knowledge of The strenthg and weakness of clustering algorithms.(L2)

TEXT BOOKS:

1. Introduction to Data Mining: Pang-Ning Tan & Michael Steinbach, Vipin Kumar, Pearson.
2. Data Mining concepts and Techniques, 3/e, Jiawei Han, Michel Kamber, Elsevier.

REFERENCE BOOKS:

1. Data Mining Techniques and Applications: An Introduction, Hongbo Du, Cengage Learning.
2. Data Mining : VikramPudi and P. Radha Krishna, Oxford.
3. Data Mining and Analysis - Fundamental Concepts and Algorithms; Mohammed J. Zaki,Wagner Meira, Jr, Oxford
4. Data Warehousing Data Mining & OLAP, Alex Berson, Stephen Smith, TMH.

MAPPING (DETAILED; HIGH: 3; MEDIUM: 2; LOW: 1):

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

Subject Code	Subject Name	L	T	P	C
R23CSE-OE0009	**FUNDAMENTALS OF WEB TECHNOLOGIES**	3	0	0	3

COURSE OBJECTIVES:

1. Creating Web User Interfaces
2. Creating dynamic Web pages
3. Implementing the usage of Scripts in Web Pages
4. Analyzing real world objects into Web Pages as Scripts Handlers
5. Analyzing look and feel kind of applications which are useful for real world
6. Web framework implementation using Model View Controller
7. Writing background scripts to run the virtual machines and servers

COURSE OUTCOMES:

1. Demonstrate knowledge on web page design elements.
2. Design web pages with dynamic content
3. Create Responsive layout with customized forms
4. Implement simple client-side scripts using AJAX
5. Build web applications using PHP

UNIT-I:

HTML: Introduction: Fundamentals of HTML, Working with text, Organizing text in HTML, Working with links and URLs, Creating tables, Working with images, Canvas, Forms, Frames and Multimedia.
HTML5: Introduction, HTML5 document structure, Creating editable content, Checking spelling mistakes.

Learning Outcomes:

After completion of this unit, student will be able to

- Identify basic steps that are followed to develop web applications [L2]
- Understand the functions of different HTML5 tags and how to use them [L2]
- Design and develop basic web pages using HTML5[L3]

UNIT-II:

CSS AND JAVASCRIPT: CSS: Introduction, CSS selectors, Inserting CSS in an HTML document, Backgrounds, Fonts and Text styles, Creating boxes, Displaying, Positioning and floating elements, Features of CSS3,Media queries. JavaScript: Overview of JavaScript, JavaScript functions, Events, Image maps and animations, JavaScript objects, working with browser and document objects.

Learning Outcomes:

After completion of this unit, student will be able to

- Learn the basic syntax of the CSS Style rule[L2]
- Get an idea about different CSS Selectors[L2]
- Use style rules to apply styles to different elements[L3]
- Understand HTML5 DOM object hierarchy[L2]
- Understand java script event handling mechanism[L2]

UNIT -III:

JQUERY and BOOTSTRAP: JQuery: Introduction, JQuery selectors, Events, Methods to access HTML elements and attribute. Bootstrap: Getting started with Bootstrap, Creating responsive layouts using Bootstrap CSS - Basic HTML structure for Bootstrap, Responsive classes, Rendering images, the grid system, Constructing data entry forms.

Learning Outcomes:

After completion of this unit, student will be able to

- Understanding the Bootstrap file structure[L2]
- Learning the basics of responsive design[L2]
- Understanding the all-important grid system in Bootstrap[L2]
- Introduce Bootstrap as a responsive design framework[L2]

UNIT –IV:

XML: Document type Definition, XML schemas, Document object model, XSLT, DOM and SAX Approaches, AJAX A New Approach: Introduction to AJAX, Integrating PHP and AJAX.

Learning Outcomes:

After completion of this unit, student will be able to

- Learn the basic building blocks of XML Documents [L1]
- Understand how name clashes are avoided using namespaces [L2]
- Learn how to create forms dynamically [L2]
- Learn how to generate dynamic tables[L2]
- Write interactive web applications using AJAX [L3]

UNIT-V:

INTRODUCTION TO PHP: Introduction, Data types, Variables, Constants, Expressions, String interpolation, Control structures, Functions, Arrays, Embedding PHP code in web pages, Object Oriented PHP.PHP Web forms: PHP and web forms, Sending form data to a server, Working with cookies and session handlers PHP with MySQL: Interacting with the database, Prepared statement, Database transactions.

Learning Outcomes:

After completion of this unit, student will be able to

- Examine the relationship between PHP and MySQL L2]
- Plan a PHP Web application [L4]
- Create and use a Logon Window [L6]
- Manage User sessions using cookies and sessions [L3]

Text Books:

1. Kogent Learning Solutions Inc, HTML 5 Black Book: Covers CSS3, JavaScript, XML, XHTML, AJAX, PHP and JQuery, Dreamtech Press, Second Edition, 2016.
2. W. Jason Gilmore, Beginning PHP and MySQL, APress, Fourth Edition, 2011.

Reference Books:

1. Snig Bahumik, Bootstrap Essentials, PACKT Publishing, 2015 (e-book).
2. Thomas A. Powell, The Complete Reference: HTML and CSS, Tata McGraw Hill, Fifth Edition, 2010
3. Andrea Tarr, PHP and MySQL, Willy India, 2012.
4. Ruby on Rails Up and Running, Lightning fast Web development, Bruce Tate, Curt Hibbs, Oreilly (2006)

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

COs	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				1			2	2	1	2
CO2	2	3	2	1	2				1			2	2	1	1
CO3	3	2	2	1	2				1			2	2	1	1
CO4	3	3	2	2	2				1			2	2	1	3
CO5	3	2	3	1	2				1			2	2	1	2

Subject Code	Subject Name	L	T	P	C
R23CSE-OE0010	**FUNDAMENTALS OF COMPUTER NETWORKS**	3	0	0	3

Course Objectives:

1. To introduce the fundamental various types of computer networks.
2. To understand state-of-the-art in network protocols, architectures, andapplications.
3. To explore the various layers of OSI Model.

Course Outcomes:

The students can

1. Understand OSI and TCP/IP reference models with an emphasis to Physical Layer, Data Link Layer and NetworkLayer.
2. Analyze the issues related to data link, medium access and transport layers by using channel allocation and connection management schemes. Analyze MAC layer protocols and LANtechnologies.
3. Solve problems related to Flow control, Error control, Congestioncontroland Network Routing.
4. Design and compute subnet masks and addresses for networkingrequirements.
5. Understand how internet works

UNIT-I:

Introduction: Network Hardware and software Reference models- The OSI Reference Model- the TCP/IP Reference Model - A Comparison of the OSI and TCP/IP Reference Models, Examples of Networks: Novell Networks, Arpanet, Internet, Network Topologies WAN, LAN, MAN.

Physical Layer: Guided Transmission Media, Digital Modulation and Multiplexing: frequency division multiplexing, wavelength division multiplexing, synchronous time division multiplexing, statistical time division multiplexing.

UNIT-II:

The Data Link Layer - Design Issues, Services Provided to the Network Layer – Framing – Error Control – Flow Control, Error Detection and Correction – Error-Correcting Codes – Error Detecting Codes, Elementary Data Link Protocols, Sliding Window Protocols.

Channel allocation methods: TDM, FDM, ALOHA, Carrier sense Multiple access protocols, Collision Free protocols – IEEE standard 802 for LANS – Ethernet, Token Bus, Token ring, Bridges and IEEE 802.11 and 802.16. Data link layer switching, virtual LANs.

UNIT-III:

Network layer Routing Algorithms: Design Issues, Routing Algorithms-Shortest path, Flooding,

Flow based Distance vector, Link state, Hierarchical, Broadcast routing, Congestion Control algorithms-General principles of congestion control, Congestion prevention polices, Choke packets, Load shedding, and Jitter Control.

Internet Working: Tunnelling, internetworking, Fragmentation, Network layer in the internet– IP protocols, IP address, Subnets, Internet control protocols, OSPF, BGP, Internet multicasting, Mobile IP, IPV6.

