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) Jonnada (Village), Denkada (Mandal), Vizianagaram Dist – 535 005
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COURSE STRUCTURE AND DETAILED SYLLABUS
B.TECH- COMPUTER SCIENCE AND INFORMATION TECHNOLOGY

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**	3	0	0	3
	R23CIT-PE3101.1	1.Devops				
	R23CIT-PE3101.2	2. Advanced Computer Architecture				
	R23CIT-PE3101.3	3. Artificial Intelligence and Neural Networks				
5.		**Open Elective- III**	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
	R23CIT-SC3101	Angular JS (Skill Oriented Course)	0	1	2	2
	R23CIT-ES3101	Tinkering Lab	0	0	2	1
8.	R23BSH-MC3101	English and Soft Skills for Job Seekers (Mandatory Course)	0	1	2	0
9.	R23CIT-SI4101	Evaluation of Community Service Project Internship	-	-	-	2
Total			**15**	**2**	**12**	**23**
Honor /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**				
	R23CIT-PE3202.1	1.Distributed Systems	3	0	0	3
	R23CIT-PE3202.2	2. Advanced Computer Networks				
	R23CIT-PE3202.3	3. Cloud Computing				
6.		**Open Elective- III**	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 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 /Minor Course-3						
Summer Internship (During the Summer Vacation after Third Year & Evaluated in IV-I Semester)						

Open Electives Courses

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

Honors & Minors Courses

Note: The registered student shall acquire 18 credits through NPTEL/Offline Courses.

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 –II to IV -II	R23CIT-HM0001	Honors MOOCS-1	0	0	0	3
6	II –II to IV -II	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 –II to IV –II	R23CIT-HM0001	Honors MOOCS-1	0	0	0	3
6	II –II to IV –II	R23CIT-HM0002	Honors MOOCS-2	0	0	0	3
Total							**18**

Track-III (Cyber 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 –II to IV -II	R23CIT-HM0001	Honors MOOCS-1	0	0	0	3
6	II –II to IV -II	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 –II to IV -II	R23CIT-HM0001	Honors MOOCS-1	0	0	0	3
6	II –II to IV -II	R23CIT-HM0002	Honors MOOCS-2	0	0	0	3
Total							**18**

Track-V (Artificial Intelligence)

S.No	Year & Semester	Course Code	Subject title	L	T	P	C
1	II-II	R23CIT-HN2205	AI for Problem Solving	3	0	0	3
2	III-I	R23CIT-HN3105	Social Network Analysis	3	0	0	3
3	III-II	R23CIT-HN3205	Deep Learning for Computer Vision	3	0	0	3
4	IV-I	R23CIT-HN4105	AI in X	3	0	0	3
5	II –II to IV -II	R23CIT-HM0001	Honors MOOCS-1	0	0	0	3
6	II –II to IV -II	R23CIT-HM0002	Honors MOOCS-2	0	0	0	3
Total							**18**

Minors Offered To CSIT BY ECE Department
(Track: Quantum Computing)

S.No	Year & Semester	Course Code	Subject title	L	T	P	C
1	II-II	R23ECE-MT2204	Foundations of Quantum Computing: Physics, Engineering, and Mathematics Computing	3	0	0	3
2	III-I	R23ECE-MT3104	Survey of Quantum Technologies and Applications	3	0	0	3
3	III-I	R23ECE-MT3104.1	Quantum Technology-1 Lab	0	0	3	1.5
4	III-II	R23ECE-MT3204	Foundations of Quantum Technologies	3	0	0	3
5	III-II	R23ECE-MT3204.1	Quantum Technology-2 Lab	0	0	3	1.5
6	IV-I	R23ECE-MT4104	1. Quantum Computation (OR) 2.Quantum Communications	3	0	0	3
7	II –II to IV -II	R23CIT-HM0001	Honors MOOCS-1	0	0	0	3
Total							**18**

B.Tech III Year - I Semester - Detailed Syllabus

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, DeterministicFinite 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.

