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

COMPUTER SCIENCE AND ENGINEERING
(Artificial Intelligence and Machine Learning)

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
E-Mail: lendi_2008@yahoo.com Website: www.lendi.edu.in

COURSE STRUCTURE AND DETAILED SYLLABUS
B.TECH- COMPUTER SCIENCE AND ENGINEERING
(Artificial Intelligence & Machine Learning)

III Year I Semester						
S.No	**Course Code**	**Course Name**	**L**	**T**	**P**	**Credits**
1.	R23CSM-PC3101	Deep Learning	3	0	0	3
2.	R23CSM-PC3102	Operating Systems	3	0	0	3
3.	R23CSM-PC3103	Object Oriented Software Engineering	3	0	0	3
4.		**Professional Elective-I**	3	0	0	3
	R23CSM-PE3101.1	1. Exploratory Data Analysis with Python				
	R23CSM-PE3101.2	2. Optimization Techniques using Machine Learning				
	R23CSM-PE3101.3	3. DevOps				
	R23CSM-PE3101.4	4. Cloud Computing				
5.		**Open Elective- I**	3	0	0	3
6.	R23CSM-PC3104	Deep Learning Lab	0	0	3	1.5
7.	R23CSM-PC3105	Operating Systems Lab	0	0	3	1.5
8.	R23CSM-SC3101	Node JS and Express JS (Skill Oriented Course)	0	1	2	2
9.	R23CSM-ES3101	Tinkering Lab	0	0	2	1
10.	R23BSH-MC3101	English and Soft Skills for Job Seekers (Mandatory Course)	0	1	2	0
11	R23CSM-SI3101	Evaluation of Community Service Project Internship	0	0	0	2
Total			**15**	**2**	**12**	**23**
Honor Course-2/Minor Course-2						

III Year II Semester						
S.No	**Course Code**	**Course Name**	**L**	**T**	**P**	**Credits**
1.	R23CSM-PC3201	Natural Language Processing	3	0	0	3
2.	R23CSM-PC3202	Automata Compiler Design	3	0	0	3
3.	R23CSM-PC3203	Computer Networks	3	0	0	3
4.		**Professional Elective-II**	3	0	0	3
	R23CSM-PE3201.1	1. Recommender Systems				
	R23CSM-PE3201.2	2. Generative AI				
	R23CSM-PE3201.3	3. Software Testing Methodology				
	R23CSM-PE3201.4	**4.** Data Visualization				
5.		**Professional Elective-III**	3	0	0	3
	R23CSM-PE3202.1	1. Advanced Data Structures and Algorithm Analysis				
	R23CSM-PE3202.2	**2.** Pattern Recognition & Visual Recognition				
	R23CSM-PE3202.3	3. Software Project Management				
	R23CSM-PE3202.4	**4.** Bioinformatics				
6.		**Open Elective - II**	3	0	0	3
7.	R23CSM-PC3204	Natural Language Processing Lab	0	0	3	1.5
8.	R23CSM-PC3205	Computer Networks Lab	0	0	3	1.5
9.	R23CSM-SC3201	React JS Essentials (Skill Oriented Course)	0	1	2	2
10.	R23CSM-MC3201	Technical Paper Writing & IPR (Mandatory Course)	2	0	0	0
Total			**20**	**1**	**8**	**23**
Honor Course-3/Minor Course-3						
Summer Internship (During the Summer Vacation after Third Year & Evaluated in IV-I Semester)						

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

Offering Department: Computer Science and Engineering & Allied Branches

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

25	R23CSE-OE0025	Mobile Adhoc Networks	3	0	0	3
26	R23CSS-OE0001	Operating Systems	3	0	0	3
27	R23CSS-OE0002	Redhat Linux	3	0	0	3
28	R23CSS-OE0003	Cloud Computing	3	0	0	3
29	R23CSS-OE0004	Distributed Operating System	3	0	0	3
30	R23CIT-OE0001	Basics of computer networks	3	0	0	3
31	R23CIT-OE0002	Cryptography and Network Security	3	0	0	3
32	R23CIT-OE0003	Mobile Computing	3	0	0	3
33	R23CIT-OE0004	Wireless sensor networks	3	0	0	3

Note: A student shall select open elective from the above list, excluding those from their respective discipline (i.e., only interdisciplinary courses).

Honors Courses

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

Track-I (Artificial Intelligence)

S.No	Year & Semester	Course Code	Subject title	L	T	P	C
1	II-II	R23CSM-HN2201	AI for Problem Solving.	3	0	0	3
2	III-I	R23CSM-HN3101	Social Network Analysis	3	0	0	3
3	III-II	R23CSM-HN3201	Deep Learning for Computer Vision	3	0	0	3
4	IV-I	R23CSM-HN4101	AI in X	3	0	0	3
5	II Year to IV Year	R23CSM-HNM001.1	Honors MOOCS-1	0	0	0	3
6	II Year to IV Year	R23CSM-HNM001.2	Honors MOOCS-2	0	0	0	3
Total							18

Track- II (Web Framework)

S.No	Year & Semester	Course Code	Subject title	L	T	P	C
1	II-II	R23CSM-HN2202	Angular JS Framework	3	0	0	3
2	III-I	R23CSM-HN3102	Design Patterns	3	0	0	3
3	III-II	R23CSM-HN3202	UX and UI Design Framework	3	0	0	3
4	IV-I	R23CSM-HN4102	Scalable Angular and Architecture Patterns	3	0	0	3
5	II Year to IV Year	R23CSM-HNM002.1	Honors MOOCS-1	0	0	0	3
6	II Year to IV Year	R23CSM-HNM002.2	Honors MOOCS-2	0	0	0	3
Total							18

Track III (Networks)

S.No	Year & Semester	Course Code	Subject title	L	T	P	C
1	II-II	R23CSM-HN2203	Introduction to Networks	3	0	0	3
2	III-I	R23CSM-HN3103	Switching, Routing, and Wireless Essentials	3	0	0	3
3	III-II	R23CSM-HN3203	Enterprise Networking, Security, and Automation	3	0	0	3
4	IV-I	R23CSM-HN4103	Wireless Sensor Networks	3	0	0	3
5	II Year to IV Year	R23CSM-HNMS03.1	Honors MOOCS-1	0	0	0	3
6	II Year to IV Year	R23CSM-HNMS03.2	Honors MOOCS-2	0	0	0	3
Total							18

Track IV (Security)

S.No	Year & Semester	Course Code	Subject title	L	T	P	C
1	II-II	R23CSM-HN2204	Cyber Security	3	0	0	3
2	III-I	R23CSM-HN3104	Secure Coding	3	0	0	3
3	III-II	R23CSM-HN3204	Vulnerability Assessment & Penetration Testing	3	0	0	3
4	IV-I	R23CSM-HN4104	Malware Analysis	3	0	0	3
5	II Year to IV Year	R23CSM-HNM003.1	Honors MOOCS-1	0	0	0	3
6	II Year to IV Year	R23CSM-HNM003.2	Honors MOOCS-2	0	0	0	3
Total							18

B.Tech III Year - I Semester

Course code	Course Title	L	T	P	Credits
R23CSM-PC3101	Deep Learning	3	0	0	3

Course Objectives:

- The objective of the course is to make students learn the frameworks of deep learning and their application

Course Outcomes:

At the end of this course, the student will be able to

1. Apply the fundamentals of linear algebra to deep learning algorithms
2. Understand the fundamental building blocks of deep learning
3. Apply the concepts of Convolution Neural Networks to computer vision applications
4. Apply the concepts of Recurrent Neural Networks to Natural Language Process
5. Apply the regularization techniques to improve the model performance

UNIT-I

Mathematical foundations of Deep Learning : Scalars, Vectors, Matrices and Tensors, Multiplying Matrices and Vectors, Identity and Inverse Matrices, Linear dependence and span, Norms, Special kinds of matrices and vectors, Trace operations, Eigen value decomposition

UNIT-II

Fundamentals of Deep Learning : Introduction to Biological Neurons, Artificial Neural Networks, McCulloch Pitts Neuron, Learning processes, Perceptron convergence theorem, XOR problem, Multilayer perceptron, Back Propagation (BP) Learning, Activation functions: Sigmoid, Linear, Tanh, ReLU, Leaky ReLU, SoftMax, loss functions; Optimizers: Gradient Descent (GD), Batch Optimization, Momentum Based GD, Stochastic GD, AdaGrad, RMSProp, Adam

UNIT-III

Convolution Neural Networks: CNN-Architectural Overview, Motivation, Layers, Filters, Parameter sharing, Regularization, Convolution and Pooling as infinitely strong prior, Variants of Convolution Operation, Efficient Convolution Computation Methods, Popular CNN Architectures (ResNet, Alexnet,VGGNet, Inception)

UNIT-IV

Recurrent Neural Networks: Architecture of traditional RNN, Types and applications of RNN, Variants of RNNs (LSTM, Bi-LSTM, GRU), Back propagation through time (BPTT), Vanishing and Exploding Gradients, NLP Applications.

UNIT-V

Regularization and Auto encoders: Regularization for Deep Learning: Bias Variance Tradeoffs, L1 and L2, Dropout, Batch Normalization, Data Augmentation, Early Stopping.

Auto encoders: Architecture, Implementation, Denoising Auto encoders, Sparse Auto encoders, Use cases

Text Books:

1. Deep Learning, Ian Good fellow, YoshuaBengio and Aaron Courvile, MIT Press, first edition, 2016
2. Deep Learning with Python, Francois Cholet, Manning Publications, first edition , Released December 2017.
3. Deep Learning Illustrated: A Visual, Interactive Guide to Artificial Intelligence – Jon Krohn, Grant Beyleveld, AglaéBassens, Released September 2019, Publisher(s): Addison-Wesley Professional, first edition , ISBN: 9780135116821
4. Deep Learning from Scratch - Seth Weidman, Released September 2019, Publisher(s): O'Reilly Media, Inc., first edition, ISBN: 9781492041412

References:

1. Artificial Neural Networks, Yegnanarayana, B., PHI Learning Pvt. Ltd, 2009.
2. Matrix Computations, Golub, G.,H., and Van Loan, C.,F, JHU Press,2013.
3. Neural Networks: A Classroom Approach, Satish Kumar, Tata McGraw-Hill Education, 2004.

B.Tech III Year - I Semester

Course code	Course Title	L	T	P	Credits
R23CSM-PC3102	Operating Systems	3	0	0	3

Course objectives:

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

Course Outcomes:

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

UNIT-I

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

UNIT–II

Process Management: Process concept: Process Concept, Process Scheduling, Operations on Processes, Inter process Communication. Multithreaded Programming: Overview, Multithreading models, Threading Issues. Process scheduling: Basic Concepts, Scheduling Criteria, Scheduling Algorithms.

UNIT-III

Synchronization: Process Synchronization, The Critical-Section Problem- Dekker's Solution, Petersons Solution, Synchronization Hardware, Semaphores, Classic Problems of Synchronization, Monitors, Synchronization examples. Principles of deadlock: System Model, Deadlock Characterization, Deadlock Prevention, Detection and Avoidance, Recovery form Deadlock.

UNIT-IV

Memory Management: Memory Management strategies: Swapping, Contiguous Memory Allocation, Segmentation, Paging, Structure of the Page Table. Virtual Memory Management: Virtual Memory, Demand Paging, Page-Replacement Algorithms, Thrashing.

UNIT-V

File system Interface- the concept of a file, Access Methods, Directory and Disk structure, File system mounting. File System implementation: File system structure, allocation methods, Free-space management. Mass-storage structure: overview of Mass-storage structure, Disk scheduling, Device drivers

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

Text Books:

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

Reference Books:

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

B.Tech III Year - I Semester

Course code	Course Title	L	T	P	Credits
R23CSM-PC3103	Object Oriented Software Engineering	3	0	0	3

Course objectives:

- To understand Software Engineering Lifecycle Models.
- To Perform software requirements analysis.
- To gain knowledge of the System Analysis and Design concepts using UML for applications.
- To understand software testing and maintenance approaches
- To gain knowledge in Project Management activities.