UNIT IV:

The Transport Layer: Elements of transport protocols – addressing, establishing a connection, releasing connection, flow control and buffering and crash recovery, End to end protocols: UDP, Real Time Tran sport Protocol.

The Internet Transport Protocol: TCP- reliable Byte Stream (TCP) end to end format, segment format, connection establishment and termination, sliding window revisited, adaptive retransmission, TCP extension, Remote Procedure Call.

UNIT – V:

Application Layer: WWW and HTTP: Architecture- Client (Browser), Server, Uniform Resource Locator HTTP: HTTP Transaction, HTTP Operational Model and Client/Server Communication**,** HTTP Generic Message Format, HTTP Request Message Format, HTTP Response Message Format.

The Domain Name System: The DNS Name Space, Resource Records, Name Servers, Electronic Mail: Architecture and Services, The User Agent, Message Formats, Message Transfer, Final Delivery.

Text Books:

1. Data Communications and Networks – Behrouz A. Forouzan, Third Edition ,TMH.
2. Computer Networks, 5ed, David Patterson,Elsevier
3. Computer Networks: Andrew S Tanenbaum, 5th Edition. PearsonEducation/PHI
4. Computer Networks, Mayank Dave, CENGAGE

References:

1. Tanenbaum and David J Wetherall, Computer Networks, 5th Edition, Pearson Edu, 2010
2. Computer Networks: A Top Down Approach, Behrouz A. Forouzan, FirouzMosharraf, McGraw Hill Education
3. An Engineering Approach to Computer Networks-S.Keshav, 2nd Edition, PearsonEducation.
4. Understanding communications and Networks, 3rd Edition, W.A. Shay, ThomsonThe TCP/IP Guide, by Charles M. Kozierok, Free online Resource,http://www.tcpipguide.com/free/index.htm.

Subject Code	|Subject Name	L	T	P	C
R23CSE-OE0011	**BASICS OF CLOUD COMPUTING**	**3**	**0**	**0**	**3**

Course Objective :

1. To provide students with the fundamentals and essentials of Cloud Computing.
2. To provide students a sound foundation of the Cloud Computing so that they are able to start using and adopting Cloud Computing services and tools in their real life scenarios.
3. To enable students exploring some important cloud computing driven commercial systems and applications.

Course Outcomes :

Upon completion of the course, it is expected that student will be able to:

1. Understand and analyze different computing paradigms
2. Understand the basics of cloud computing and different cloud deployment models.
3. Understand different cloud implementation and management strategies.
4. Understand and evaluate different cloud service models.
5. Identify, analyze and use different cloud services /applications/tools available from key cloud providers.

UNIT-I:

Computing Paradigms: High-Performance Computing, Parallel Computing, Distributed Computing, Cluster Computing, Grid Computing, Cloud Computing, Bio computing, Mobile Computing, Quantum Computing, Optical Computing, Nano computing..

UNIT-II:

Cloud Computing Fundamentals: Motivation for Cloud Computing, The Need for Cloud Computing, Defining Cloud Computing, Definition of Cloud Computing, Cloud Computing is a Service, Cloud Computing is a Platform, Principles of Cloud computing, Five Essential Characteristics, Four Cloud Deployment Models

UNIT-III:

Cloud Computing Architecture and Management: Cloud architecture, Layer, Anatomy of the Cloud, Network Connectivity in Cloud Computing, Applications on the Cloud, Managing the Cloud, Managing the Cloud Infrastructure, Managing the Cloud Application, Migrating Application to Cloud, Phases of Cloud Migration Approaches for Cloud Migration.

UNIT-IV:

Cloud Service Models: Infrastructure as a Service, Characteristics of IaaS. Suitability of IaaS, Pros and Cons of IaaS, Summary of IaaS Providers, Platformas a Service, Characteristics of PaaS, Suitability of PaaS, Pros and Cons of PaaS, Summary of PaaS Providers, Software as a Service, Characteristics of SaaS, Suitability of SaaS, Pros and Cons of SaaS, Summary of SaaS Providers, Other Cloud Service Models.

UNIT-V:

Cloud Providers and Applications : EMC, EMC IT, Captiva Cloud Toolkit, Google Cloud Platform, Cloud Storage, Google Cloud Connect, Google Cloud Print, Google App Engine, Amazon Web Services, Amazon Elastic Compute Cloud, Amazon Simple Storage Service, Amazon Simple Queue service, Microsoft, Windows Azure, Microsoft Assessment and Planning Toolkit, SharePoint, IBM, Cloud Models, IBM Smart Cloud, SAP Labs, SAP HANA Cloud Platform, Virtualization Services Provided by SAP, Sales force, Sales Cloud, Service Cloud: Knowledge as a Service, Rack space, VMware, Manjra soft, Aneka Platform**.**

Text Book:

i. Essentials of Cloud Computing, K. Chandra sekhran, CRC press.

Reference Books:

i. Cloud Computing: Principles and Paradigms, Rajkumar Buyya, James Broberg and Andrzej M. Goscinski,Wiley.
ii. Distributed and Cloud Computing, Kai Hwang, Geoffery C. Fox, Jack J. Dongarra, Elsevier.
iii. Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance, Tim Mather, Subra Kumara swamy, Shahed Latif, O 'Reilly.

Subject Code	Subject Name	L	T	P	C
R23CSE-OE0012	**INTRODUCTION TO MACHINE LEARNING**	3	0	0	3

Course Objectives:

- To familiarize with a set of well-known Machine Learning (ML) algorithms.
- The ability to implement machine learning algorithms.
- To understand how machine learning algorithms are evaluated.
- To formulate machine learning problems corresponding to different applications.
- To understand a range of machine learning algorithms with their pros and cons.

Course Outcomes:

- Illustrate the characteristics of machine learning algorithms.
- Summarize the process of classification using decision tree approach.
- Apply Bayesian classifier to label data points an ML approach.
- Understand computational and instance-based learning.
- Understand advanced computational and types of learning.

UNIT I: (10 Hours)

Introduction: Well- posed learning problems, designing a learning system, perspectives, and issues in machine learning. Applications of machine learning. **Concept Learning:** Concept learning and the general to specific ordering. Concept learning task, Concept learning as search, Find-s: finding a maximally specific hypothesis, version spaces and the candidate elimination algorithm, Remarks on version spaces and candidate elimination, Inductive bias.

Learning Outcomes: Student will be able to

- Summarize the process of machine learning.
- Recognize various machine learning Applications.
- Understand various candidate elimination algorithms

UNIT II: (09 Hours)

Decision Tree Learning: Decision tree representation, Appropriate problems for decision tree learning, the basic decision tree learning algorithm, Hypothesis space search in decision tree learning, Inductive bias in decision tree learning, Issues in decision tree learning

Learning Outcomes: Student will be able to

- Summarize the process of classification.
- Construct a decision tree for any sample data.

UNIT III: (11 Hours)

Bayesian learning: Bayes theorem, Byes 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 – Chap Man & Hall CRC Press, 2015

References

1. Ethem Alpaydin, Introduction to machine learning, 2nd edition, PHI.
2. Kevin P. Murphy, "Machine Learning," A Probabilistic Perspective, MIT Press, 2012

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

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO 2	PSO 3
CO1	3	3	1	2	2			1	2	1		2	1	2	1
CO2	3	3	1	2	2			1	2	1		2	1	2	1
CO3	3	3	3	3	3			1	2	1		2	1	2	1
CO4	3	3	1	2	2			1	2	1		2	1	2	1
CO5	3	3	1	2	2			1	2	1		2	1	2	1

Subject Code	Subject Name	L	T	P	C
R23CSE-OE0013	**ESSENTIALS OF CYBER SECURITY**	3	0	0	3

Course Objectives:

1. Understand the fundamental concepts and principles of cyber security.
2. Understand Security architecture, risk management, attacks, incidents, and emerging IT and IS technologies.
3. To Provide the importance of Cyber Security and the integral role of Cyber Security professionals.
4. Recognize the importance of cybersecurity in protecting digital assets and information.
5. Analyze real-world cyber-attack scenarios and case studies.