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, Requirement's 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-offs 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/

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:

- 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	PO 8	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
CO.*	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	

R23CIT-HN3105	Social Network Analysis	L	T	P	C
		3	0	0	3

Course Objective:

- Social network analysis is to understand a community by mapping the relationships that connect them as a network, and then trying to draw out key individuals, groups within the network and/or associations between the individuals.

Course Outcomes:

- Understand the importance of social network analysis and various network measures.
- Summarize network growth models and applications of link analysis
- Apply different graph visualization tools on community detection and link predictions.
- Development of models using cascading behavior with promising network effects.
- Development of Recommendation Systems

Unit-1:(10 Hours)

Introduction to Social Network Analysis, Introduction to Colab, Introduction to NetworkX, **Network Measures**- Basics, Node Centrality, Transitive and Reciprocity, Similarity and Degeneracy.

Unit-2: (10 Hours)

Network Growth Models-Properties of real world network, Random Network Model, Ring Lattice, Network Model, Watts Strogatz Model, Link **Analysis**- Applications, Signal Networks, Strong and Weak Ties.

Unit 3:(10 Hours)

Graph Visualization Tools. Community Detection - Applications, Types of communities, Detection Methods, Overlapping, Community Detection Vs Community v's Search. **Link Prediction**- Applications, Temporal changes in network, Prediction Networks and Heuristic Models.

Unit 4:(10 Hours)

Cascade Behaviour- Models, Probabilistic Cascades, Epedemic Models, Independent Models, CascadePrediction. **Network Effects&Anomaly Detection**- Outliers and Network Based Anomalies, Challenges Anomaly detection in static and dynamic models.,

Unit-5:(08 Hours)

Graph Representation Learning, Coding on Graph Representation Learning- Criteria on GRL, Representation Learning Methods**, Applications and Case Studies**- Malicious activities on OSNs and Recommendation Systems.

Books and references

1. Social Network Analysis, Tanmoy Chakraborty, Wiley, 2021
2. Network Science, Albert-Lazzlo Barabasi
3. Social Network Analysis: Methods and Applications, Stanley Wasserman, Katherine Faus

Link:https://onlinecourses.nptel.ac.in/noc22_cs117/preview

R23CIT-HN3205	Deep Learning for Computer Vision	L	T	P	C
		3	0	0	3

Course Objective:

- Recognise and describe how mathematical and scientific concepts are applied in computer vision.
- Identify and interpret appropriate sources of information relating to computer vision.
- Apply knowledge of computer vision to real life scenarios.

Course Outcomes:

- Describe how mathematical and scientific concepts are applied in computer vision through images.
- Identify appropriate sources of information and architecture relating to computer vision.
- Understand the concept of visualization using CNN.
- Apply the concepts of advanced CNN and RNN techniques for computer vision problems.
- Apply knowledge of computer vision to real life scenarios.

Unit-1: (10 Hours)

Introduction and Overview: Introduction to Image Formation:Capture and Representation; Linear Filtering, Correlation and Convolution. **Visual Features and Representations:** Edge, Blobs, Corner Detection; Scale Space and Scale Selection; SIFT, SURF; HoG, LBP, etc.

Unit-II:(10 Hours)

Visual Matching: Bag-of-words, VLAD; RANSAC, Hough transform; Pyramid Matching; Optical Flow. **Deep Learning Review-** Review of Deep Learning, Multi-layer Perceptrons, Backpropagation. **Convolutional Neural Networks (CNNs)-** Introduction to CNNs; Evolution of CNN Architectures: AlexNet, ZFNet, VGG, InceptionNets, ResNets, DenseNets

Unit-III:(10 Hours)

Visualization and Understanding CNNs: Visualization of Kernels; Backprop-to-image/Deconvolution Methods; Deep Dream, Hallucination, Neural Style Transfer; CAM,Grad-CAM, Grad-CAM++; Recent Methods (IG, Segment-IG, SmoothGrad)

Unit-IV(10 Hours)