Course Outcomes:

1. Compare various Software Development Lifecycle Models.
2. Analyze requirements for different use cases.
3. Design use case diagrams for various case studies.
4. Apply different test cases and test strategies for different applications.
5. Analyze the project management activities.

UNIT-I

Introduction to Software Engineering: Software Myths, Software Models-Waterfall Model, Agile Model Software Engineering Failures, What is Software Engineering Modelling, Problem-Solving, Knowledge Acquisition, Rationale. Software Engineering Concepts- Participants and Roles, Systems and Models, Work Products, Activities, Tasks, and Resources.

Software Engineering Development Activities- Requirements Elicitation, Analysis, System Design, Object Design, Implementation, and Testing. Managing Software Development- Communication, Rationale Management, Software Configuration Management, Project Management, Software Life Cycle.

Applications:

- Knowledge-based systems and formal methods
- Algorithms and programming languages
- Search engines and information retrieval
- AI for software systems • Web-based systems in various application areas

UNIT–II

Requirement Elicitation: Requirement Elicitation Concepts- Functional Requirements, Nonfunctional Requirements, Completeness, Consistency, Clarity, Correctness, Realism, Verifiability, and Traceability, Greenfield Engineering, Reengineering, and Interface Engineering. Requirements Elicitation Activities- Identifying Actors, Identifying Scenarios, Identifying Use Cases, Refining Use Cases, Identifying Relationships among Actors and Use Case. Managing Requirements Elicitation- Negotiating Specifications with Clients: Joint Application Design, Maintaining Traceability, Documenting Requirements Elicitation.

Analysis: Analysis Concepts- Analysis Object Models and Dynamic Models, Entity, Boundary, and Control Objects, Generalization and Specialization, Analysis Activities from Use Cases to Objects: Identifying Entity Objects, Identifying Boundary Objects, Identifying Control Objects.

Applications:

- To facilitate focused and fruitful brainstorming sessions.
- Improvement in document analysis.
- At the core of interface, analysis is the idea of deconstructing how external and internal systems interact with each other and with end-users.

UNIT-III

System Design- Decomposition System: System Design Concepts- Subsystems and Classes, Services and Subsystem Interfaces, Coupling and Cohesion, Layers and Partitions, Architectural Styles. System Design Activities- Starting Point: Analysis Model for a Route Planning System, Identifying Design Goals, Identifying Subsystems. Modeling with UML: An Overview of UML, Modelling Concepts, A Deeper View into UML.

Applications:

- Modularity and Interfaces in System Design.
- Evolution of Existing system.
- Upgrade Specifications of existing system.
- Create a Distributed System by connecting multiple systems together.

UNIT-IV

Testing Concepts: Faults, Erroneous States, and Failures, Test Cases, Test Stubs and Drivers, Corrections.

Testing Activities: Component Inspection, Usability Testing, Unit Testing, Integration Testing, System Testing. Managing Testing: Planning Testing, Documenting Testing, Assigning Responsibilities, Regression Testing, Automating Testing, Model-Based Testing.

Applications:

- Web Application Testing
- Desktop Application Testing
- Mobile Application Testing

UNIT-V

Project Management: Project Management Concepts: Tasks and Activities, Work Products, Work Packages, and Roles, Work Breakdown Structure, Task Model, Skill Matrix, The Software Project Management Plan.

Project Management Activities: Planning the Project, Organizing the Project, Controlling the Project, Terminating the Project

Applications:

- Task management and tracking
- Project planning and Gantt charts
- Document sharing
- Team collaboration tools
- Timeline management
- Resource management

Text Books:

1. Bernd Bruegge and Allen H. Dutoit, "Object-Oriented Software Engineering: Using UML, Patterns and Java", Third Edition, Pearson Education, 2009.
2. Roger S. Pressman, Object-Oriented Software Engineering: An Agile Unified Methodology, First Edition, Mc Graw-Hill International Edition, 2014

Reference Books

1. Stephen Schach, Object-Oriented and Classical Software Engineering, 8th ed, McGraw-Hill, 2010.
2. Object-Oriented Software Engineering, Practical Software Development Using UML and Java 2nd Edition, Timothy C. Lethbridge Robert Laganière, McGraw-Hill, 2004.

B.Tech III Year - I Semester

Course code	Course Title	L	T	P	Credits
R23CSM-PE3101.1	Exploratory Data Analysis with Python **(Professional Elective-I)**	3	0	0	3

Course Objectives:

- To introduce the fundamental operations of Numpy.
- To enable students to apply advanced Numpy functionalities.
- To equip learners with skills in data analysis using Pandas.
- To develop proficiency in data pre-processing and extraction techniques.
- To build competence in data visualization using Matplotlib, and to introduce natural language processing basics with libraries like NLTK

Course Outcomes:

1. Understand and apply Numpy operations for array creation, reshaping, slicing, and transformation to manipulate large datasets efficiently.
2. Apply advanced indexing, slicing, stacking, and broadcasting techniques
3. Utilize Pandas for data analysis tasks such as creating and modifying Data Frames, handling missing data, and reading various data file formats
4. Perform data pre-processing, database import, and web scraping using Python
5. Create insightful data visualizations using Matplotlib and evaluate basic Natural Language Processing tasks using NLTK and related Python libraries.

UNIT-I

Numpy Arrays - Creating a Numpy Array- Basic ndarray- Array of zeros- Array of one's-Random numbers in ndarray- An array of your choice- Imatrix in Numpy- Evenly spaced ndarray. **The Shape and Reshaping of Numpy Array**- Dimensions of Numpy array- Shape of Numpy array- Size of Numpy array- Reshaping a Numpy array-Flattening a Numpy array-Transpose of a Numpy array. **Expanding and Squeezing a Numpy Array**- Expanding a Numpy array- Squeezing a Numpy array- Sorting in Numpy Arrays

UNIT-II

Indexing and Slicing of NumPy Array: Slicing1-DNum Pyarrays-Slicing2-DNumPyarrays-Slicing 3-DNumPyarrays-NegativeslicingofNumPyarrays.**Stacking and Concatenating Numpy Arrays**- Stackingndarrays-Concatenatingndarrays-BroadcastinginNumpyArrays.

UNIT-III

Operations using Pandas-Creating data frame-concat ()-Setting conditions- Adding a new column. **Perform following operations using pandas**-Filling Nan with string-Sorting based on column values- group by(). **Read the following file formats using pandas**-Text files -CSVfiles-Excelfiles-JSONfiles

UNIT-IV

Read the following file for mats- Picklefiles-ImagefilesusingPILc.MultiplefilesusingGlob-Importingdata from database**.** Demonstrate web scraping using python.

Case Study: Perform following preprocessing techniques on loan prediction dataset: Feature Scaling- Feature Standardization- Label Encoding- One Hot Encoding

UNIT-V

Visualizations using matplotlib- Bar Graph- Pie Chart- Box Plot- Histogram-Line Chart and Sub plots-Scatter Plot. Getting started with NLTK, NLTK using PIP, SciKit-Learn&NLTK, Python NLTK/ Spicy/ Py NLPI.

Text Book:

1. Python for Data Analysis, Oreilly, Wes McKinney, BIM Publishers, first edition, 2012.

Reference Books:

1. "Hands-On Exploratory Data Analysis with Python: Performed A techniques to understand, summarize, and investigate your data" by Suresh Kumar Machida and Us man Ahmed.

Links

1. https://www.analyticsvidhya.com/blog/2020/04/the-ultimate-numpy-tutorial-for-datascience- beginners/
2. https://www.analyticsvidhya.com/blog/2021/07/data-science-with-pandas-2-minutesguide-to-key- concepts/
3. https://www.analyticsvidhya.com/blog/2020/04/how-to-read-common-file-formatspython/4. https://www.analyticsvidhya.com/blog/2016/07/practical-guide-data-preprocessingpython-scikit-learn/
4. https://www.analyticsvidhya.com/blog/2020/02/beginner-guide-matplotlib-datavisualization-exploration-python/6.

B.Tech III Year - I Semester

Course code	Course Title	L	T	P	Credits
R23CSM-PE3101.2	Optimization Techniques using Machine Learning (**Professional Elective-I**)	3	0	0	3

Course Objectives:

The students will be able

- To understand and analyze how to deal with changing data.
- To identify and interpret potential unintended effects in the project.
- Understand and define procedures to operationalize and maintain applied machine learning models.

Course Outcomes:

After completion of course, students would be able to:

1. Solve linear programming problems using the simplex method
2. Design strategies for risk mitigation, and make informed decisions regarding ML development approaches and team structuring.
3. Implement responsible machine learning practices by identifying feedback loops, optimizing metric design
4. Integrate machine learning models into production environments
5. Deploy ML models using QUAM (Quality Assurance for ML)

UNIT-I

Introduction: What is optimization? Formulation of LPP, Solution of LPP: Simplex method, Basic Calculus for optimization: Limits and multivariate functions, Derivatives and linear approximations: Single variate functions and multivariate functions.

UNIT-II

Machine Learning Strategy ML readiness, Risk mitigation, Experimental mindset, Build/buy/partner, setting up a team, Understanding and communicating change.

UNIT-III

Responsible Machine Learning AI for good and all, Positive feedback loops and negative feedback loops, Metric design and observing behaviours, Secondary effects of optimization, Regulatory concerns.

UNIT-IV

Machine Learning in production and planning: Integrating info systems, users break things, time and space complexity in production, when to retain the model? Logging ML model versioning, Knowledge transfer, Reporting performance to stakeholders.

UNIT-V

Care and feeding of your machine learning model MLPL Recap, Post deployment challenges, QUAM monitoring and logging, QUAM Testing, QUAM maintenance, QUAM updating, Separating Data stack from Production, Dashboard Essentials and Metrics monitoring.

Text Books:

1. Jeeva Jose, Introduction to Machine Learning, Khanna Book Publishing 2020.
2. Rajiv Chopra, Machine Learning, Khanna Book Publishing 2021
3. Optimization for Machine Learning, Suvrit Sra, Sebastian Nowozin and Stephen J. Wright, MIT Press, 2011.
4. Optimization in Machine Learning and Applications, Suresh Chandra Satapathy, Anand J. Kulkarni, Springer, 2019.

Reference Books:

1. Algorithms for Optimization by Mykel J. Kochenderfer and Tim A. Wheeler, MIT Press, 2019.
2. Accelerated Optimization for Machine Learning: First-Order Algorithms by Cong Fang, Huan Li, and Zhouchen Lin, Springer, 2020.
3. https://www.coursera.org/learn/optimize-machine-learning-model-performance

B.Tech III Year - I Semester

Course code	Course Title	L	T	P	Credits
R23CSM-PE3101.3	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-I:

Introduction to DevOps: 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)

Unit-II:

Continuous Integration & Delivery (CI/CD): Introduction to CI/CD Concepts (Build, Test, Deploy Automation), CI/CD Tools (Jenkins, GitLab CI, CircleCI)

Unit-III:

Containerization & Orchestration: 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)

Unit-IV:

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

Unit-V:

Monitoring & Security in DevOps: 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.

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/**

B.Tech III Year - I Semester

Course code	Course Title	L	T	P	Credits
R23CSM-PE3101.4	Cloud Computing **(Professional Elective-I)**	3	0	0	3

Course Objectives:

- CloudComputing is a large-scale distributed computing paradigm which has become a driving force for information technology over the past several years.