Course Outcomes:

1. Understand Cyber Security architecture principles
2. Analyze the System and application security threats and vulnerabilities
3. Estimate operational cyber security strategies and policies.
4. Apply security model to handle mobile, wireless devices and related security issues.
5. Analyze the functionality of Security Technologies and Controls in Cybersecurity

UNIT - I: (8 Hours)

Introduction to Cyber Security: Need for Cyber security - History of Cyber security - Defining Cyberspace and Cyber security, scope of Cyber security, Importance of Cyber security in the modern world, Evolution of cyber threats,Importance of Cybersecurity in the digital age.

Foundations of Cyber Security: Cyber Security principles, threat models, and cyber laws. Confidentiality, integrity, and availability (CIA) Triad– Cyber security Framework, Security principles and concepts, Risk management.to better understand the dynamics of Cyber Security.

Learning Outcomes:student will be able to

- Outline the Importance of Cyber security. (L2)
- Understand the Security architecture principles and concepts. (L2)
- Understand the Design of Cyber security Framework. (L2)

UNIT-II: (10 Hours)

Common Threats and Attack Vectors: Introduction, Proxy Servers and Anonymizers, Password Cracking, Key loggers and Spywares, Virus and Worms, Trojan Horses and Backdoors, Steganography, DoS and DDoS Attacks, SQL Injection, Buffer Overflow, Attacks on Wireless Networks, Social Engineering attacks: Introduction, Phishing, spear phishing, pretexting, Identity Theft (ID Theft).

Learning Outcomes:student will be able to

- Understand about the Cyber security Threats and Attacks. (L2)
- Summarize the various types of application security vulnerabilities(L2)
- Analyze the System and application security threats and vulnerabilities(L4)

UNIT-III: (12 Hours)

Introduction to Cyber Crime, law and Investigation: Introduction to Cybercrime**,** Definition and scope of cybercrime, Categories of cybercrimes, Impact of cybercrime, Cybercrime and Information Security, classifications of cybercrimes, Cybercrime: The Legal Perspectives, cybercrime and theIndian IT Act 2000, a Global perspective on Cybercrimes.

Cyber laws: Introduction to Cyber Laws, Need for Cyber laws The Indian Context, The Indian IT Act, Challenges to Indian Law and Cybercrime Scenario in India, Consequences of Not Addressing the Weakness in Information Technology Act, Digital Signatures and the Indian IT Act, Information Security Planning and Governance, Information Security Policy Standards.

Learning Outcomes: student will be able to

- Extend The Categories of cybercrimes and Impact of cybercrime(L2)
- Understand about the Need for Cyber laws and Cybercrime Scenario in India(L2)
- Estimate operational cyber security strategies and policies(L5)
- Develop an understanding of cybercrimes and various legal perspectives involved(L3)

UNIT-IV: (10 Hours)

Cybercrime-Mobile and Wireless Devices: Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit Card Frauds in Mobile and Wireless Computing Era, Authentication Service Security, Attacks on Mobile/Cell Phones.

Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile Devices-Related Security Issues, Organizational Security Policies and Measures in Mobile Computing Era, Laptops.

Learning Outcomes: student will be able to

- Understand Various devices and related security issues (L2)
- Develop a security model to handle Policies and Measures in Computing era(L3)
- Develop a security model to handle mobile, wireless devices and related security issues of an organization (L3)

UNIT-V: (8 Hours)

Security Technologies and Controls in Cyber security: Access control mechanisms, Encryption, Firewalls, intrusion detection systems (IDS), intrusion prevention systems (IPS), Network Security, Security Information and Event Management (SIEM),functionality of cyber security tools.

Legal and Ethical Aspects of Cyber Security: Laws and regulations governing cyber security,
Ethical considerations in cyber security practices, Privacy issues.

Learning Outcomes: student will be able to

- Analyze the functionality of Security Technologies and Controls in Cyber security(L4)
- Outline the Ethical considerations in cyber security practices(L2)
- Understand the functionality of cyber security tools(L2)

Text Books:

1. Computer Security: Principles and Practice, Third Edition, William Stallings, Lawrie Brown ,Pearson Education, 2014.
2. Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Nina Godbole, SunitBelapure, 1st Edition Publication Wiley, 2011.
3. William Stallings, Effective Cyber security: A Guide to Using Best Practices and Standards, 1st edition, 2019.
4. Mark Rhodes, Ousley, Information Security, 1st Edition, MGH, 2013.

Reference Books:

1. Principles of Information Security, MichaelE. Whitman and Herbert J. Mattord, CengageLearning.
2. 2. Charles J. Brooks, Christopher Grow, Philip A. Craig, Donald Short, Cybersecurity Essentials, Wiley Publisher, 2018.
3. Yuri Diogenes, ErdalOzkaya, Cyber security - Attack and Defense Strategies, Packt Publishers,

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

CNO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO2	PSO3
	3	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**1**
	3	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**2**	**-**	**1**
	3	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**-**	**-**
	3	**2**	**1**	**1**	**2**	**-**	**-**	**-**	**-**	**1**	**-**	**1**	**-**	**-**	**1**
	3	**2**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**1**	**-**	**1**	**1**	**2**	**-**
	3	**2**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**1**	**-**	**1**	**2**	**2**	**1**

** For Entire Course, PO & PSO Mapping*

Subject Code	Subject Name	L	T	P	C
R23CSE-OE0014	**INTRODUCTION TO REACT JS**	3	0	0	3

Course Objectives:

- To learn essential React JS skills for front-end development.
- To explore client-side JavaScript application development and the React library.
- To implement React components, hooks, and state management for building interactive UIs.
- To gain experience with React.js, JSX, HTML, CSS, and JavaScript.
- To create a functional front-end web application using React.

Course Outcomes:

1. Understand the anatomy of React Java Script. (L2)
2. Understand the life cycle methods of React JS. (L2)
3. Implement React components for building applications. (L3)
4. Apply React hooks for component reusability and monitoring. (L3)
5. Implement React rendering for interactive applications. (L3)

Unit 1 (10 Hours)

React JS: Introduction to React JS, React vs Angular, React Version History, Architecture of the React Application, Installation, Creating and Running React App, Anatomy of React Project.
Templating using JSX: Expressions, Operators, Attributes, Fragments.

Learning Outcomes: Student will be able to

- Understand react framework for building applications. (L2)
- Understand the installations of react packages. (L2)
- Implement templates in react applications. (L3)

Unit 2 (8 Hours)

React Core: Props, State, Event Handling, Lists and Keys, Styling, Pagination, React Life Cycle, Life Cycle Methods, State Management, Mounting Life Cycle.

Learning Outcomes: Student will be able to

- Understand event handling in React. (L2).
- Implement life cycle methods in react. (L3).
- Implement props and states in building react apps. (L3)

Unit 3 (10 Hours)

React Components: Pure Components, memo, Refs, Portals, Higher Order Components (HOC), Context, HTTP requests (POST & GET).

Learning Outcomes: Student will be able to

- Understand http request methods in handling end points. (L2)
- Implement components to handle react requests. (L3)
- Implement higher order components and refs in react. (L3)

Unit 4 (12 Hours)

React Hooks: Introduction to Hooks, useState, useEffect, Run Effects, Fetching Data, useContext, useReducer, useCallBack, useMemo, useRef, Custom Hooks

Learning Outcomes: Student will be able to

- Understand react hooks. (L2)
- Apply hooks and custom methods for handling components. (L3)
- Implement context and callback methods in hooks. (L3)

Unit 5 (8 Hours)

React Render: Introduction to Rendering, useState, useReducer, State Immutability, Parent & Child, Memo, Context, useCallBack.