CNNs for Recognition and Verification (Siamese Networks, Triplet Loss, Contrastive Loss, Ranking Loss); CNNs for Detection: Background of Object Detection, R-CNN, Fast R-CNN, Faster R-CNN, YOLO, SSD, RetinaNet; CNNs for Segmentation: FCN, SegNet, U-Net, Mask-RCNN. **Recurrent Neural Networks (RNNs):** Review of RNNs; CNN + RNN Models for Video Understanding: Spatio-temporal Models, Action/Activity Recognition

Unit-V:(08 Hours)

Attention Models: Introduction to Attention Models in Vision; Vision and Language: Image Captioning, Visual QA, Visual Dialog; Spatial Transformers; Transformer Networks. **Deep Generative Models:**Deep Generative Models: GANs, VAEs; Other Generative Models: PixelRNNs, NADE, Normalizing Flows. Applications.

Books and references

●Ian Goodfellow, Yoshua Bengio, Aaron Courville, Deep Learning, 2016
●Michael Nielsen, Neural Networks and Deep Learning, 2016
●Yoshua Bengio, Learning Deep Architectures for AI, 2009
●Richard Szeliski, Computer Vision: Algorithms and Applications, 2010.
●Simon Prince, Computer Vision: Models, Learning, and Inference, 2012.
●David Forsyth, Jean Ponce, Computer Vision: A Modern Approach, 2002.

Link:https://onlinecourses.nptel.ac.in/noc20_cs88/preview

R23ECE-MT3104	Survey of Quantum Technologies and Applications	L	T	P	C
		3	0	0	3

Course Objectives:

- To introduce the four foundational verticals of quantum technologies: computation, communication, sensing, and materials.
- To provide students with qualitative understanding of key quantum physics principles behind modern quantum tech.
- To explore the real-world hardware platforms used to build quantum systems.
- To introduce applications and potential impact of quantum technologies in real systems.
- To build awareness of India's and global quantum research directions and strategic roadmaps.

Course Outcomes:

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

- **CO1:** Describe the basic physical principles of quantum phenomena such as superposition, entanglement, and tunneling. (L2)
- **CO2:** Explain different physical implementations of qubits and their applications in quantum computing. (L2)
- **CO3:** Understand the working and application of quantum sensing devices such as atomic clocks and magnetometers. (L2)
- **CO4:** Explain core principles and real-world implementations of quantum communication systems. (L2)
- **CO5:** Discuss recent advances and future directions in quantum technologies across multiple domains. (L2)

UNIT – I: Introduction to Quantum Technologies and Principles of Quantum Physics

- Overview of the four verticals in quantum technology
- Motivation for quantum technologies in India and globally
- Quantum states and wavefunctions
- Measurement and observables, Hermitian operators
- Heisenberg uncertainty, Schrödinger equation
- Key quantum phenomena: Superposition, Entanglement, No-cloning theorem
- Feynman's quantum simulator idea

Learning Outcomes:

- Identify fundamental differences between classical and quantum systems.
- Describe core quantum mechanical concepts necessary for technological applications.

UNIT – II: Quantum Computation: Qubits, Circuits, and Implementations

- What is a qubit? Comparison with classical bits
- Review of classical logic gates
- Di Vincenzo criteria
- Basic quantum gates and circuits
    - Hardware implementations (qualitative)Superconducting qubits (charge, flux, phase)
    - Semiconductor qubits (quantum dots, spins)
    - Topological qubits
    - Trapped ions, Rydberg atoms, NV centers, NMR qubits
    - Photonic and integrated photonic qubits
- Applications: RSA breaking with Shor's algorithm, Grover's algorithm
- Quantum error correction overview

Learning Outcomes:

- Identify and describe various types of physical qubits.
- Explain the structure and use of basic quantum circuits.

UNIT – III: Quantum Sensing: Theory and Applications

- Introduction to quantum sensing and metrology
- Single-photon and entangled-photon detection
- Quantum-enhanced measurements
- Gravimetry, Magnetometry, Atomic clocks
- Real-world quantum sensing platforms and global status

Learning Outcomes:

- Explain the working principles of quantum sensors.
- List practical applications of quantum-enhanced measurement systems.