Course Outcomes:

1. Understand different computing paradigms
2. Understand the basics of cloud computing and different cloud deployment models.
3. Understand different cloud implementation an dmanagement strategies.
4. Understand different cloud service models.
5. Analyzeandusedifferentcloudservices/applications/toolsavailablefrom key cloud providers.

UNIT-I:

Computing Paradigms: High-Performance Computing, Parallel Computing, Distributed Computing, Cluster Computing, Grid Computing, Cloud Computing, Biocomputing,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, and Cloud Computing is a Service; Cloud Computing is a Platform, Principles of Cloud computing, Five Essential Characteristics, and Four Cloud Deployment Models

UNIT-III:

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

UNIT-IV:

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

UNIT-V:

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

Text Book:

1. Essentials of Cloud Computing, K.Chandrasekharan, and CRC press, First Edition, 5 Dec 2014.

Reference Books:

1. Cloud Computing: Principles and Paradigms, Rajkumar Buyya, James Broberg and Andrej M. Goscinski, Published by Wiley,1st Edition, 1 Jan 2013.
2. Distributed and Cloud Computing, KaiHwang, Geoffrey. Fox, Jack J.Dongarra, Elsevier, Published by Morgan Kaufmann; 1st Edition, 18 Dec 2013.
3. Cloud Security and Privacy :An Enterprise Perspective on Risks and Compliance, TimMather, SubraKumaraswamy, ShahedLatif, PublishedbyO'Reilly Media; 1st Edition, 4 Sept 2009.

B.Tech III Year - I Semester

Course code	Course Title	L	T	P	Credits
R23CSM-PC3104	Deep Learning Lab	0	0	3	1.5

Course Objectives:

- To introduce numerical computing techniques such as matrix operations and eigenvalue decomposition for effective data representation and transformation using Python.
- To familiarize students with dimensionality reduction techniques, particularly Principal Component Analysis (PCA), for managing and visualizing high-dimensional data.
- To enable understanding and application of neural network fundamentals, including perception and multilayer feed forward networks, for solving basic and intermediate classification tasks.
- To provide knowledge and hands-on skills for designing and implementing advanced deep learning models like RNNs, LSTMs, BiLSTMs, and Auto encoders in text and anomaly detection contexts.
- To train students in developing and evaluating Convolution Neural Networks (CNNs) for performing effective image classification on benchmark datasets.

Course Outcomes:

1. Apply numerical methods, matrix operations, and eigenvalue decomposition techniques using Python for data preparation and feature transformation.
2. Analyze and implement dimensionality reduction techniques such as Principal Component Analysis (PCA) to handle high-dimensional data.
3. Apply perception and multilayer neural network algorithms to classify basic logic gates and real-world datasets such as MNIST.
4. Design and implement advanced deep learning models including RNNs, LSTMs, BiLSTMs, and Auto encoders for text classification and anomaly detection.
5. Develop and evaluate convolution neural networks for image classification tasks using datasets like Fashion-MNIST.

Experiments:

1. Numerical Methods to solve matrix problems in Python
2. Eigen Value decomposition techniques
3. Dimensionality Reduction-PCA
4. Implement perception learning algorithm and attempt to solve two input i) AND gate ii) Or Gate iii) EXOR gate problems.
5. Design and implement a perception learning algorithm and attempt to solve XOR problem
6. Implement a Multilayer Feed Backward Neural network algorithm on MNIT digits dataset.
7. Build your own recurrent networks and long short-term memory networks on IMDB movie reviews classification data.
8. Design and implement a BiLSTM on given a product review dataset to classify the review rating from 1 to 5 classes
9. Design and implement Auto encoders for credit card fraud detection.
10. Design and implement a Convolution Neural Network for image classification on the Fashion-MNIST dataset.

Text Books:

1. Reza Zadeh and Bharath Ramsundar, “Tensor flow for Deep Learning”, O’Reilly publishers, first edition, March 2018

References:

1. https://github.com/fchollet/deep-learning-with-python-notebooks

B.Tech III Year - I Semester

Course code	Course Title	L	T	P	Credits
R23CSM-PC3105	Operating Systems Lab	0	0	3	1.5

Course objectives:

- To implement process scheduling algorithms to understand CPU management and process execution efficiency.
- To apply memory management techniques by simulating various allocation and deal location algorithms.
- To identify and implement solutions for critical section problems and virtual memory management using appropriate algorithms.
- To develop file allocation strategies by implementing common file organization algorithms.
- To understand and write shell scripts for automating basic tasks in a Unix/Linux environment.

Course Outcomes:

1. Simulate various CPU process scheduling algorithms to analyze system performance.
2. Implement system calls for process creation, management, and inter-process communication.
3. Apply different memory management techniques including paging, segmentation, and allocation methods.
4. Simulate page replacement, banker's algorithm, and file allocation strategies to evaluate their efficiency.
5. Implement synchronization mechanisms in concurrent programming and demonstrate multithreading concepts for safe process execution.

List of Experiments:

1. Simulate the following CPU scheduling algorithms
a) Round Robin b) SJF c) FCFS d) Priority
2. Multiprogramming-Memory management-
Implementation of fork (), wait (), exec() and exit (), System calls
3. Simulate the following
a) Multiprogramming with a fixed number of tasks (MFT)
b) Multiprogramming with a variable number of tasks (MVT)
4. Simulate Bankers Algorithm for Dead Lock Avoidance
5. Simulate Bankers Algorithm for Dead Lock Detection.
6. Simulate the following page replacement algorithms.
a) FIFO b) LRU c) LFU
7. Simulate the following File allocation strategies
a) Sequenced b) Indexed c) Linked
8. Write a C program to simulate producer and consumer problem using semaphores
9. Write C program to create a thread using pthreads library and let it run its function.
10. Write a C program to illustrate concurrent execution of threads using pitheads library.

Text Books:

1. Operating System -Abraham Silberchatz, Peter B. Galvin, Greg Gagne 7th Edition, John Wiley
2. The ultimate guide Unix, Sumiton das, McGraw-Hill Higher Education , 3rd Edition, January 21, 2012

B.Tech III Year - I Semester

Course code	Course Title	L	T	P	Credits
R23CSM-SC3101	Node JS and Express JS (Skill Oriented Course)	0	1	2	2

Course Objectives

- To understand the Node's Web Server Development.
- To create and manage web servers using built-in Node.js modules
- To understand and handle file system operations using built-in Node.js modules.
- To build web applications using Express.js**.**
- To integrate MongoDB with Node.js for database operations and implement RESTful APIs.

Course Outcomes

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

1. Explain the architecture and features of Node.js and compare it with traditional web server technologies.
2. Utilize Node.js modules and the Node Package Manager (NPM) to structure and manage application dependencies.
3. Create and deploy server-side applications that handle HTTP requests and perform file system operations.
4. Develop web applications using Express.js, including routing, middleware integration, and static content delivery.
5. Implement CRUD operations with MongoDB and build RESTful APIs using Node.js and Express.js.

Unit 1:

Introduction to Node.js: Node JS – Introduction,What is Node.js?Advantages of Node.js, Traditional Web Server Model vs Node.jsProcess Model,

Setup Development Environment: Installing Node.js (Windows/Linux), Working in REPL (Read-Eval-Print Loop),Node.js Console.

Experiment 1:

Objective: Install Node.js on Windows/Linux and run a basic Node.js script using console.

Task: Write a Node.js script that prints system information (OS, CPU, memory) using built-in modules.

Experiment 2:

Objective: Work with REPL (Read-Eval-Print Loop).

Task: Perform arithmetic operations and variable declarations in the Node.js REPL console.

Experiment 3:

Objective: Demonstrate difference between synchronous and asynchronous execution.

Task: Create a simple example using setTimeout() and explain the Node.js event loop.

Unit 2:

Node.js Modules and Web Server: Modules in Node.js: Functions, Buffer, Module, Module Types, Core Modules vs Local Modules, module.exports,

Node Package Manager (NPM): What is NPM?Installing Packages Locally & Globally, package.json and dependencies, Updating Packages. **Web Server:**Creating a Web Server, Handling HTTP Requests, Sending Responses.

Experiment 4:

Objective: Create and use custom local modules in Node.js.

Task: Develop a math module and import it in the main file to perform calculations.

Experiment 5:

Objective: Install external modules using NPM and manage package.json.

Task: Use the lodash module to perform array and object operations.

Experiment 6:

Objective: Create a basic HTTP web server.

Task: Handle HTTP GET requests and send appropriate responses using http module.

Unit 3:

File System, Callbacks, and Events: File System Module: Synchronous vs Asynchronous Operations, File Operations: Open, Read, Write, Close, Delete, Getting File Information, **Callbacks:**Understanding Callbacks, Blocking vs Non-Blocking Code,

Events: Event Emitter Class, Creating and Handling Events, Returning Event Emitters, Inheriting Events.

Experiment 7:

Objective: Perform file operations using File System module.

Task: Create a file, write content to it, then read and delete it using asynchronous methods.

Experiment 8:

Objective: Implement and understand callback functions.

Task: Create a program with nested callbacks and refactor it using named functions.

Experiment 9:

Objective: Use EventEmitter to handle custom events.

Task: Emit and listen to events like userLoggedIn or dataReceived in a Node.js script.

Unit 4:

Express.js and Debugging: Express.js Framework: Configuring Routes, Serving Static Files, Working with Middleware, **Debugging Node.js Applications:**Core Node.js Debugger, Debugging with Visual Studio

Experiment 10:

Objective: Set up a basic Express.js server.

Task: Create routes for home (/), about (/about), and contact (/contact) pages.

Experiment 11:

Objective: Use middleware in Express.js.

Task: Implement a custom middleware that logs request time and method before routing.

Experiment 12:

Objective: Debug a Node.js application.

Task: Use console.log and Visual Studio Code debugger to find and fix errors in a sample Express app.

Unit 5:

Database Connectivity and REST APIs: MongoDB with Node.js: Introduction to MongoDB, Connecting to MongoDB, Connection Strings and Configuration, Performing CRUD Operations (Select, Update, Delete),

Creating REST APIs: Designing and Implementing RESTful Services.

Experiment 13:

Objective: Connect Node.js with MongoDB.

Task: Use the mongodb or mongoose package to insert and retrieve student records from a MongoDB collection.

Experiment 14:

Objective: Perform CRUD operations with MongoDB.

Task: Create endpoints in Express to Create, Read, Update, and Delete records.

Experiment 15:

Objective: Create a RESTful API using Express and MongoDB.

Task: Build an API for a simple Book Management System with endpoints like /books, /books/:id.

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 - I Semester

Course code	Course Title	L	T	P	Credits
R23CSM-ES3101	Tinkering Lab	0	0	2	1

Course Objective

- A small unique idea can be become big changer when it gets 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 Outcome:

In the tinkering lab, students able to

1. Apply prior knowledge to develop and conceptualize scientific methods and engineering techniques.
2. Analyze real-world problems through self-directed exploration and iterative experimentation.
3. Design and develop technical experiments or prototypes with available financial and mentoring support.
4. *Evaluate and refine self-initiated projects by learning from failures, feedback, and performance metrics.*
5. Create innovative, application-oriented solutions by integrating technical skills, creativity, and exploratory learning.