Learning Outcomes: Student will be able to

- Understand the working react rendering. (L2)
- Implement userReducer and context for rendering react apps. (L3)

TEXT BOOKS:

1. React.js Book: Learning React JavaScript Library From Scratch by Greg Sidelnikov, Learning Curve.
2. React: Quickstart Step-By-Step Guide To Learning React Javascript Library (React.js, Reactjs, Learning React JS, React Javascript, React Programming) by Lionel Lopez

REFERENCE BOOKS:

- Full-Stack React Projects: Learn MERN stack development by building modern web apps using MongoDB, Express, React, and Node.js, 2nd Edition by Shama Hoque, Packt

Course Code	Subject Name	L	T	P	C
R23CSE-OE0015	**Deep Learning**	3	0	0	3

Course Objectives

1. Understand the fundamentals of machine learning algorithms and their challenges.
2. Learn the architecture and training of deep feedforward networks.
3. Master regularization techniques to improve deep learning model performance.
4. Explore optimization methods for training deep neural networks.
5. Gain comprehensive knowledge of convolutional neural networks and their applications.

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

1. Apply machine learning algorithms to solve practical problems, demonstrating understanding of overfitting and underfitting (Application).
2. Analyse and design deep feedforward networks using gradient-based learning techniques (Analysis).
3. Evaluate the effectiveness of various regularization techniques to enhance model performance and robustness (Evaluation).
4. Analyse advanced optimization strategies to efficiently train deep neural networks (Synthesis).
5. Understand the convolutional neural networks, explaining their significance in the context of deep learning history and neuroscientific principles.

Unit-I – Machine Learning Basics (8 Hours)

Learning Algorithms-Capacity,OverfittingandUnderfitting-HyperparametersandValidationSets-Estimators,BiasandVariance -SupervisedLearningAlgorithms -UnsupervisedLearningAlgorithms -ChallengesMotivatingDeepLearning.

Learning Outcomes: Student will be able to understand the fundamentals of machine learning.

Application:ML Algorithms can use in health care, NLP and computer vision applications.

Unit – II: DeepNetworks (8 Hours)

Deep Feed forward Networks: Example: Learning XOR - Gradient-Based Learning - Hidden Units - Architecture Design – BackPropagation and Other Differentiation Algorithms.

Learning Outcomes: Student will be able to analyse the fundamentals of deep learning.

Application: Deep Networks can use in NLP and finance applications for solving complex problems.

Unit – III: Regularization for Deep Learning (8 Hours)

Parameter Norm Penalties – Norm Penaltiesas Constrained Optimization- Regularization and Under Constrained Problems – DatasetAugmentation-NoiseRobustness- SemiSupervisedLearning- MultiTaskLearning- EarlyStopping - ParameterTyingandParameterSharing – SparseRepresentations -BaggingandOtherEnsembleMethods -Dropout.

Learning Outcomes: Student will be able to evaluate the regularization importance in deep neural networks.

Application: Regularization is used for improve the performance of network in various applications like computer vision and NLP etc.

Unit – IV: Optimization for Training Deep Models (8 Hours)

How Learning Differs from Pure Optimization- Challenges in Neural Network Optimization- Basic Algorithms – Parameter Initialization Strategies – Algorithms with Adaptive Learning Rates- Approximate Second Order Methods- Optimization Strategies and Meta-Algorithms.

Learning Outcomes: Student will be able to analyse the fundamentals of optimization techniques in deep learning.

Application: Optimization techniques are using in many applications like NLP,computer vision and finance sector.

Unit – V: Convolutional Networks (8 Hours)

The Convolution Operation- Motivation- Pooling – Convolution and Pooling as an Infinitely Strong Prior – Variants of the Basic Convolution Function- The Neuro scientific Basis for Convolutional Networks – Convolutional Networks and the History of Deep Learning.

Learning Outcomes: Student will be able tounderstand the purpose of CNN and its importance in deep learning.

Application:CNN used in the area of computer vision applications and many more like NLP, finance and manufacturing sectors.

Text Books: Ian Goodfellow and Yoshua Bengio and Aaron Courville," Deep Learning"MIT Press, 2017.
References Books:
1. Shai ShalevShwartz, Shai BenDavid"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-OE0016	**DevOps**	3	0	0	3

Course Objectives:
DevOps improves collaboration and productivity by automating infrastructure and workflows and continuously measuring applications performance.
(Need to write at least 5 objects for this course)

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

1. Enumerate the principles of continuous development and deployment, automation of configuration management, inter-team collaboration, and IT service agility
2. Understand different actions performed through Version control tools like Git.
3. Illustrate the types of version control systems, continuous integration tools, continuous monitoring tools, and cloud models
4. Ability to Perform Automated Continuous Deployment
5. Understand to leverage Cloud-based DevOps tools using Azure DevOps

Need to write what is the skill gained by student at the end of each unit and mention the blooms taxonomy levels in parenthesis for each course outcome

UNIT –I:
Introduction to Software Engineering: Phases of Software Development life cycle. Models ,Values and principles of agile software development.
Learning outcomes:

- Identify and describe the phases of the Software Development Life Cycle (SDLC) (Knowledge, Understanding). (L1 & L2)
- Compare and contrast different software development models (e.g., Waterfall, Agile) and their applications (L3)
- Apply the values and principles of agile software development in real-world scenarios (L3)

UNIT -II: Introduction To DevOps -Devops Essentials – Introduction To AWS, GCP, Azure – Version control systems: Git and Github.
Learning outcomes:

- Understand the essentials of DevOps and its importance in modern software development (L2)
- Demonstrate the use of version control systems(L3)
- Compare cloud platforms and their relevance to DevOps practices (L3)

UNIT –III:
DevOps adoption in projects: Technology aspects, Agiling capabilities, Tool stack implementation, People aspect, processes.
Learning outcomes:

- Analyze the technology aspects required for successful DevOps adoption (L4)
- Analyze the agile capabilities and tool stack implementation for DevOps in various projects (L4)
- Analyze the people and process aspects necessary for DevOps adoption and their impact on project success (L4)

UNIT -IV:

CONTINUOUS INTEGRATION USING JENKINS: Install & Configure Jenkins, Jenkins Architecture Overview, Creating a Jenkins Job, Configuring a Jenkins job, Introduction to Plugins, Adding Plugins to Jenkins, Commonly used plugins (Git Plugin, Parameter Plugin, HTML Publisher, Copy Artifact and Extended choice parameters). Configuring Jenkins to work with java, Git and Maven, Creating a Jenkins Build and Jenkins workspace.

Learning outcomes:

- Install and configure Jenkins for continuous integration (L3)
- implement Jenkins jobs and pipelines, including configuring jobs and adding plugins (L3)
- Understand Jenkins in continuous integration by creating and managing builds (L2)

UNIT–V: BUILDING DEVOPS PIPELINES USING AZURE : Create Github Account, Create Repository, Create Azure Organization, Create a new pipeline, Build a sample code, Modify azure-pipelines.yaml file

Learning outcomes:

- Create and manage repositories on GitHub and integrate them with Azure DevOps (Application). (L3)
- Implement new pipeline in Azure DevOps and build sample code using azure-pipelines.yaml file(L3)
- Analyze the Modification and optimization Azure DevOps pipelines for continuous deployment (L4)

Text Books:

- Roberto Vormittag, "A Practical Guide to Git and GitHub for Windows Users: From Beginner to Expert in Easy Step-By-Step Exercises", Second Edition, Kindle Edition, 2016.
- Jason Cannon, "Linux for Beginners: An Introduction to the Linux Operating System and Command Line", Kindle Edition, 2014

Reference Books:

- Hands-On Azure Devops: Cicd Implementation For Mobile, Hybrid, And Web Applications Using Azure Devops And Microsoft Azure: CICD Implementation for … DevOps and Microsoft Azure (English Edition) Paperback – 1 January 2020 by Mitesh Soni
- Jeff Geerling, "Ansible for DevOps: Server and configuration management for humans", First Edition, 2015.
- David Johnson, "Ansible for DevOps: Everything You Need to Know to Use Ansible for DevOps", Second Edition, 2016.
- MariotTsitoara, "Ansible 6. Beginning Git and GitHub: A Comprehensive Guide to Version Control, Project Management, and Teamwork for the New Developer", Second Edition, 2019.