UNIT – IV: Quantum Communication: Principles and Platforms

- Basics of classical digital communication
- Shannon entropy and classical information theory
- Quantum key distribution (QKD) and security principles
- Eavesdropping and no-cloning
- Quantum communication via fiber and satellite
- Overview of major global projects (Micius satellite, India's QKD experiments)

Learning Outcomes:

- Describe how quantum mechanics ensures secure communication.
- Differentiate fiber-based and satellite-based QKD systems.

UNIT – V: Integration, Roadmaps and Future Trends

- Overview of cross-domain quantum technologies
- National and global roadmaps (India Quantum Mission, EU QT Flagship, IBM, Google)
- Research challenges in scaling, error correction, and decoherence
- Interdisciplinary role of quantum materials (brief integration)
- Quantum advantage and commercialization of quantum systems

Learning Outcomes:

- Summarize current national/global strategies in quantum tech development.
- Identify open problems and future research opportunities in quantum systems.

Textbooks:

1. **Manenti R., Motta M.**, Quantum Information Science, 1st Edition, Oxford University Press, 2023
2. **M. A. Nielsen & I. L. Chuang**, Quantum Computation and Quantum Information, 10th Anniversary Edition, Cambridge University Press, 2010

Reference Books:

1. **A. Pathak**, Elements of Quantum Computation and Quantum Communication, CRC Press, 2015
2. **Phillip Kaye, Raymond Laflamme, Michele Mosca**, An Introduction to Quantum Computing, Oxford University Press, 2006
3. **David McMahon**, Quantum Computing Explained, Wiley, 2008

R23ECE- MT 3204	Foundations of Quantum Technologies (3:0) – Mandatory	L	T	P	C
		3	0	0	3

Course Objectives:

- To introduce the key principles of quantum mechanics in a simple and intuitive manner.
- To connect quantum ideas with real-life applications in communication, computing, and sensing.
- To expose students to basic concepts from quantum information, statistical physics, and computational models relevant to emerging technologies.

Unit 1: Introduction to Quantum Ideas

classical to quantum thinking is introduced using experiments like the photoelectric effect and blackbody radiation. Key discoveries such as Planck's quantum hypothesis, Bohr's atomic model, and wave-particle duality (de Broglie) are covered with real-world relevance (e.g., LEDs, solar cells).

Unit 2: Basics of Quantum Mechanics

concept of quantum states, wave functions, and probabilities. Dirac notation (bra-ket), superposition, and measurement. Real-life examples such as electron in an atom, and quantum tunneling,. Simple models like a particle in a box and harmonic oscillator,

Unit 3: Spin, Entanglement, and Quantum Applications

using simple models (like spin-½ particles), and how entanglement plays a role in quantum communication. Quantum teleportation and quantum key distribution,. The no-cloning theorem and quantum superposition, secure data sharing and quantum sensing.

Unit 4: Basics of Quantum Information and Noise

quantum information differs. Shannon entropy, and its quantum counterpart (von Neumann entropy) noise, decoherence, and the challenge of maintaining quantum states in real systems, communication channels and qubit errors.

Unit 5: Introduction to Quantum Computation and Post-Quantum Ideas

quantum computers powerful is provided, including the idea of quantum parallelism. The concept of computational problems (like searching and factoring) ,. Complexity classes such as P, NP, and BQP. The importance of quantum-safe encryption and post-quantum cryptography .

Course Outcomes:

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

1. Explain key differences between classical and quantum systems using real-world examples.
2. Describe quantum mechanical concepts such as superposition, uncertainty, and entanglement.
3. Understand the role of spin and entanglement in modern technologies like quantum communication.
4. Recognize how noise and decoherence impact quantum devices.
5. Appreciate the potential of quantum computing and the need for post-quantum cryptography.