List of Sample Projects:

- Face Recognition Door lock System
- Hand gesture recognition
- Text to speech
- Smart City
- Private chat room
- Android app controlled roboticarm
- Smart Traffic System
- Vehicle Accident Alam System
- Smart dustbin
- Surveillance BOT
- Automatic Water Gardening System
- e-Mirror
- Smart Parking System
- Service Bot
- Drone Surveillance
- Wallpaintingrobot
- Home automation
- Automated wheelchair
- AnyInnovativeIdea–RealTime application

Expectations from the Lab:

- Workshop on empathy, ideation, and identifying real-world problems.
- Understanding the basic logics with interaction as teams.
- Working Hand-on using present tools available
- Students form teams, plan their mini project and starts working with the help of the mentor
- Students do Hands-on building, troubleshooting, testing
- Finalize, document, and prepare for demonstration

B.Tech III Year - I Semester

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 - I Semester

Course code	Course Title	L	T	P	Credits
R23CSM-HN3101	Social Network Analysis **Honors Course-2(Track-1)**	**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:

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

Unit-1

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

Unit-2

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

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

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

Unit-5

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:

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

Course code	Course Title	L	T	P	Credits
R23CSM-HN3102	Design Patterns **Honors Course-2(Track-2)**	3	0	0	3

Course Objectives:

- Demonstration of patterns related to object oriented design.
- Describe the design patterns that are common in software applications.
- Analyze a software development problem and express it.
- Design a module structure to solve a problem, and evaluate alternatives.
- Implement a module so that it executes efficiently and correctly.

Course Outcomes:

1. Distinguish between different categories of design patterns
2. Ability to identify appropriate patterns for design of given problem.
3. Ability to understand and apply common design patterns to incremental/iterative development.
4. Exploit well-known design patterns (such as Iterator, Observer, Factory and Visitor).
5. Design the software using Pattern Oriented Architectures.

Unit I:

What is a Design Pattern?, Design Patterns in Smalltalk MVC, Describing Design Patterns, The Catalogue of Design Patterns, Organizing The Catalogue, How Design Patterns solve Design Problems, How to Select a Design pattern, How to Use a Design Pattern.

Unit II:

A Case Study: Designing a Document Editor, Design Problems , Document Structure, Formatting , Embellishing the User Interface, Supporting Multiple Look-and-Feel Standards, Supporting Multiple Window Systems, User Operations Spelling Checking and Hyphenation, Summary, Creational Patterns, Abstract Factory, Builder , Factory Method, Prototype, Singleton, Discussion of Creational Patterns.

Unit III:

Structural Pattern Part-I, Adapter, Bridge, Composite.
Structural Pattern Part-II, Decorator, Facade, Flyweight, Proxy

Unit IV:

Behavioral Patterns Part: I, Chain of Responsibility, Command, Interpreter, Iterator.
Behavioral Patterns Part: II, Mediator, Memento, Observer, Discussion of Behavioral Patterns.

Unit V:

Behavioral Patterns Part: III, State, Strategy, Template Method, Visitor, Discussion of Behavioral Patterns. What to Expect from Design Patterns, A Brief History, The Pattern Community, An Invitation, A Parting Thought.

TEXT BOOKS:

1. Design Patterns: Elements of Reusable Object-Oriented Software by Gamma et al, 1994
2. Patterns of Enterprise Application Architecture by Martin Fowler, 2002

REFERENCE BOOKS:

1. Flask Web Development by Miguel Grinberg, 2014
2. Design Patterns in C# by Vaskaran Sarcar, 2018
3. Official Documentation of Chosen Framework, 2023

B.Tech III Year - I Semester

Course code	Course Title	L	T	P	Credits
R23CSM-HN3103	Switching, Routing, and Wireless Essentials **Honors Course-2(Track-3)**	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

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

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

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

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

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:

1. 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

Weblinks

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

B.Tech III Year - I Semester

Course code	Course Title	L	T	P	Credits
R23CSM-HN3104	Secure Coding **Honors Course-2(Track-4)**	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.

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.

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.

UNIT–IV:

Database and Web Specific Input Issues-Quoting the Input, Use of stored procedures, Building SQL statements securely, XSS related attacks and remedies.

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.

Text Book:

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

Reference Books:

1. Robert C. Seacord, “Secure Coding in C and C++”, Pearson Education, 2nd edition, 2013.
2. Julia H. Allen, Sean J. Barnum, Robert J. Ellison, Gary McGraw, Nancy R. Mead, “Software Security Engineering: A guide for Project Managers”, Addison-Wesley Professional, 2008.

B.Tech III Year - II Semester

Course code	Course Title	L	T	P	Credits
R23CSM-PC3201	Natural Language Processing	3	0	0	3

Course Objectives:

- To introduce the fundamental concepts and challenges of Natural Language Processing (NLP), including text normalization, statistical models, and neural embeddings.
- To explore sequence labelling and tagging methods such as Hidden Markov Models (HMM), Conditional Random Fields (CRF), and RNN-based techniques, along with formal grammars and syntactic structures.
- To familiarize students with various parsing techniques and semantic representation frameworks, including statistical parsing, dependency grammars, and Word Sense Disambiguation.
- To expose learners to practical NLP applications such as Information Extraction, Sentiment Analysis, Semantic Role Labelling, and Machine Translation.
- To provide hands-on experience in building and evaluating NLP systems for Question Answering, Dialog Systems, and Speech Recognition using deep learning and AI-driven approaches.

Course Outcomes:

Upon completion of the course, the student will be able to

1. Apply fundamental Natural Language Processing (NLP) techniques such as tokenization, stemming, lemmatization, language modeling, word embeddings, and neural language models to analyze and process text.
2. Analyze sequence labeling techniques using probabilistic models like HMM, CRF, and RNN-based approaches, and interpret formal grammar structures and treebanks.
3. Implement syntactic parsing techniques including top-down, bottom-up, statistical, and dependency parsing, and apply semantic representation.
4. Design NLP applications in information extraction, semantic role labeling, sentiment analysis, and machine translation.
5. Design advanced NLP systems such as question answering, dialogue systems, and speech processing tools,

UNIT I:

Introduction: Introduction to NLP (Overview, applications, challenges), Regular Expressions & Text Normalization (Tokenization, case folding, stemming, lemmatization), Edit Distance (Levenshtein distance, applications in NLP), N-gram Language Models (Smoothing, perplexity, applications), Ambiguity, Naive Bayes, and Sentiment Classification (Ambiguity in language, Naive Bayes for text classification, sentiment analysis), Vector Semantics (Word embeddings, cosine similarity), Neural Networks and Neural Language Models (Feed forward networks, Word2Vec, Glove), RNN, LSTM, GRU (Recurrent architectures, handling long-term dependencies), Part-of-Speech Tagging (Definition, applications, tagsets (Penn Treebank)).

UNIT II:

HMM and Maximum Entropy Models (Probabilistic sequence models, applications), CRF (Conditional Random Fields) (Overview, usage in sequence labeling), Sequence Processing with Recurrent Networks (Applications of RNNs, LSTMs in tagging and entity recognition), Formal Grammars of English (CFGs, derivations, basic structures), Treebanks as Grammars (Penn Treebank, constituency structures).

UNIT III:

Syntactic Parsing (Top-down, bottom-up parsing), Statistical Parsing and PCFG (Probabilistic CFGs, statistical approaches), Dependency Parsing (Dependency grammars, transition-based and graph-based parsing), The Representation of Sentence Meaning (Logical forms, semantic representation, challenges), Word Sense Disambiguation (WSD) (Supervised and unsupervised methods, Lesk algorithm).

UNIT IV:

Information Extraction (Named entity recognition, relation extraction), Semantic Role Labeling (Predicate-argument structure, Frame Net), Lexicons for Sentiment and Discourse Coherence (Sentiment lexicons, discourse parsing), Machine Translation (Statistical, rule-based, neural machine translation).

UNITV:

Question Answering (QA systems, applications in NLP), Dialog Systems and Chat bots (Architecture, types, conversational AI), Speech Recognition and Synthesis (ASR systems, TTS systems, deep learning techniques).

Textbooks

1. Jurafsky D., Martin J. H., Speech and Language Processing, Prentice Hall, 3rd Edition, 2024.
2. Manning C., Schütze H., Foundations of Statistical Natural Language Processing, MIT Press, 1st Edition , 1999.
3. Daniel Jurafsky, James H.Martin—Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech, Pearson Publication, 2nd Edition,2014.
4. Steven Bird, Ewan Klein and Edward Loper, —Natural Language Processing with Python, First Edition, OReilly Media, 2009.

References:

1. Breck Baldwin, —Language Processing with Java and Ling Pipe Cook book, Atlantic Publisher, 2015.
2. Richard MReese, Natural Language Processing with Java, Oreilly Media, 2015.
3. NitinIndurkhyaandFredJ.Damerau,—HandbookofNaturalLanguageProcessing, Second Edition, Chapman and Hall/CRC Press, 2010.
4. Tanveer Siddiqui, U.S. Tiwary, Natural Language Processing and Information Retrieval, Oxford University Press, 2008.

Links:

1. https://onlinecourses.nptel.ac.in/noc23_cs45/preview
2. https://www.coursera.org/specializations/natural-language-processing

B.Tech III Year - II Semester

Course code	Course Title	L	T	P	Credits
R23CSM-PC3202	Automata Compiler Design	3	0	0	3

Course Objectives :

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

Course Outcomes :

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

UNIT - 1

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

Introduction to Compiler Design: Language Processors, Phases of Compilers

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:

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

B.Tech III Year - II Semester

Course code	Course Title	L	T	P	Credits
R23CSM-PC3203	Computer Networks	3	0	0	3

Course Objectives:

- Understand fundamental concepts of computer networks
- To acquire the knowledge on design principles of network infrastructure. the basics Physical layer and their functionality.
- Understand the functionalities of the Data Link Layer and their protocols.
- Understand the functionalities of the Network Link Layer and routing Algorithms.
- Analyze different protocols in Application Layer

Course Outcomes:

1. Analyze different types of network topologies, various Reference models.
2. Analyze network performance metrics and data transmission Techniques.
3. Analyze different data link layer framing techniques and Link Layer Protocols.
4. Analyze the medium access techniques and different routing algorithms.
5. Understand various Application layer protocols.

Unit 1

Introduction: Components of a Data Communication system, Dataflow, Network Topologies Categories of Networks: LAN, MAN,WAN, network hardware, network software, reference models: OSI,TCP/IP, Internet.

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, error detection and correction, CRC.

Data Link Layer protocols: Simplex protocol for Noisy Channel. HDLC configuration and transfer modes, HDLC frame format, point to point protocol (PPP): frame format, transition phase, multiplexing.

Applications: Error correction and detecting procedures on binary data.

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, distance vector routing, Link state routing Algorithms, Hierarchical routing, Broad cast, Multi cast Routing, the network layer in the internet (IPv4), 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, Internet transport layer protocols: UDP and TCP

Application layer:www architecture , web documents: static ,dynamic, active document, HTTP transaction: persistent, non-persistent, Proxy server, HTTP Generic Message Format, HTTP Request Message Format, HTTP Response Message Format, Domain Name System (DNS), SMTP (Simple Mail Transfer Protocol).

Applications: users can forward several emails and it also provides a storage facility,allows users to access, retrieve and manage files in a remote computer layer provides access to global information about various services.

Text Books:

1. Data Communications and Networking ,Behrouz A Forouzan,Fifth Edition.
2. Computer Networks, Andrew S. Tanenbaum, Fifth Edition, Pearson Education

Reference Books:

1. Computer Networks, Mayank Dave, Cengage India Private Limited; 1st edition (1 January 2012);
2. D. Comer, “Computer Networks and Internets”, Pearson; 6th edition (2 January 2014)
3. Larry L. Peterson and Bruce S. Davie, “Computer Networks - A Systems Approach” (5th ed), Morgan Kaufmann/ Elsevier, 2011

B.Tech III Year - II Semester

Course code	Course Title	L	T	P	Credits
R23CSM-PE3201.1	Recommender Systems **(Professional Elective-II)**	3	0	0	3

Course Objectives:

- To introduce the foundational principles of linear algebra and their role in developing content-based recommender systems.
- To equip students with practical knowledge of collaborative filtering techniques and approaches to enhance recommendation accuracy.
- To provide an in-depth understanding of knowledge-based and hybrid recommendation strategies used in diverse applications.
- To develop the ability to evaluate and interpret the performance of recommender systems using established metrics and evaluation methodologies.
- To enable learners to design and implement advanced recommendation models integrating social tagging, trust frameworks, and collaborative search systems.