Web References :

- https://www.jenkins.io/user-handbook.pdf
- https://maven.apache.org/guides/getting-started/

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

Course	CNO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
DevOps		3	3	2	2					2			1	3	1	2
		3	3	2	2					2			1	3	1	2
		3	3	2		2				2			1	3	1	2
		3	3	2		2				2			1	3	1	2
		3	3	2		2				2			1	3	1	2
		3	3	2	2	2				2			1	3	1	2

Subject Code	Subject Name	L	T	P	C
R23CSE-OE0017	**Mobile Computing**	3	0	0	3

Course Objective:

1. Understand the fundamental concepts, architecture, and paradigms of mobile computing and GSM.
2. Comprehend the motivation for specialized MAC techniques in wireless communications, addressing issues such as hidden and exposed terminals, near and far terminals and IEEE 802.11.
3. Analyze the IP and Mobile IP network layers, focusing on packet delivery, handover management, location management, registration, tunneling, encapsulation and DHCP.
4. Understand conventional TCP/IP protocols and specialized protocols like Indirect TCP, Snooping TCP, and Mobile TCP for mobile networks and database issues in mobile computing.
5. Introduce the concept, applications, and challenges of Mobile Ad hoc Networks (MANETs), and to explore various routing algorithms such as DSR, AODV, and DSDV.

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

1. Understand t the fundamental concepts, architecture, and paradigms of mobile computing and GSM.
2. Understand the need for specialized MAC techniques in wireless communications, addressing challenges like hidden and exposed terminals, near and far terminals and IEEE 802.11.
3. Understand the concept of the IP and Mobile IP network layers, focusing on packet delivery, handover management, location management, registration, tunnelling, encapsulation, route optimization, and DHCP.
4. Understand proficient in conventional TCP/IP protocols as well as specialized protocols like Indirect TCP, Snooping TCP, and Mobile TCP.
5. Understand the concept, applications, and challenges of Mobile Ad hoc Networks (MANETs).

UNIT I

Introduction: Mobile Communications, Mobile Computing – Paradigm, Promises/Novel Applications and Impediments and Architecture; Mobile and Handheld Devices, Limitations of Mobile and Handheld Devices.

GSM – Services, System Architecture, Radio Interfaces, Protocols, Localization and Calling, Handover, Security, New Data Services, GPRS.

Learning Outcome:

1) Student able to understand the basic concepts of mobile communications and GSM.

UNIT –II

(Wireless) Medium Access Control (MAC): Motivation for a specialized MAC (Hidden and exposed Terminals, Near and far terminals), SDMA, FDMA, TDMA, CDMA.

Learning Outcome:

1) Student able to differentiate the SDMA,FDMA,TDMA and CDMA.

UNIT –III

Mobile Network Layer:IP and Mobile IP Network Layers, Packet Delivery and Handover Management, Location Management, Registration, Tunnelling and Encapsulation, Route Optimization, DHCP.

Learning Outcome:

1) Student able to explain the Mobile IP in mobile networks.

UNIT –IV

Mobile Transport Layer: Conventional TCP/IP Protocols, Indirect TCP, Snooping TCP, Mobile TCP, Other Transport Layer Protocols for Mobile Networks.

Learning Outcome:

1) Student able to understand the issues of databases and Mobile TCP/IP in mobile networks.

UNIT V

Mobile Ad hoc Networks (MANETs): Introduction, Applications & Challenges of a MANET, Routing, Classification of Routing Algorithms, Algorithms such as DSR, AODV, DSDV, etc., Mobile Agents, Service Discovery. **Protocols and Platforms for Mobile Computing:** WAP, Bluetooth, XML, J2ME, Java Card, PalmOS, Windows CE, SymbianOS, Linux for Mobile Devices, Android.

Learning Outcomes:

1) Student able to identify the best routing protocol for mobile networks for data transmission.

Text Books:

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

Reference Book:

1. ASOKE K TALUKDER, HASAN AHMED, ROOPA R YAVAGAL, “Mobile Computing, Technology Applications and Service Creation” Second Edition, Mc Graw Hill.
2. UWE Hansmann, Lother Merk, Martin S. Nocklous, Thomas Stober, “Principles of Mobile Computing,” Second Edition, Springer.

Course Code	Subject Name	L	T	P	C
R23CSE-OE0018	Java Full-Stack Development (Open Elective)	0	1	2	2

Course Objectives:

1. Understand the basics of full-stack web development and the software development life cycle.
2. Design simple and responsive web pages using HTML, CSS, and JavaScript.
3. Develop basic backend applications using Java Servlets, JSP, and connect to databases.
4. Learn how to use SQL for database management.
5. Build and deploy a simple full-stack project using basic tools.

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

1. Understand the structure of a full-stack web application.
2. Design interactive and responsive web pages.
3. Write basic backend logic and connect to a database.
4. Apply simple SQL queries to manage data effectively.
5. Build and deploy a simple full-stack project.

Unit 1: Frontend Development

Introduction to Full-Stack Development

- What is Full-Stack Development?
- Frontend, Backend, and Databases overview

HTML & CSS Basics

- HTML5: Elements, Forms, Tables
- CSS3: Selectors, Flexbox, Grid
- Responsive design with media queries

JavaScript Basics

- Variables, Loops, Functions
- Simple DOM Manipulation and Event Handling

Unit 2: Backend Development

Java Servlets & JSP

- Servlet lifecycle
- Handling HTTP requests and responses
- Basic JSP: Scripting and Expressions

Introduction to Hibernate

- What is Hibernate?
- Basic setup and configuration
- Mapping simple Java classes to database tables

Unit 3: Database Development

SQL Basics

- SELECT, INSERT, UPDATE, DELETE
- Simple JOINs
- Basic database normalization

Hibernate Basics

- Using annotations for mapping
- Simple one-to-many relationships
- Basic queries with HQL

Unit 4: Introduction to Frameworks

Spring & Spring Boot

- What is Spring? IoC and Dependency Injection
- Introduction to Spring Boot: Starter packs, auto-configuration
- Simple Spring Boot application connecting to a database

Unit 5: REST APIs & Deployment

RESTful APIs

- Basic REST concepts: GET, POST, PUT, DELETE
- Building a simple REST API with Spring Boot

Deployment Basics

- Using Git/GitHub for version control
- Testing APIs with Postman
- Simple project deployment (local server)

Project & Capstone

Mini Projects:

- Online Book Store
- Student Portal or basic E-Commerce App

Tools:

- Git/GitHub for version control
- Maven/Gradle for builds
- Postman for testing

Project & Deployment Tools

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

Full-Stack Capstone Project

- Online Book Store / Student Portal
- E-Commerce App with Payment Gateway.

CONTEMPORARY TOPICS:

1. Micro services Architecture using Spring Boot and Spring Cloud
2. JWT-Based Authentication and Authorization in Web Applications
3. Containerization and Deployment using Docker and Kubernetes
4. Integration of No SQL Databases like MongoDB with Java Applications

APPLICATIONS:

1. **Online Book Store**
   - Features: User registration/login, book catalog, shopping cart, order management, admin panel
   - Tech Stack: Java Spring Boot , React/HTML-CSS-JS , MySQL
2. **Student Information Portal**
   - Features: Student profiles, course registration, grade tracking, admin dashboard
   - Tech Stack: Java Servlets + Hibernate, Bootstrap + JavaScript , PostgreSQL
3. **Job Placement Management System**
   - Features: Company registration, student applications, interview tracking, placement stats
   - Tech Stack: Spring Boot + JSP , HTML/CSS + JavaScript , MySQL

TEXT BOOKS:

1. "Learning Web Design" by Jennifer Niederst Robbins, 5th Edition, O'Reilly Media
2. "Beginning Hibernate: For Hibernate 5" by Joseph B. Ottinger, Jeff Linwood, Dave Minter, 4th Edition, Apress

REFERENCE BOOKS:

1. "Web Programming and Internet Technologies"byUttam 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**	**PSO 3**
117.1	3	2	2	1	3				1		1	1	2	3	3
117.2	3	2	2	1	3				1		1	1	2	3	3
117.3	3	3	3	2	3				1		1	2	3	3	3
117.4	3	3	3	2	3				1		1	2	3	3	3
117.5	2	2	2	2	2				1		1	1	2	2	2
117*	3	2	2	2	3				1		1	1	2	3	3

Subject Code	Subject Name	L	T	P	C
R23CSE-OE0019	Human Computer Interface	3	0	0	3

Course Objectives:

1. Demonstrate an understanding of guidelines, principles, and theories influencing human Computer interaction.
2. Recognize how a computer system may be modified to include human diversity.
3. Select an effective style for a specific application.
4. Design mock ups and carry out user and expert evaluation of interfaces.
5. Carry out the steps of experimental design, usability and experimental testing, and evaluation of human computer interaction systems.
6. Use the information sources available, and be aware of the methodologies and technologies supporting advances in HCI.