Text/Reference Books:

1. Griffiths, D. J., Introduction to Quantum Mechanics, Cambridge Univ. Press (2024)
2. A. Pathak, Elements of Quantum Computation and Quantum Communication, CRC Press (2015)
3. Nielsen & Chuang, Quantum Computation and Quantum Information, Cambridge Univ. Press (2010)
4. Quantum Physics for Beginners – NPTEL Video Lectures, Prof. V. Balakrishnan (IIT Madras)
5. Manenti & Motta, Quantum Information Science, Oxford Univ. Press (2023)

R23ECE-MT3104.1	Quantum Technology Laboratory-1 (QT-LAB)	L	T	P	C
		0	0	3	1.5

Course Objectives

1. To equip students with computational techniques (Python/Julia/Matlab) for solving matrix problems, eigenvalue problems, and data fitting.
2. To enable understanding of quantum mechanical systems through simulations of two-level systems, Rabi oscillations, and the Jaynes–Cummings model.
3. To provide exposure to classical experiments such as the Zeeman effect, RLC circuits, and polarization optics.
4. To introduce finite element and numerical methods for solving electromagnetism-related problems.
5. To integrate hardware and computational experiments to develop problem-solving and analytical skills.

Course Outcomes

After completing this lab, students will be able to:

1. Implement numerical methods (matrix operations, SVD, Monte Carlo methods, least squares fitting) and validate with simulations.
2. Analyze and simulate quantum phenomena like coupled two-level systems, Rabi oscillations, and light–matter interaction models.
3. Perform and interpret classical physics experiments such as the Zeeman effect, diffraction, interference, and polarization optics.
4. Apply computational methods to solve problems in electromagnetism, such as electrostatic charge distributions.
5. Design, build, and test simple electronic and digital circuits (RLC resonance, digital logic circuits).

List of experiments

A. Numerical Techniques (Computational – Python/Julia/Matlab)

1. **Matrix Inverse & Eigenvalue Problem** – Implement numerical methods to compute inverse and eigenvalues of matrices; validate with built-in libraries.
2. **Singular Value Decomposition (SVD)** – Decompose a matrix, demonstrate data compression/denoising applications.
3. **Monte Carlo Sampling & Random Number Generation** – Generate pseudo-random numbers and apply Monte Carlo integration for estimating π or other functions.
4. **Least Squares Fitting & Error Analysis** – Fit experimental/synthetic data to models; analyze errors and residuals.

B. Applications to Quantum Mechanics (Computational Quantum Physics)

5. **Eigen Energies of Coupled Two-Level Systems** – Numerical diagonalization to find eigen energies and eigenstates.
6. **Jaynes-Cummings Model Simulation** – Study eigen energies of a two-level system coupled to an oscillator.
7. **Rabi Oscillations in Driven Two-Level System** – Simulate time evolution of population inversion under resonant drive.
8. **ZEEMAN EFFECT experiment.**

Tools: Zeeman effect kit

C. Applications to Electromagnetism & Optics (Simulation + Bench Experiments)

9. **Electrostatic Charge Distributions (Finite Element Simulation)** – Solve Laplace's equation for simple geometries (parallel plates, spheres).
10. **Diffraction & Interferometry** – Experimental setup for single-slit diffraction and interferometric measurement of wavelength.
11. **Polarization Optics** – Study of Polarizing Beam Splitter (PBS), Half-Wave Plate (HWP), and Quarter-Wave Plate (QWP).

D. Circuits & Digital Systems (Hardware)

12. **Series & Parallel RLC Circuits** – Measure resonance curves, extract quality factor and intrinsic losses.
13. **Digital Circuits with ICs** – Implementation of Adder, Encoder/Decoder, and D Flip-Flop using IC chips.

Suggested Reference Books

1. **Numerical Recipes in C/Python/Fortran**, W.H. Press et al., Cambridge University Press.
2. **Computational Physics**, N. J. Giordano & H. Nakanishi, Pearson Education.
3. **Principles of Quantum Mechanics**, R. Shankar, Springer.
4. **Optics**, Eugene Hecht, Pearson.
5. **Fundamentals of Electric Circuits**, Charles K. Alexander & Matthew N.O. Sadiku, McGraw Hill

R23ECE-MT3204.1	Quantum Technology-2 Laboratory (QT-2 - LAB)	L	T	P	C
		0	0	3	1.5

Course Objectives

1. To introduce the principles of RF measurements, including transient response, S-parameters, and spectrum analysis.
2. To develop the ability to design and analyze basic digital logic circuits and understand their timing characteristics.
3. To expose students to advanced signal processing techniques such as homodyne and heterodyne detection.
4. To provide hands-on experience with quantum computing simulators, quantum gates, and entanglement.
5. To apply concepts of quantum cryptography through simulation of secure key distribution protocols.