Course Outcomes:

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

1. Understand the fundamentals of linear algebra and basic concepts, architecture, and types of recommender systems including content-based filtering.
2. Apply collaborative filtering techniques such as user-based, item-based, and model-based methods.
3. Analyze knowledge-based recommendation systems and various hybrid recommendation architectures for effective personalization.
4. Differentiate the performance metrics and experimental designs used to assess the effectiveness of recommender systems.
5. Design recommendation systems incorporating social tagging, trust mechanisms, and collaborative web search features to enhance user engagement and relevance

Unit-I:

Linear Algebra notation: Matrix addition, Multiplication, transposition, and inverses; covariance matrices. Introduction: Recommender Systems Function, Applications of recommendation systems, Issues with recommender system. Content-based recommendation: A High-Level Architecture of Content-based Systems, Advantages and Drawbacks of Content-based Filtering, Item Representation, Methods for Learning User Profiles.

Unit-II:

Collaborative Recommendation: User-based nearest neighbor recommendation, Item-based nearest neighbor recommendation, model-based and preprocessing-based approaches. Attacks on collaborative recommender systems: Attack dimensions, Attack types, Countermeasures, Privacy aspects – distributed collaborative filtering

Unit-III:

Knowledge-based recommendation: Introduction, Knowledge representation and reasoning, interacting with constraint-based recommenders, Interacting with case-based recommenders. Hybrid recommendation approaches: Opportunities for hybridization, Monolithic hybridization design, Parallelized hybridization design, Pipelined hybridization design.

Unit-IV:

Evaluating recommender systems: Introduction, General properties of evaluation research, Popular evaluation designs, Evaluation on historical datasets, Alternate evaluation designs. Community-BasedWebSearch-TheCollaborativeWebSearchSystem.SharedWebSearch - The HeyStaks System, The HeyStaks Recommendation Engine.

Unit-V:

Social Tagging Recommenders Systems- Folksonomy,The Traditional Recommender Systems Paradigm, BibSonomy as Study Case, Tag Acquisition Trust and Recommendations Introduction, Computational Trust, Trust-Enhanced Recommender Systems.

Text Books

1. Charu C. Aggarwal, "Recommender Systems: The Textbook", Springer, 1st Edition, 2016.
2. Gilbert Strang, "Introduction to Linear Algebra", Wellesley-Cambridge Press. 5th Edition, 2016.
3. RicciF.,RokachL.,ShapiraD.,KantorB.P.,RecommenderSystemsHandbook,Springer (2011), 1st edition.
4. Jamie Callan et al., "Collaborative Web Search: Who, What, Where, When, and Why", Springer, 1st Edition, 2010.

References:

1. JannachD.,ZankerM.andFelFeringA.,RecommenderSystems:AnIntroduction, Cambridge University Press (2011), 1st edition.
2. ErwinKreyzig, AdvancedEngineeringMathematics, 10thEdition, Wiley, 2011.4. Aggarwal, C. C. Recommender Systems: The Textbook. Springer 2016

B.Tech III Year - II Semester

Course code	Course Title	L	T	P	Credits
R23CSM-PE3201.2	Generative AI **(Professional Elective-II)**	3	0	0	3

Course Objectives:

The primary objective of this course is to provide students with:

- A deep understanding of generative modeling concepts and techniques.
- Hands-on experience in building and evaluating generative models.
- Insight into modern architectures like GANs, VAEs, Diffusion Models, and Transformers.
- Awareness of ethical, societal, and regulatory implications of generative AI.
- Skills to deploy generative models in practical applications across domains.

Course Outcomes:

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

1. Explain the foundational concepts of generative modeling and its mathematical basis.
2. Implement core generative models like VAEs, GANs, and diffusion models.
3. Develop and fine-tune large language models (LLMs) using transformer architectures.
4. Evaluate generative models based on performance, interpretability, and fairness.
5. Apply generative AI tools to real-world applications while addressing ethical and safety concerns.

Unit-I:

Introduction to Generative Models: Definition and applications of generative models, Types of generative models: Explicit vs Implicit, Mathematical foundations: Probability distributions, KL divergence, Bayesian inference, Maximum Likelihood Estimation (MLE), EM Algorithm

Unit-II:

Variational Autoencoders and Diffusion Models: Autoencoders and latent variable models, Variational Autoencoders (VAEs): Derivation and implementation, Denoising Score Matching and Diffusion Probabilistic Models, Training strategies, advantages, and limitations Unit-III:

Generative Adversarial Networks (GANs): Architecture and intuition behind GANs, Training challenges: Mode collapse, convergence, Variants of GANs: DCGAN, WGAN, CycleGAN, StyleGAN, Applications: Image generation, translation, and editing

Unit-IV:

Transformer Models and Large Language Models: Attention mechanisms and Transformer architecture, Pre-training and fine-tuning (BERT, GPT, T5), Text generation, summarization, translation, Prompt engineering and retrieval-augmented generation (RAG)

Unit-V:

Ethics, Evaluation and Applications of Generative AI: Model evaluation metrics: FID, BLEU, Perplexity, Bias, fairness, and explainability in generative models, Intellectual property, misinformation, and content authenticity

Text Books

1. Ian Goodfellow, Yoshua Bengio, Aaron Courville – Deep Learning, MIT Press, 2016
2. David Foster – Generative Deep Learning: Teaching Machines to Paint, Write, Compose, and Play, 2nd Edition, O'Reilly, 2022

References:

1. Sebastian Raschka, Machine Learning with PyTorch and Scikit-Learn, Packt Publishing, 2022
2. Francois Chollet – Deep Learning with Python, Manning, 2021
3. https://paperswithcode.com

B.Tech III Year - II Semester

Course code	Course Title	L	T	P	Credits
R23CSM-PE3201.3	Software Testing Methodology **(Professional Elective-II)**	3	0	0	3

Course Objectives:

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

Course Outcomes:

1. Understand the concepts of Software Testing.
2. Apply testing techniques to design the test cases for checking the functionality of software.
3. Apply testing techniques to design the test cases for checking the structural aspects of software.
4. Apply validation techniques across the software life cycle.
5. Apply knowledge to design the test cases effectively and using the modern tools.

Unit I:

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

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

Unit II:

Static Testing: inspections, Structured Walkthroughs, Technical reviews

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

Unit III:

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

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

Unit IV:

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

Regression Testing: Objectives, Types, Techniques.

Unit V:

Efficient Test Suite Management: Test case design Why does a test suite grow, Minimizing the test suite and its benefits, test suite prioritization techniques, Understanding severity vs priority.

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

Text Books:

1. Software Testing, Principles and Practices, Naresh Chauhan, Oxford, 2nd Edition, 2016.
2. Software testing techniques - Baris Beizer, International Thomson computer press, second edition, 2002.
3. Foundations of Software testing, Aditya P Mathur, 2nd edition , 2013.

Reference books:

1. Software Testing- Yogesh Singh, CAMBRIDGE
2. Software Testing, Principles, techniques and Tools, M G Limaye, TMH
3. Effective Methods for Software testing, Willian E Perry, 3ed, Wiley
4. Hands-On Test Management with Jira. Afsana Atar, Packt Publishing

B.Tech III Year - II Semester

Course code	Course Title	L	T	P	Credits
R23CSM-PE3201.4	Data Visualization **(Professional Elective-II)**	3	0	0	3

Course Description: The goal of this course is to introduce students to data visualization including principles, techniques and algorithms, to create effective visualizations based on principles from graphic design, visual art, perceptual psychology, and cognitive science. Students will learn the value of visualization, specific techniques in data visualization, grammar of graphics and how to leverage visualization tools.

Course Objectives:

- To discuss core Skills of Visual Analysis
- To demonstrate Time- Series, Ranking and Deviation Analysis
- To introduce distribution, Covariance and multivariate analysis
- To demonstrate Dashboard Design- Basic
- To demonstrate Dashboard Design–Advanced

Course Outcomes:

1. Understand the fundamental concepts and core skills of visual data analysis including basic design principles and user- centered representation.
2. Analyze data using time-series, ranking, and deviation techniques to identify patterns and trends.
3. Develop effective data visualizations using distribution, covariance, and multivariate analysis methods.
4. Design interactive dashboards for real-time data monitoring and decision-making applications.
5. Evaluate and improve dashboard designs based on usability, functionality, and user feedback principles.

UNIT-I

Core Skills For Visual Analysis: Information visualization – effective data analysis – traits of meaningful data – visual perception – making abstract data visible –building blocks of information visualization – analytical interaction – analytical navigation – optimal quantitative scales – reference lines and regions – trellises and crosstabs– multiple concurrent views – focus and context – details on demand – over-plotting reduction – analytical patterns – pattern examples.

UNIT-II

Time-Series, Ranking, and Deviation analysis: Time-series analysis – time-series patterns – time-series displays – time-series best practices – part- to-whole and ranking patterns – part-to-whole and ranking displays – best practices – deviation analysis – deviation analysis displays – deviation analysis best practices.

UNIT-III

Distribution, Correlation, And Multivariate Analysis: Distribution analysis – describing distributions – distribution patterns – distribution displays – distribution analysis best practices – correlation analysis – describing correlations – correlation patterns – correlation displays – correlation analysis techniques andbest practices – multivariate analysis – multivariate patterns – multivariate displays – multivariate analysis techniques and best practices.

UNIT-IV

Information Dashboard Design-Basic: Information dashboard– Introduction– dashboard design issues and assessment of needs- Considerations for designing dashboard-visual perception – Achieving eloquence.

UNIT-V

Information Dashboard Design-Advanced: Advantages of Graphics _Library of Graphs – Designing Bullet Graphs – Designing Spark lines – Dashboard Display Media–Critical Design Practices – Putting it all together- Unveiling the dashboard.

Textbook(s):

1. Ben Fry, Visualizing data: Exploring and explaining data with the processing environment, 1stedition, O'Reilly, 2008, 978-0596514556
2. Shixia Liu, Weikai Yang, Junpeng Wang - Visualization for Artificial Intelligence (2025)-Springer, First Edition.
3. Kieran Healy, Data Visualization: A Practical Introduction Paper back, Princeton University Press, 2018 ,13978-0691181622, First Edition, 2018.
4. Edward R.Tufte ,The visual displayofquantitativeInformation,2ndEdition, Graphics Press, 2001, 978-1930824133

Reference(s):

1. Evan Stubbs, The value of business analytics: I dentifying the path to profitability, 2011, 9781118012390, 1118012399
2. GertH.N. Laursen, Jesper Thorlund, Business Analytics for Managers: Taking business intelligence beyond reporting,2010 , 9780470890615, 0470890614
3. Nathan Yau, Data Points: Visualization that means something, 2013, 9781118654934, 1118654935
4. Stephen Few, Information dashboard design: Displaying data for a t-a-glance monitoring, 2ndEdition, 2013, 9781118654934, 1118654935
5. StephenFew,Nowyouseeit:SimpleVisualizationtechniquesforquantitativeanalysis, 2009 , 9780970601988,0970601980

B.Tech III Year - II Semester

Course code	Course Title	L	T	P	Credits
R23CSM-PE3202.1	Advanced Data Structures and Algorithm Analysis **(Professional Elective-III)**	3	0	0	3

Course Objectives:

The main objectives of the course is to

- Provide knowledge on advance data structures frequently used in Computer Science domain
- Develop skills in algorithm design techniques popularly used
- Understand the use of various data structures in the algorithm design

Course Outcomes:

At the end of the course, a student will be able to

1. Implement List ADTs and their operations.
2. Develop programs for sorting.
3. Develop programs for implementing trees and their traversal operations.
4. Implement graph traversal algorithms.
5. Implement NP Hard and NP Complete Problems

UNIT– I:

Introduction to Algorithm Analysis, Space and Time Complexity analysis, Asymptotic Notations. AVL Trees– Creation, Insertion, Deletion operation sand Applications B-Trees – Creation, Insertion, Deletion operations and Applications

UNIT– II:

Heap Trees(Priority Queues)–Min and Max Heaps, Operations and Applications Graphs– Terminology, Representations, Basic Search and Traversals, Connected Components and Biconnected Components, applications

Divide and Conquer: The General Method, Quick Sort, Merge Sort, Strassen's matrix multiplication, Convex Hull

UNIT– III:

Greedy Method: General Method, Job Sequencing with deadlines, Knapsack Problem, Minimum cost spanning trees, Single Source Shortest Paths

Dynamic Programming: General Method, All pairs shortest paths, Single Source Shortest Paths – General Weights (Bellman Ford Algorithm), Optimal Binary Search Trees, 0/1 Knapsack, String Editing, Travelling Salesperson problem

UNIT– IV:

Backtracking: General Method, 8-Queens Problem, Sum of Subsets problem, Graph Coloring, 0/1 Knapsack Problem

Branch and Bound: The General Method, 0/1 Knapsack Problem, Travelling Salesperson problem

UNIT– V:

NP Hard and NP Complete Problems: Basic Concepts, Cook's theorem

NP Hard Graph Problems: Clique Decision Problem (CDP), Chromatic Number Decision Problem (CNDP), Traveling Salesperson Decision Problem (TSP)

NP Hard Scheduling Problems: Scheduling Identical Processors, Job Shop Scheduling

Textbooks:

1. Fundamentals of Data Structures inC++, Horowitz,Ellis; Sahni, Sartaj; Mehta,Dinesh 2nd Edition Universities Press, 2008.
2. Computer Algorithms/C++ Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran, 2nd Edition University Press, 2007.

Reference Books:

1. Data Structures and program design in C,Robert Kruse, Pearson Education Asia
2. An introduction to Data Structures with applications, Trembley & Sorenson, Mc GrawHill
3. The Art of Computer Programming, Vol.1: Fundamental Algorithms, Donald E Knuth, Addison-Wesley, 1997.
4. DataStructuresusingC&C++:Langsam,Augenstein&Tanenbaum,Pearson,1995
5. Algorithms+ Data Structures & Programs: ,N.Wirth, PHI
6. FundamentalsofDataStructuresinC++:HorowitzSahni&Mehta,GalgottiaPub.
7. Data structures in Java:, Thomas Standish, Pearson Education Asia

Online Learning Resources:

1. https://www.tutorialspoint.com/advanced_data_structures/index.asp
2. http://peterindia.net/Algorithms.html
3. AbdulBari,1. Introductionto Algorithms(youtube.com)

B.Tech III Year - II Semester

Course code	Course Title	L	T	P	Credits
R23CSM-PE3202.2	Pattern Recognition & Visual Recognition **(Professional Elective-III)**	3	0	0	3

Course Objective:

- Understand basic mathematical and statistical techniques commonly used in pattern recognition.

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

1. Understand the foundational principles of pattern recognition
2. Analyze pattern recognition models using Bayesian decision theory
3. Apply image processing techniques for feature extraction and motion estimation using edge detection
4. Design visual recognition systems using hierarchical recognition techniques
5. Investigate recent advancements in pattern recognition, assess classifier performance

UNIT-I

Introduction and mathematical Preliminaries Principles of pattern recognition: Uses, mathematics, Classification and Bayesian rules, Clustering vs classification, Basics of linear algebra and vector spaces, Eigen values and eigen vectors, Rank of matrix and SVD

UNIT-II

Pattern Recognition Basics Bayesian decision theory, Classifiers, Discriminant functions, Decision surfaces, Parameter estimation methods, Hidden Markov models, dimension reduction methods, Fisher discriminant analysis, Principal component analysis, non-parametric techniques for density estimation, non-metric methods for pattern classification, unsupervised learning, algorithms for clustering: K-means, Hierarchical and other methods

UNIT-III

Image Processing and Feature Extraction: Image preprocessing, Image representations (continuous and discrete), Edge detection. Motion Estimation: Regularization theory, Optical computation, Stereo Vision, Motion estimation, Structure from motion.

UNIT-IV

Visual Recognition Human visual recognition system, Recognition methods: Low-level modelling (e.g. features), Mid-level abstraction (e.g. segmentation), High-level reasoning (e.g. scene understanding); Detection/Segmentation methods; Context and scenes, Importance and saliency, Large-scale search and recognition, Egocentric vision, systems, Human-in-the-loop interactive systems, 3D scene understanding.

UNIT-V

Recent advancements in Pattern Recognition Comparison between performance of classifiers, Basics of statistics, covariance and their properties, Data condensation, feature clustering, Data visualization, Probability density estimation, Visualization and Aggregation, FCM and soft-computing techniques, Examples of real-life datasets.

TEXT BOOKS:

1. Sergios Theodoridis and Konstantinos Koutroumbas, Pattern Recognition, Academic Press, 4th Edition, 2009
2. Pattern Recognition and Machine Learning by Christopher M. Bishop, Springer, 2006.
3. Pattern Classification by Richard O. Duda , Peter E. Hart, David G. Stork, Wiley, 1973.

REFERENCEBOOKS:

1. https://nptel.ac.in/courses/106/106/106106046/
2. Rafael C. Gonzalez and Richard E. Woods, Digital Image Processing, Pearson, 4th Edition, 2018
3. Bernd Jahne, Digital Image Processing, Springer, 6th Edition, 2005
4. Anil K. Jain, Fundamentals of Digital Image Processing, Pearson, 2001

B.Tech III Year - II Semester

Course code	Course Title	L	T	P	Credits
R23CSM-PE3202.3	Software Project Management **(Professional Elective-III)**	3	0	0	3

Course Objectives:

- To understand the basic concepts and effectively planning the software projects.
- To implement the project plans through managing people, communications and change
- To conduct activities necessary to successfully complete and close the Software projects
- To develop software projects based on current technologies.
- To develop awareness regarding the theoretical and methodological issues related to software project management.

Course Outcomes:

1. Identify the theoretical and methodological issues involved in modern software project management
2. Identify project goals, constraints, deliverables, performance criteria, control needs, and resource requirements in consultation with stakeholders
3. Estimate project cost and perform cost-benefit evaluation among projects
4. Document and evaluate outcomes of risk management plans
5. Select and use project management frameworks for hiring the staff.

Unit I:

Project, Management, Software Project Management activities, Challenges in software projects, Stakeholders, Objectives & goals

Project Planning: Step-wise planning, Project Scope, Project Products & deliverables, Project activities, Effort estimation, Infrastructure

Unit II:

Lifecycle models, Choosing Technology, Prototyping Iterative & incremental Process Framework: Lifecycle phases, Process Artifacts, Process workflows

Unit III:

Estimation techniques, Function Point analysis, SLOC, COCOMO, Use case-based estimation

Activity Identification Approaches, Network planning models, Critical path analysis

Unit IV:

Risk categories, Identification, Assessment, Planning and management, PERT technique, Monte Carlo approach

Creating a framework for monitoring & control, Progress monitoring, Cost monitoring, Earned value Analysis, Software Quality Assurance, Quality Metrics.

Unit V:

Change Management, Impact analysis of change on budget and schedule, Managing people – Organizational behaviour – Best methods of staff selection – Motivation – The Oldham – Hackman job characteristic model – Stress – Health and Safety – Ethical and Professional concerns – Working in teams – Decision making – Organizational structures – Dispersed and Virtual teams – Communications genres – Communication plans – Leadership.

Text Books:

1. Software Project Management, Bob Hughes & Mike Cotterell, TATA Mcgraw-Hill, 5th Edition, 2009
2. Software Project Management, Walker Royce: Pearson Education, 1st Edition, 2005.

Reference books:

1. Software Project Management in practice, Pankaj Jalote, Pearsontion, 1st Edition, January 2002.
2. Software Project Management, Joel Henry, Pearson Education, 1st Edition , 2004.

B.Tech III Year - II Semester

Course code	Course Title	L	T	P	Credits
R23CSM-PE3202.4	Bioinformatics **(Professional Elective-III)**	3	0	0	3

Course Objectives:

The students should be able to understand the scope of Bioinformatics. They should know about popular bioinformatics databases and sequence alignment algorithms.

Course Outcomes:

After completion of course, students would be able to:

1. Understand the historical development, scope, and core objectives of bioinformatics, along with key data models
2. Utilize biological databases effectively and work with sequence search methods
3. Compare biological sequences using dynamic programming algorithms
4. Interpret pairwise and multiple sequence alignments using appropriate bioinformatics tools
5. Apply gene and protein prediction methods, use molecular visualization tools, and construct phylogenetic trees to infer evolutionary relationships from sequence data.

Unit-I:

Introduction: History, scope and important contributions, aims and tasks of Bioinformatics, applications of Bioinformatics, challenges and opportunities, introduction to NCBI data model, various file formats for biological sequences.

UNIT-II:

Biological Databases and Data Search Methods|: Importance of databases, biological databases, primary sequence databases, composite sequence databases, secondary databases, nucleic and sequence databases, protein sequence databases, structure databases, bibliographic databases, specialized genomic resources, analysis packages. Methods for searching sequence databases like FASTA and BLAST algorithms, Statistical analysis and evaluation of BLAST results.

UNIT-III:

Sequence Comparison Methods: Methods for comparison of two sequences, Needleman Wush and Smith Waterman algorithms. Analysis of computational complexities, merits and demerits of these algorithms, theory of scoring matrices and their use for sequence comparison.

UNIT-IV:

Sequence Alignment Methods: Sequence analysis of biological data, significance of sequence alignment, pair wise sequence alignment methods, use of scoring matrices and gap penalties in sequence alignments, multiple sequence alignment methods, tools and applications of multiple sequence alignment.

UNIT-V:

Predictive Methods Using DNA and Protein Sequences: Gene prediction strategies, protein prediction strategies, molecular visualization tools, phylogenetic analysis: concept of trees, phylogenetic trees and multiple alignments.

Textbook(s):

1. Andreas D Baxevanis & B F Francis, “Bioinformatics-A practical guide to analysis of Genes and Proteins”, John Wiley, 2010
2. T K Attwood, D J Parry-Smith, “Introduction to Bioinformatics”, Pearson Education, 2005
3. Neil C. Jones, Pavel A. Pevzner, “An introduction to Bioinformatics Algorithms”, MIT Press, 2005

Reference(s):

1. Gary Benson Roderic, “Algorithms in Bioinformatics”, Springer, 2004
2. Foundations of Bioinformatics, Manoj Darbari, Khanna Book Publishing Co., 2013.

B.Tech III Year - II Semester

Course code	Course Title	L	T	P	Credits
R23CSM-PC3204	Natural Language Processing Lab	0	0	3	1.5

Course Objectives:

- To introduce foundational concepts and methods in Natural Language Processing.
- To provide an understanding of statistical language modelling using n-grams, smoothing techniques, and methods for Part-of-Speech tagging such as the Hidden Markov Model and Viterbi algorithm.
- To enable students to explore and construct syntactic parsing techniques using Context-Free Grammars (CFGs).
- To equip students with the ability to design and implement deep learning models.
- To develop analytical skills for handling advanced NLP applications including Word Sense Disambiguation (WSD), Named Entity Recognition (NER), Relation Extraction, and speech technologies like ASR and TTS.