Course Outcomes:

UNIT-I:

The User Interface: Introduction, Importance of the User Interface, Importance and benefits of Good Design History of Human Computer Interface. Characteristics of Graphical and Web User Interface: Graphical User Interface, popularity of graphics, concepts of Direct Manipulation, Graphical System advantage and disadvantage, Characteristics of GUI. Web User Interface, popularity of web, Characteristics of Web Interface, Merging of Graphical Business systems& the Web, Principles of User Interface Design.

UNIT-II:

The User Interface Design Process: Obstacles and Pitfall in the development Process, Usability, The Design Team, Human Interaction with Computers, Important Human Characteristics in Design, Human Consideration in Design, Human Interaction Speeds, Performance versus Preference, Methods for Gaining and Understanding of Users

UNIT-III:

Understanding Business Functions: Business Definitions & Requirement analysis, Determining Business Functions, Design standards or Style Guides, System Training and Documentation

UNIT-IV:

Principles of Good Screen Design: Human considerations in screen Design, interface design goals, test for a good design, screen meaning and purpose, Technological considerations in Interface Design System Menus and Navigation Schemes: Structure, Functions, Context, Formatting, Phrasing and Selecting, Navigating of Menus, Kinds of Graphical Menus Windows Interface: Windows characteristic, Components of Window, Windows Presentation Styles, Types of Windows, Window Management, Web systems.

UNIT-V:

Device and Screen-Based Control: Device based controls, Operable Controls, Text entry/read-Only Controls, Section Controls, Combining Entry/Selection Controls, Other Operable Controls and Presentation Controls, Selecting proper controls

Text Books:

1. Wilbert O. Galitz, “The Essential Guide to User Interface Design”, Wiley India Edition
2. Prece, Rogers, “Sharps Interaction Design”, Wiley India.
3. Ben Shneidermann,”Designing the user interfaces”. 3rd Edition, Pearson Education Asia.

References Books:

1. Soren Lauesen, “User Interface Design” , Pearson Education
2. Alan Cooper, Robert Riemann, David Cronin, “Essentials of Interaction Design”, Wiley
3. Alan Dix, Janet Fincay, GreGoryd, Abowd, Russell, Bealg,”HumanComputer Interaction”, Pearson Education

Subject Code	Subject Name	L	T	P	C
R23CSE-OE0020	**Cryptography and network security**	3	0	0	3

Course Objectives:

- Understand the fundamentals of Information Security
- Acquire knowledge on Security Needs to provide confidentiality, integrity and authenticity.
- Understand the various key cryptography concepts
- Design security applications using security policies
- Understand the Security Issues in TCP/IP

Course Outcomes:

1. Analyze the vulnerabilities in any computing system and hence be able to design a security solution
2. Identify the security needs in the network
3. Explain the basic objectives of symmetric &Asymmetric key cryptography technique to secure the communication over the internet
4. Identify the security policies to provide strong authentication
5. Understand basic ecommerce security protocols.

Unit 1: Introduction.

The History of Information Security, Balancing Information Security and Access, Introduction and Security Trends, General Security Concepts and introduction to what is an "info sphere", Operational Security and People's Role in Information Security.

Learning outcomes: Student should be able to

1. Understand various types of Information Security concepts (L2)
2. Analyze the role of information security.(L4)

Unit 2: Security Needs.

The Need for Security, Business Needs, Needs to protect against Threats and Attacks, Security in Emails. Secure Software Development.

Learning outcomes: Student should be able to

1. Understand the need of security to deal with the threats and attacks.(L2)

Unit 3: Cryptography Concepts.

Concepts of Data encryption, Introduction, Plaintext & Cipher text, Substitution Techniques, Transposition Techniques, Encryption & Decryption, Symmetric& Asymmetric key Cryptography. Public Key Infrastructure (PKI), Different attacks on Cryptosystems

Network Security & Web Security.

Security Issues in TCP/IP – TCP, DNS, Routing (Topics such as basic problems of security in TCP/IP, IPsec, BGP Security, DNS Cache poisoning etc), Network Defense tools – Firewalls, Intrusion Detection, Filtering, DNSSec, NSec3, Distributed Firewalls

Learning outcomes: Student should be able to

1. Understand various Cryptography Concepts (L2)
2. Analyze the impact of Symmetric& Asymmetric key Cryptography in real time applications (L4)
3. Understand Security Issues in TCP/IP. (L2)
4. Identify the tools to provide the web and network security. (L2)

Unit 4: Security Policies and Security Handshake Pitfalls:
What is security policy, high and low level policy, user issues? Protocol problems, assumptions, Shared secret protocols, public key protocols, mutual authentication, reflection attacks, use of timestamps, nonce and sequence numbers, session keys, one-and two-way public key based authentication.
Learning Outcomes: Student should be able to

1. Understand various Security Policies for authentication (L2)
2. Identity various Security Handshake (L2)

Unit 5: Network Security:
Electronic mail security, IP security, Network management security. Security for electronic commerce: E-commerce security analysis, protocol, SSL, SET
System Security:
Intruders and Viruses, Firewalls, Intrusion Detection.
Learning outcomes: Student should be able to

1. Apply the concepts of the cryptography and security in case studies. (L4)

Text Books:
1. Michael E Whitman and Herbert J Mattord, "Principles of Information Security", Vikas Publishing House, New Delhi.
2 Micki Krause, Harold F. Tipton, " Handbook of Information Security Management", CRC Press LLC
3. AtulKahate, Cryptography and Network Security, McGraw Hill
4 Kaufman, c., Perlman, R., and Speciner, M., Network Security, Private Communication in a public world, 2nd ed., Prentice Hall PTR., 2002
5. Stallings, W.,.Cryptography and Network Security: Principles and Practice, 3rd ed., Prentice Hall PTR.,2003
6. Stallings, W. Network security Essentials: Applications and standards, Prentice Hall, 2000

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

CNO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO2	PSO 3
	3	2						1				2		1	1
	2	2						1				2		1	1
	2	2						1				2		1	1
	2	2						1				2		1	1
	2	2						1				2		1	1
	2	2						1				2		1	1

Subject Code	Subject Name	L	T	P	C
R23CSE-OE0021	**QUANTUM COMPUTING**	**3**	**0**	**0**	**3**

Course Objectives:

1. To understand the components of computing in a Quantum world
2. To gain knowledge on mathematical representation of quantum physics and operations.
3. To write computations in the real world (standard) in a Quantum computer and simulator.

Course Outcomes:

By the end of this course, the student is able to

1. Analyze the behavior of basic quantum algorithms
2. Implement simple quantum algorithms and information channels in the quantum circuit model
3. Simulate a simple quantum error-correcting code
4. Prove basic facts about quantum information channels
5. Know about Quantum Computing Models

UNIT –I:

Introduction: Quantum Measurements Density Matrices, Positive-Operator Valued Measure, Fragility of quantum information: Decoherence, Quantum Superposition and Entanglement, Quantum Gates and Circuits.