Course Outcomes

After completing this lab, students will be able to:

1. Perform RF characterization using oscilloscope, vector network analyzer, and spectrum analyzer.
2. Design, test, and troubleshoot digital logic circuits for real-world applications.
3. Implement and compare homodyne and heterodyne detection for weak signal recovery.
4. Simulate and analyze quantum states, superposition, measurements, and entanglement using Qiskit.
5. Demonstrate secure communication by implementing the BB84 quantum key distribution protocol.

A. Radio Frequency Technology (Measurement & Analysis)

1. **Oscilloscope-Based Ring-Up & Ring-Down in RLC Circuits** – Study transient response and measure damping.
2. **Vector Network Analyzer (VNA) Characterization** – Transmission/reflection measurements of coaxial cables (open, short, matched); extract S-parameters and plot VSWR.
3. **Spectrum Analyzer—Noise from a Resistor**
   Aim: Measure thermal noise vs temperature/bandwidth; compare theory. Tools: Spectrum analyzer, precision resistors, temp control (optional).
4. **Digital Logic: Adder, Decoder & D Flip-Flop**
   Aim: Build/test basic IC logic blocks; timing & hazards. Tools: Breadboard, TTL/CMOS ICs, DSO, PSU.
5. **Data Acquisition and Demodulation: Homodyne vs Heterodyne Detection**
   Objective: Compare two demodulation schemes for weak signal recovery Tools: ADC, MATLAB/Python, signal generator
   Learning: Quantum signal detection techniques

6. **Introduction to Qiskit and IBM Quantum Lab**
   - Objective: Familiarize with the quantum circuit composer and running circuits on simulators.
   - Tools: Qiskit, IBM Quantum Composer
   - Equipment: PC with internet, Python + Qiskit
7. **Quantum States and Superposition**

- Objective: Construct single-qubit circuits to observe $|0\rangle$, $|1\rangle$, and superposition states.
- Tools: Qiskit Statevector simulator
- Output: Visualize Bloch sphere and probability amplitudes

8. **Measurement and Probability in Quantum Systems**

- Objective: Implement basic measurement circuits and interpret probabilistic outcomes.
- Tools: Qiskit Aer
- Equipment: Online IDE or Jupyter Notebook

9. **Quantum Gates and Reversibility**

- Objective: Construct and verify effects of X, H, Z, and composite gates.
- Output: Truth table comparison with classical logic

10. **Entanglement Using Bell States**

- Objective: Create and measure Bell pairs using H and CNOT gates.
- Verification: Bell inequality simulation

11. **BB84 Quantum Key Distribution (Quantum Cryptography)** Objective: Simulate BB84 protocol for secure key generation

Output: Compare error rate with and without eavesdropper

12. .QKD with Eavesdropper Detection

Objective: Model Eve in BB84, simulate her measurement, and detect error rate.
Discussion: Quantum no-cloning theorem implications

Reference Books

1. David M. Pozar, Microwave Engineering, Wiley, 4th Edition, 2011.
2. Guillermo Gonzalez, Microwave Transistor Amplifiers: Analysis and Design, Prentice Hall, 2nd Edition, 1996.
3. Michael A. Nielsen & Isaac L. Chuang, Quantum Computation and Quantum Information, Cambridge University Press, 2010.
4. Chris Bernhardt, Quantum Computing for Everyone, MIT Press, 2019.
5. Robert A. Meyers (Ed.), Encyclopedia of Complexity and Systems Science – Quantum Computing Section, Springer, 2009

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.