Course Outcomes:

At the end of this course, the student will be able to

1. Apply text pre-processing techniques such as tokenization, stemming, lemmatization, and compute edit distance to prepare and analyze text data.
2. Construct n-gram language models with smoothing, compute perplexity, and implement POS tagging using HMM and Viterbi algorithm for sequence labelling tasks.
3. Develop syntactic parsing solutions using Context-Free Grammars, PCFGs, and dependency parsing approaches for sentence structure analysis.
4. Implement neural models such as RNNs, LSTMs, and attention-based Seq2Seq architectures for tasks like next-word prediction and machine translation.
5. Analyze and evaluate semantic and speech-related tasks using Word Sense Disambiguation, Named Entity Recognition, Relation Extraction, ASR, and TTS systems.

Experiments:

1. To implement text preprocessing techniques such as tokenization, case folding, stemming, lemmatization, and calculate the edit distance between text strings.
2. Create unigram, bigram, and trigram language models. Apply smoothing techniques to handle unseen data. Compute the perplexity of a given test sentence.
3. To construct a Part-of-Speech (POS) tagger using the Hidden Markov Model (HMM) and implement the Viterbi algorithm to decode the most probable sequence of tags for a given sentence.
4. Implement Recurrent Neural Network (RNN) architectures for next-word prediction using pre-trained word embeddings such as Word2Vec or GloVe.
5. Construct Context-Free Grammars (CFGs) to generate sentences applying top-down and bottom-up parsing algorithms for syntactic analysis.
6. To implement Probabilistic Context-Free Grammars (PCFGs) for statistical parsing and explore dependency parsing using graph-based and transition-based methods for syntactic analysis.
7. Implement and compare two approaches to Word Sense Disambiguation (WSD): Supervised Approach: Using a Decision Tree classifier for WSD and Unsupervised Approach: Using the Lesk Algorithm for WSD.
8. To implement Information Extraction using Named Entity Recognition (NER) and Relation Extraction.
9. Construct Automatic Speech Recognition (ASR) and Text-to-Speech (TTS) Systems using Deep Learning Techniques.
10. Build a Neural Machine Translation model using sequence-to-sequence (Seq2Seq) architecture with attention mechanisms.

Text Books:

1. Bharath Ramsundar, Reza Bosagh Zadeh,"Tensorflow for Deep Learning", O'Reilly publishers, 1st Edition, 2018.

References:

2. https://github.com/fchollet/deep-learning-with-python-notebooks

B.Tech III Year - II Semester

Course code	Course Title	L	T	P	Credits
R23CSM-PC3205	Computer Networks Lab	0	0	3	1.5

Course Objectives:

- Understanding Network Fundamentals and Familiarization with Packet Tracer.
- Design simple and complex network topologies.
- Configure network devices such as routers, switches, and access points
- 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.

Week2

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

Week3

A. To study pc to pc communication using parallel port

B. Study of Client Server Architecture

Week 4

A. Study of Basic network commands.

B). Implementation file sharing using FTP server.

Week 5

A. Study of networking/ Internet working device configuration commands

Week 6: 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.

Week 7: Subnet planning and its implementation (VLSM).

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

Week 8: To configure WLAN

1. Understand how to establish WLAN.

Week 9: To configure hub/switch and router with interfaces

Week 10: 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.

Reference Books:

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

Web Links:

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

B. Tech III Year - II Semester

Course code	Course Title	L	T	P	Credits
R23CSM-SC3201	React JS Essentials (Skill Oriented Course)	0	1	2	2

Course Objectives:

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

Course Outcomes:

- Understand the anatomy of React Java Script.
- Understand the life cycle methods of React JS.
- Implement React components for building applications.
- Apply React hooks for component reusability and monitoring.
- Implement React rendering for interactive applications.

Unit-I:

Introduction to ReactJS & JSX: Introduction to ReactJS, ReactJS vs Angular, React Version History, Architecture of a React Application, Installing React and Environment Setup, Creating and Running a React App using create-react-app, Anatomy of a React Project. **Templating using JSX:** JSX Syntax and Usage, Embedding Expressions in JSX, Using JavaScript Operators in JSX, JSX Attributes and Differences from HTML, Using Fragments for Grouping Elements

ReactJS Basics & JSX

Lab 1: Setting Up React Environment

- Install Node.js, create a new React app using Create React App (CRA), understand the folder structure, and run a basic React app.

Lab 2: JSX Practice

- Create a React component using JSX that renders a welcome message and current date/time dynamically.

Lab 3: Rendering Elements

- Create a simple app that renders multiple React components such as Header, Content, and Footer.

Unit-II:

React Core Concepts: Props and Prop Drilling, State and State Management, Event Handling in React, Working with Lists and Keys, Inline and External Styling in React, Implementing Pagination Logic, React Component Lifecycle Overview, Lifecycle Methods: componentDidMount, componentDidUpdate, componentWillUnmount, Mounting and Unmounting Lifecycle.

Props, State & Lifecycle

Lab 4: Functional and Class Components

- Create the same UI using both functional and class-based components to compare them.

Lab 5: Passing Props to Components

- Build a parent-child component structure where the parent passes data (props) to children to display personalized user messages.

Lab 6: List Rendering and Keys

- Display a list of products or users using the .map() function and use keys correctly for each list item.

Unit-III:

Advanced React Components: Pure Components and Performance Optimization, Using React.memo for Memoization, Refs and DOM Manipulation, Portals for Rendering Outside Root DOM, Higher-Order Components (HOC), Context API for Prop Drilling Solutions, Making HTTP Requests using Fetch or Axios (GET, POST).

React Router Basics

- Set up routing in a React app with pages: Home, About, and Contact. Use Link and Route components.

Lab 8: Route Parameters

- Create a blog app with a post listing page. When a post is clicked, navigate to a detailed view using route parameters.

Lab 9: API Integration with Axios

- Fetch data from a public API (e.g., JSONPlaceholder, OpenWeather, or GitHub users) and display it in a card or table format.

Unit-IV:

React Hooks: Introduction to React Hooks, Basic Hooks: useState, useEffect, Run Effects on Mount/Update, Fetching Data with Hooks, Context with useContext, Reducer Logic using useReducer, Performance Hooks: useCallback, useMemo, Referencing DOM with useRef, Creating and Using Custom Hooks.

React Hooks

Lab 10: Managing State with useState

- Create a counter app with increment/decrement/reset functionality using useState.

Lab 11: Effect Hook Demo

- Build a component that fetches current time or random quotes from an API and updates periodically using useEffect.

Lab 12: Handling Forms

- Create a form with name, email, and password fields. Handle form submission and display the entered data below the form.

Unit-V:

React Rendering and Optimization: React Rendering Process, Managing State with useState and useReducer, Importance of State Immutability, Communication between Parent & Child Components, Using memo for Functional Component Optimization, Sharing Data with Context, Optimizing Performance with useCallback.

Rendering & Optimization

Lab 13: Context API for Global State

- Implement a theme switcher or login system using React Context API for state sharing across components.

Lab 14: Code Splitting and Lazy Loading

- Demonstrate code splitting by lazily loading heavy components using React.lazy and Suspense.

Lab 15: Complete React Application (SPA)

- Build a complete React application (e.g., To-Do List, Weather App, Student Dashboard) integrating routing, state, props, and API.

Textbooks:

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

References:

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

B.Tech III Year - II Semester

Course code	Course Title	L	T	P	Credits
R23CSM-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)
- Constructclearandfocusedresearchproposalthataddressaspecificgapintheadvancemento f k n o w l e d g e 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 & Parishit Bansal, 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 - II Semester

Course code	Course Title	L	T	P	Credits
R23CSM-HN3201	Deep Learning for Computer Vision **Honors Course-3(Track-1)**	**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:

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

Unit-1

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

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

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

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

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

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

Link:

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

B.Tech III Year - II Semester

Course code	Course Title	L	T	P	Credits
R23CSM-HN3202	UX and UI Design Framework **Honors Course-3(Track-2)**	3	0	0	3

Course Objectives:

- To understand the principles and processes involved in UX and UI design.
- To explore frameworks and tools used for designing user-centered digital interfaces.
- To develop skills in designing interactive prototypes and conducting usability testing.
- To integrate design thinking into web and mobile application development.

Course Outcomes:

1. Understand the fundamental concepts of UX and UI design
2. Apply UX research techniques such as user interviews, persona creation, and journey mapping to define user goals and structure content effectively.
3. Design user interfaces using visual design principles, responsive frameworks, and accessibility standards to ensure inclusivity and usability.
4. Develop wireframes and interactive prototypes using industry-standard tools while incorporating navigation strategies and design heuristics.
5. Evaluate and validate UX/UI designs through usability testing, metric analysis, and iterative refinement based on real-world feedback and case studies.

Unit I:

Introduction to UX/UI Design- Fundamentals of UX and UI, Difference between UX and UI, Human-Centered Design (HCD) process, Design Thinking: Empathize, Define, Ideate, Prototype, Test, Importance of UX in product success, Psychology and cognitive principles in design

Unit II:

UX Research and Analysis- User research methods: Interviews, surveys, observation, Creating user personas, Journey mapping and empathy maps, Information architecture and content strategy, Competitive analysis, Defining user needs and goals

Unit III:

UI Design Principles and Frameworks- Visual design elements: Layouts, color theory, typography, iconography, UI design principles: Consistency, feedback, visibility, affordance, Introduction to UI frameworks: Material Design, Bootstrap, Ant Design, Fluent UI, Designing responsive interfaces (mobile-first approach), Accessibility standards (WCAG) and inclusive design

Unit IV:

Prototyping and Interaction Design- Wireframing tools: Figma, Adobe XD, Sketch, Balsamiq, Low-fidelity vs high-fidelity prototypes, Interactive design and microinteractions, Design patterns and UI components, Navigation and layout design strategies, Heuristic evaluation

Unit V:

Usability Testing and Design Validation- Types of usability testing: Moderated, unmoderated, A/B testing, Conducting usability tests and recording feedback, Analyzing test data and iteration, Metrics for usability (SUS, NPS, Task success rate), Final project: End-to-end UX/UI case study, Real-world examples and current trends in UX/UI

Text Books:

1. Don't Make Me Think by Steve Krug (Latest Edition), 2014
2. The Design of Everyday Things by Don Norman, 2013

Reference Books:

1. About Face: The Essentials of Interaction Design by Alan Cooper, 2014
2. Lean UX by Jeff Gothelf, Lean UX: Designing Great Products with Agile Teams, 3rd Edition, 2012
3. A Project Guide to UX Design by Russ Unger and Carolyn Chandler, 2012

B.Tech III Year - II Semester

Course code	Course Title	L	T	P	Credits
R23CSM-HN3203	Enterprise Networking, Security, and Automation **Honors Course-2(Track-3)**	3	0	0	3

Course Objectives

- Configure a single-area OSPFv2 network using a network simulator or real equipment.
- Understand the principles of Network Address Translation (NAT) for IPv4 and its role in network security and addressing.
- Analyze different VPN technologies like PPTP, L2TP/IPsec, and OpenVPN
- Apply network troubleshooting methodologies to identify and resolve common network issues.
- Understand the principles of network automation and its role in automating network configuration and management tasks.

Course Outcomes:

- Apply the different OSPFv2 components like areas, routers, neighbors, and LSAs
- Understand the fundamental concepts of network security, including threats, vulnerabilities, and security controls.
- Apply the various technologies used to connect geographically dispersed locations in a WAN
- Apply network design principles to optimize WAN performance, scalability, and security
- Apply the knowledge to design, implement, and manage automated network solutions.