UNIT –II:

Quantum Basics and Principles: No cloning theorem & Quantum Teleportation, Bell's inequality and its implications, Quantum Algorithms & Circuits.

UNIT -III:

Algorithms: Deutsch and Deutsch–Jozsa algorithms, Grover's Search Algorithm, Quantum Fourier Transform, Shore's Factorization Algorithm.

UNIT –IV:

Performance, Security and Scalability: Quantum Error Correction: Fault tolerance; Quantum Cryptography, Implementing Quantum Computing: issues of fidelity; Scalability in quantum computing.

UNIT -V:

Quantum Computing Models: NMR Quantum Computing, Spintronics and QED MODEL, Linear Optical MODEL, Nonlinear Optical Approaches; Limits of all the discussed approaches, Future of Quantum computing.

Text Books:

1. Eric R. Johnston, Nic Harrigan, Mercedes and Gimeno-Segovia “Programming Quantum Computers: Essential Algorithms And Code Samples, SHROFF/O’Reilly.
2. Dr. Christine Corbett Moran, Mastering Quantum Computing with IBM QX: Explore the world of quantum computing using the Quantum Composer and Qiskit, Kindle Edition Packt

Subject Code	Subject Name	L	T	P	C
R23CSE-OE0022	**BIG DATA ANALYTICS**	3	0	0	3

Course Objectives:

- Optimize business decisions and create a competitive advantage with Big Data analytics
- Introducing Hadoop concepts for developing solutions.
- Derive business benefits from unstructured data
- Imparting the architectural concepts of Hadoop and introducing map- reduce paradigm
- To introduce programming tools PIG & HIVE in the Hadoop ecosystem.

Course Outcomes:

1. Understands the basic concepts and challenges of handling Big Data.
2. Applying data modelling techniques of Big Data.
3. Analyze Hadoop components & its applications.
4. Analyze spark for optimized query execution and memory caching.
5. Understand the Big data frame work and its applications.

UNIT-I

Introduction: Introduction to Big data, Characteristics &Classification of Data, Challenges of conventional systems(storage), Intelligent data analysis, The Life cycle of Big Data Analytics, Typesof Big Data Analytics, Analytic processes, and tools, Big Data Industry Applications, Analysisvs. Reporting.

Learning Outcomes: Students will be able to

- Understands the Basic concept of Big Data.
- Understands their challenges in the industry

UNIT-II

Working with Big Data: Google File System, Hadoop Distributed File System (HDFS) –Building blocksof Hadoop (Name node, Datanode, Secondary Name node, Job Tracker,Task Tracker),WhatisNoSQL,WhyNoSQL, Use of No SQL in Industry, Comparison of SQL, No SQL, and New SQL ,No SQL Business Drivers ,No SQL Case Studies,

Learning Outcomes:Students will be able to

- Understand HDFS and its basic building blocks
- Understand No SQL for working with Data sets.

UNIT-III

IntroductiontoHadoop:why Hadoop, RDBMS versus Hadoop, History of Hadoop, Components of Hadoop, Hadoop Distributed File System (HDFS), Processing Data withHadoop, How Map Reduce Works, Anatomy of a Map Reduce Job run ,Map Reduce Features Hadoop environment. Interacting with Hadoop Ecosystem.

Learning Outcomes:Studentswill beableto

- UnderstandandimplementHadoopComponents.
- UnderstandtheConceptofInteractingwiththeHadoopEcosystem.

UNIT-IV

SPARK: SPARK BASICS, Using the Spark Shell, RDD Data Types and RDD Creation, RDDs (Resilient Distributed Datasets) in Spark, General RDD Operations: Transformations & Actions, RDD Lineage, RDD Persistence, Overview, Distributed Persistence

Learning Outcomes: Student will be able to

- Understand Hadoop Architecture,
- Explain about Hadoop Ecosystem components.

UNIT-V

Frameworks and Applications: HIVE : Hive Shell, Hive Services, Hive Meta store, Comparison with Traditional Databases **Learning,**Frameworks: Applications on Big Data Using Pig and Hive, Data processing operators in Pig, Hive Architecture of Hive, Hive services, HiveQL, Querying Data in Hive, fundamentals of H Base and Zoo keeper.

Outcomes: Students will be able to

- Work with PIG and Hive Tech.
- Understandprogrammingtoolsof HIVEintheHadoopechosystem.
- Appling acompletebusinessdataanalyticsolution.

Text Books :

1. BigDataAnalytics2ndEdition,SeemaAcharya,SubhashiniChellappan,WileyIndiaPvt.Ltd, SecondEdition,1Jan 2019.
2. Min Chen, Shiwen Mao, Yin Zhang,Victor C.M. Leung, "Big Data: Related Technologies, Challenges and Future Prospects", Springer; 2014.
3. BigJava4thEdition,CayHorstman,WileyJohnWiley&Sons,INC,byWileyIndiaPvt. Ltd,2008.
4. Hadoop:TheDefinitiveGuidebyTomWhite,3rdEdition,O'Reilly,12June 2012.
5. Tom White, "Hadoop- The Definitive Guide", O'reilly, 4th Edition, April 2015.

Reference Books :

1. HadoopinPracticebyAlexHolmes,MANNINGPubl,SecondEdition,5Feb2015.
2. HadoopMapReduceCookbook,SrinathPerera,ThilinaGunarathne,Ingramshorttitle, 1Jan 2013.
3. Hadoop for Dummies by Dirk deRoos, Paul C.Zikopoulos, RomanB.Melnyk,BruceBrown,Rafael Coss,byForDummies, FirstEdition,7 May2014.
4. Eric Sammer, "Hadoop Operations", O'Reilley, 2nd Edition., October 2012.

Software Links :

1. Hadoop:http://hadoop.apache.org/+
2. Hive:https://cwiki.apache.org/confluence/display/Hive/Home
3. Piglatin:http://pig.apache.org/docs/r0.7.0/tutorial.html
4. http://www.jbonneau.com/doc/2012-04-27-big_data_lecture_1.pdf
5. https: //www.ibm.com / developerworks / community / blogs / Susan Visser Editionntry/flash book understanding big data analytics for enterprise class hadoop and streaming data? Langen

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

Subject Code	Subject Name	L	T	P	C
R23CSE-OE0023	**BLOCK CHAIN TECHNOLOGIES**	**3**	**0**	**0**	**3**

Course Objective:

1. To provide conceptual understanding of the function of Blockchain as a method of securing distributed ledgers.
2. To understand the structure of a Blockchain and why/when it is better than a simple distributed database
3. To make students understand the technological underpinnings of Blockchain operations as distributed data structures and decision making systems.

Course Outcomes:

Upon completion of the course, it is expected that student will be able to:

1. Define and explain the fundamentals of Blockchain.
2. Understand decentralization and the role of Blockchain in it.
3. UnderstandandanalyzeBitcioinCryptocurrencyandunderlyingBlockchainnetwork.
4. Understand Etherium currency and platform, and develop applications using Solidity.
5. Understand Hyper ledger project and its components; critically analyze the challenges and future opportunities in Block chain technology.

UNIT-I:

Introduction: History and basics, Types of Blockchain, Consensus, CAP Theorem.

Cryptographic Hash Functions: Properties of hash functions, Secure Hash Algorithm, Merkle trees, Patricia trees.

UNIT-II:

Decentralization: Decentralization using Blockchain, Methods of decentralization, decentralization framework, Blockchain and full ecosystem decentralization, Smart contracts, Decentralized Organizations, Platforms for decentralization.

UNIT-III:

Bitcoin: Introduction to Bitcoin, Digital keys and addresses, Transactions, Blockchain, The Bitcoin network, Bitcoin payments, Bitcoin Clients and APIs, Alternatives to Proof of Work, Bitcoin limitations.

UNIT-IV:

Etherium: Smart Contracts, Introduction to Ethereum, The Ethereum network, Components of the Ethereum ecosystem, Blocks and Blockchain, Fee schedule, Ethereum Development Environment, Solidity.

UNIT-V:

Hyperledger: Introduction, Hyperledger Projects, Protocol, Architecture, Hyperledger Fabric, Sawtooth Lake, Corda.

Challenges and Opportunities: Scalability, Privacy, Blockchain for IoT, Emerging trends

Text Book:

1. Mastering Block chain, Imran Bashir, Second Edition, PacktPublishing.

References:

1. Mastering Bitcoin: Unlocking Digital Cryptocurrencies, 3rd Edition Andreas Antonopoulos,O'Reilly.
2. Blockchain Blueprint for a New Economy, Melanie Swan,O'Reilly.
3. Mastering Bitcoin: Programming the Open Blockchain, Antonopoulos, Andreas M. O'Reilly.
4. Blockchain Technology: Cryptocurrency and Applications, S. Shukla, M. Dhawan, S. Sharma, S. Venkatesan, Oxford University Press

Subject Code	Subject Name	L	T	P	C
R23CSE-OE0024	**MULTIMEDIA APPLICATION DEVELOPMENT**	3	0	0	3

COURSE OBJECTIVES: To learn

1. To understand the definition of multimedia
2. To understand and differentiate text, image, video & audio.
3. To describe the ways in which multimedia information is captured, processed, and rendered
4. Introduce multimedia quality of service (QoS) and to compare subjective and objective methods of assessing user satisfaction and multicast protocols to provide QoS guarantees
5. Discuss privacy and copyright issues in the context of multimedia

COURSE OUTCOMES: Upon successful completion of the course, the student is able to

1. Describe different realizations of multimedia tools and the way in which they are used
2. Analyze the structure of the tools in the light of low-level constraints imposed by the adoption of various QoS schemes (i.e. bottom up approach)
3. Analyze the effects of scale and use on both presentation and lower-level requirements (i.e. top down approach)
4. State the properties of different media streams;
5. Compare and contrast different network protocols and to describe mechanisms for providing QoS guarantees in the network.

UNIT – I Classes: 12

Introduction: Definitions - Brief history of Multimedia; its market; content and copyright –public Domain, establishment of Copyright, fair use, multimedia copyright issues; resources for multimedia developers – Uses of multimedia - Making multimedia : Stages of a project

UNIT – II Classes: 14

Hardware Macintosh Versus Windows Platform – Connections – SCSI – IDE – EIDE – ULTRA – IDE – ATA – ULTRA - ATA - Memory and Storage Devices - Input Devices - Output Hardware – CommunicationDevices Basic Software Tools :Text Editing - Word Processing - OCR Software - Painting and Drawing Tools - 3D Modeling and Animation Tools - Image Editing - Sound Editing – Animation – Video - Digital Movie tools - Movie Editors - Compressing Movie Files MLR Institute of Technology B.Tech-IT Academic Regulations &Syllabi – MLR18

UNIT – III Classes: 14

Text : Fonts – Designing – Choosing -Menus for Navigation - Buttons for Interaction – Fields for Readings - HTML Documents - Symbols and Icons – Animating - Fonts Foundries – Managing Fonts - Character sets and Alphabets - Mapping Text – Fontographer - Hypermedia Structures – Hypertext tools Sound : Power of sound - Multimedia System Sound - MIDI Versus Digital Audio - Preparing Digital Audio Files - Making MIDI Audio - Audio File Formats - Sound for the World Wide Web – Adding Sound to Your Multimedia Project - Toward Professional Sound - The Red Book Standard – Space Considerations - Production Tips - Audio Recording -

Keeping Track of Your Sounds - Testing and Evaluation

UNIT – IV Classes: 12

Introduction: The Bandwidth Bottleneck - Internet Services - MIME-Types - World Wide Web and HTML – Dynamic Web Pages and XML - Multimedia on the Web. Tools for the World Wide Web: Web Servers - Web Browsers - Web Page Makers and Site Builders - Plug ins and Delivery Vehicles - Text – Images –Sound - Animation, Video and Presentation - Beyond HTML - 3D Worlds, designing for the World Wide Web..

UNIT – V Classes: 08

Multimedia File Handling: Compression & De compression - Data & file formats standards - Digital voice, Audio, video – Video image and Animation - Full motion video - storage and retrieval Technologies

Text Books:

1. Multimedia making it work Tay Vaughan Tata McGrawHill, Delhi
2. Multimedia – Technology and applications David Hillman Galgotia Publications, Delhi

Subject Code	Subject Name	L	T	P	C
R23CSE-OE0025	**MOBILE AD-HOC NETWORKS**	3	0	0	3

Course Objectives:

- To understand the concepts of Ad Hoc Wireless Networks
- To understand the Data Transmission in MANETS
- To understand the MAC protocols for ad-hoc networks
- To understand and analyze the various routing protocols and model link cost
- Understanding cross layer design in Adhoc Networks

Course Outcomes:

1. Evaluate the principles and characteristics of mobile ad hoc networks (MANETs) and what distinguishes them from infrastructure-based networks
2. Discuss the challenges in designing MAC, routing, and transport protocols for wireless ad-hoc sensor networks
3.. Understand the MAC Protocols for Ad Hoc Wireless Networks
4. Illustrate the various Routing Protocols And Transport Layer In Ad Hoc Wireless
5. Demonstrate the issues and challenges in security provisioning and also familiar with the mechanisms for implementing security and trust mechanisms in MANETs and WSNs

UNIT - 1

INTRODUCTION: Introduction to ad-hoc networks – definition, characteristics features, applications. Characteristics of wireless channel, ad-hoc mobility models: indoor and outdoor models.

UNIT - 2

MEDIUM ACCESS PROTOCOLS: MAC Protocols: Design issues, goals and classification. Contention based protocols – with reservation, scheduling algorithms, protocols using directional antennas. IEEE standards: 802.11a, 802.11b, 802.11g, 802.15. HIPERLAN.

UNIT - 3

NETWORK PROTOCOLS: Routing Protocols: Design issues, goals and classification. Proactive Vs reactive routing, unicast routing algorithms, Multicast routing algorithms, hybrid routing algorithm, energy aware routing algorithm, hierarchical routing, QoS aware routing.

UNIT - 4

END – END DELIVERY AND SECURITY: Transport Layer: Issues in designing – Transport layer classification, adhoc transport protocols.
Security issues in adhoc networks: issues and challenges, network security attacks, secure routing protocols.

UNIT – 5

CROSS LAYER DESIGN:
Cross layer Design: Need for cross layer design, cross layer optimization, parameter optimization techniques, cross layer cautionary perspective. Integration of adhoc with Mobile IP networks.

TEXT BOOKS:

1. C. Siva Ram Murthy and B. S. Manoj, Ad hoc Wireless Networks Architecture and Protocols, 2nd edition, Pearson Edition, 2007.
2. Charles E. Perkins, Ad hoc Networking, Addison – Wesley, 2000.

REFERENCES:

1. Stefano Basagni, Marco Conti, Silvia Giordano and Ivan stojmenovic, Mobile ad-hoc networking, Wiley-IEEE press, 2004.
2. Mohammad Ilyas, The handbook of ad-hoc wireless networks, CRC press, 2002.
3. T. Camp, J. Boleng, and V. Davies " A Survey of Mobility Models for Ad-hoc Network"
4. Research, "Wireless Commun, and Mobile Comp.. Special Issue on Mobile Ad-hoc Networking Research, Trends and Applications, Vol. 2, no. 5, 2002, pp. 483 – 502.
5. A survey of integrating IP mobility protocols and Mobile Ad-hoc networks, Fekri M.bduljalil and Shrikant K. Bodhe, IEEE communication Survey and tutorials, no: 12007.

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

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

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. Silbers chatz 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 SE Linux 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 journal ctl.

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.

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 Matplot lib.

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 Stagging –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 Hobbsand 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, JamesH.Martin — Speechand 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, OReilly Media, 2009.

Reference Text Books:

3. BreckBaldwin,— Language Processing with Javaand Ling Pipe Cook book, Atlantic Publisher, 2015.
4. Richard M Reese,—Natural Language Processing with Java, OReilly Media, 2015.
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