Unit-I

OSPF Concepts and Configuration: Single-Area OSPFv2 Concepts - Single-Area OSPFv2 Configuration

Unit – II

Network Security: Network Security Concepts - ACLs Concepts - ACLS for IPv4 Configuration - NAT for IPv4

Unit – III

WAN: WAN Concepts - VPN and IPsec Concepts

Unit – IV

Optimize, Monitor, and Troubleshoot Networks: QoS Concepts - Network Management - Network Design - Network Troubleshooting

Unit – V

Network Virtualization and Automation: Network Virtualization - Network Automation

Contemporary Topics need to mention (Compulsory)

Software-Defined Networking (SDN) , IPv6 Security, Cloud-based VPNs, Cloud-based Network Architectures

Text Books:

1. Enterprise Networking, Security, and Automation Companion Guide (CCNAv7) Cisco Networking Academy ISBN-13: 978-0-13-663432-4, ISBN-10: 0-13-663432-X

References Books:

1. 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)

Weblinks

1. https://ptgmedia.pearsoncmg.com/images/9780136634324/samplepages/9780136634324_Sample.pdf
2. https://www.oreilly.com/library/view/enterprise-networking-security/9780136634171/

B.Tech III Year - II Semester

Course code	Course Title	L	T	P	Credits
R23CSM-HN3204	Vulnerability Assessment & Penetration **Honors Course-2(Track-4)**	3	0	0	3

Course Objectives:

- To identify penetration testing process.
- To identify the various information gathering and scanning procedures of security systems.
- To identify various system hacking procedures.
- To understand the impact of hacking in real time machines.
- 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.

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.

UNIT-III:

System Hacking: Password cracking techniques- Key loggers- Escalating privileges- Hiding Files, Double Encoding, Steganography technologies and its Counter measures. Active and passive sniffing- ARP Poisoning, MAC Flooding- SQL Injection - Error- based, Union-based, Time-based, Blind SQL, Out-of-band, Injection Prevention Techniques.

UNIT IV:

Advanced System Hacking: Broken Authentication, Sensitive Data Exposure, XML External Entities, Broken Access Code, XSS - Stored, Reflected, DOM Based.

UNIT V:

Wireless Pentest: Wi-Fi Authentication Modes, Bypassing WLAN Authentication, Types of Wireless Encryption, WLAN Encryption Flaws, AP Attack, Attacks on the WLAN Infrastructure, DoS-Layer1, Layer2, Layer 3, DDoS Attack, Client Disassociation, Wireless Hacking Methodology, Wireless Traffic Analysis**.**

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

OPEN ELECTIVES

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

Course Objectives:

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

Course Outcomes:

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

UNIT – I

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

UNIT – II

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

UNIT – III

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

UNIT – IV

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

UNIT – V

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

Textbooks

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

Course code	Course Title	L	T	P	Credits
R23ECE-OE0002	Micro Processors and Interfacing **(Open Elective)**	3	0	0	3

Course Objectives: students are provided with

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

Course Outcomes: Student is able to

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

UNIT 1

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

UNIT 2

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

UNIT 3

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

UNIT 4

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

UNIT-5

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

Text Books:

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

References:

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

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

Course Objectives:

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

Course Outcomes:

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

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

UNIT-I

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

UNIT-II

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

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

UNIT-III

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

UNIT IV

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

UNIT-V

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

Text Books

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

Reference Books

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

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

Course Objectives:

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

Course Outcomes:

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

UNIT – I

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

UNIT – II

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

UNIT – III

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

UNIT – IV

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

UNIT – V

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

Textbooks:

1. Rafael C. Gonzalez & Richard E. Woods, Digital Image Processing, Pearson.
2. Anil K. Jain, Fundamentals of Digital Image Processing, PHI Learning. (Indian Author)
3. S. Jayaraman, S. Esakkirajan, and T. Veerakumar, Digital Image Processing, McGraw-Hill. (Indian Author)

Course code	Course Title	L	T	P	Credits
R23ECE-OE0005	Introduction to Internet of Things **(Open Elective)**	3	0	0	3

Course Objectives:

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

Course Outcomes:

The students should be able to:

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

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

UNIT - I

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

UNIT - II

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

UNIT - III

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

UNIT - IV

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

UNIT - V

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

Text Books:

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

Reference Books:

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

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

Course Objectives:

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

Course Outcomes:

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

UNIT-I

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

Architectures:

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

UNIT - II

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

UNIT - III

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

UNIT - IV

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

UNIT-V

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

Sensor Network Platforms and Tools:

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

Textbooks

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

References

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

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

Course Objectives:

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

Course Outcomes:

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

UNIT – I

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

UNIT – II

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

UNIT – III

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

UNIT – IV

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

UNIT – V

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

Textbooks:

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

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

Course Objectives

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

Course Outcomes

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

UNIT-I

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

UNIT-II

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

UNIT-III

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

UNIT-IV

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

UNIT-V

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

Textbooks:

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

References:

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

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

Course Objectives:

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

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

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

UNIT–I

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

UNIT–II

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

UNIT–III

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

UNIT–IV

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

Geothermal: Classification – Dry rock and hot acquifer – Energy analysis – Geothermal based electric power generation

UNIT–V

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

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

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

Text Books:

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

Reference Books:

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

Weblinks:

1. https://nptel.ac.in/courses/103103206

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

Course objectives:

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

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

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

UNIT – I

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

UNIT - II

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

UNIT - III

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

UNIT - IV

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

UNIT - V

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

Text books:

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

Reference books:

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

Web Links:

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

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

Course Objectives:

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

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

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

UNIT-I

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

UNIT-II

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

UNIT-III

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

UNIT–IV

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

UNIT-V

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

Textbooks

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

Publishing company, New Delhi, 1997

Reference Books

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

Web Links:

1. https://onlinecourses.nptel.ac.in/noc20_mg43
2. https://onlinecourses.swayam2.ac.in/nou20_cs08/preview
3. https://www.udemy.com/course/electrical-safety

Course code	Course Title	L	T	P	Credits
R23EEE-OE0004	Utilization of Electrical Energy **(Open Elective)**	3	0	0	3

Course Objectives:

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

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

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

UNIT-I

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

UNIT-II

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

UNIT-III

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

UNIT–IV

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

UNIT-V

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

Textbooks:

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

Reference Books:

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

Web Links:

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

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

Course Objectives:

The objectives of the course are to

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

Course Outcomes

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

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

UNIT I

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

UNIT II

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

UNIT III

Queuing Theory: Introduction – Basic queuing process, basic structure of queuing models terminology: arrival Pattern, service channel, population, departure pattern, queue discipline, Kendall's notation.
Single Channel model with poisson arrivals, exponential service times with infinite queue length
Simulation: Basic concept of simulation, discrete event simulation, applications of simulation, merits and demerits of simulation, Monte Carlo simulation, simulation of Inventory system, simulation of Queuing system. Simulation languages
Applications: Decision making in uncertainty situations

UNIT IV

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

Applications: Project planning control in manufacturing and maintenance

UNIT V

Game Theory: Optimal solution of two-person zero sum games, the max min and min max principle. Games without saddle points, mixed strategies. algebraic method, Reduction by principles of dominance, graphical method for [2x n] and [mx2] game problems, Linear programming model

Applications: Determination of optimal strategies in competition between industries

Text books:

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

Reference books:

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

Web Source References:

1. https://onlinecourses.nptel.ac.in/noc22_mg15
2. https://onlinecourses.nptel.ac.in/noc22_ma48
3. https://onlinecourses.nptel.ac.in/noc24_mg30
4. https://www.britannica.com/topic/operations-research
5. https://www.theorsociety.com/about-or

Course code	Course Title	L	T	P	Credits
R23MEC-OE0002	3D Printing Technology **(Open Elective)**	3	0	0	3

Course Objectives:

The objectives of the course are

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

Course Outcomes

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

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

UNIT-I

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

UNIT-II

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

UNIT-III

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

UNIT-IV

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

UNIT-V

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

Text Books

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

References

1. Rapid Prototyping: Laser-based and Other Technologies, Patri K. Venuvinod and Weiyin Ma,Springer.
2. Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping and RapidTooling, D.T. Pham, S.S. Dimov, Springer.
3. Rapid Prototyping: Principles and Applications in Manufacturing, Rafiq Noorani, John Wiley &Sons.

4. Additive Manufacturing, Second Edition, Amit Bandyopadhyay Susmita Bose, CRC PressTaylor & Francis Group.
5. Additive Manufacturing: Principles, Technologies and Applications, C.P Paul, A.N Junoop, McGraw Hill.

Web resources

1. https://www.nist.gov/additive-manufacturing
2. https://www.metal-am.com/
3. http://additivemanufacturing.com/basics/
4. https://www.3dprintingindustry.com/
5. https://www.thingiverse.com/
6. https://reprap.org/wiki/RepRap

Course code	Course Title	L	T	P	Credits
R23MEC-OE0003	Statistical quality control **(Open Elective)**	3	0	0	3

Course Objectives:

The Objectives of this course are to

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

Course outcomes:

Upon completion of this course students will be able to

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

UNIT –I

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

Application:

Quality control concepts used to meet customer requirements in manufacturing industries

UNIT II

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

Application: Perform Process capability studies in machine tool industries

UNIT III

Statistical Process Control: Control charts: Statistical basis of the Control Charts-principles, Control limits for X and R-Charts, analysis of pattern on control charts, Type I and Type II errors, p chart, c chart construction. Simple Numerical Problems, revised control limits

Application:

Identify the assignable causes Quality control in manufacturing to control the processes

UNIT- IV

ACCEPTANCE SAMPLING: Fundamental concept in acceptance sampling, Need of acceptance sampling, operating characteristics curve. Producer risk and consumer risk in sampling plans. Acceptance plans, single sampling plan, double sampling plan –exercises.

Application: Selection of sampling plan to minimize risk in purchasing parts, components from the suppliers

UNIT- V

Quality Systems: The Concept of Six Sigma, Objectives of Six Sigma, The Frame-Work of Six Sigma Programme, Six Sigma Problem Solving Approach, The DMAIC Model: Cost of Poor Quality, Benefits and Costs of Six Sigma.

Need for ISO 9000 and Other Quality Systems, ISO 9000: 2000 Quality System – Elements, Implementation of Quality System, Documentation, Quality Auditing, QS 9000, ISO 14000 – Concept, Requirements and Benefits.

Case Studies of TQM projects and Six Sigma projects.

Application: Systems followed in manufacturing units for quality excellence

Text books:

1. Subburaj Ramaswamy, Total Quality Management, Tata Mcgraw Hill Publishing Company Ltd.
2. Statistical Quality Control, M.Mahajan, Dhanpat Rai Publishing Co Pvt Ltd

Reference Books:

1. Introduction to statistical quality control: By D.C. Montgomery, John Wiley &Sons Inc.
2. Forrest W. Breyfogle, Implementing Six Sigma, John Wiley & Sons, Inc.
3. Statistical Quality Control – R.C. Gupta– Khanna Publishers, Delhi
4. Grant,E,L.and LavenWorth,R.S.: Statistical Quality Control, McGraw Hill.
5. Evans, J R and W M Lindsay, An Introduction to Six Sigma and Process Improvement, Cengage Learning.

Web Source References:

1. https://nptel.ac.in/courses/112/107/112107259/- Inspection and Quality controlmanufacturing.
2. https://nptel.ac.in/courses/110105039
3. https://www.youtube.com/watch?v=qb3mvJ1gb9g
4. https://nptel.ac.in/courses/110104085
5. https://onlinecourses.nptel.ac.in/noc20_mg19

Course code	Course Title	L	T	P	Credits
R23MEC-OE0004	Hybrid Vehicle Technologies **(Open Elective)**	3	0	0	3

Course Objectives:

The course is intended to

- Familiarize the fundamentals of conventional and hybrid electric vehicle components.
- Understand the configurations and working of hybrid and electric drive-trains.
- Understand the architecture, operation and energy management of PHEVs
- Study and understand different power converters used in hybrid and electrical vehicles.
- Familiarize with different batteries and other energy storage systems.

Course outcomes:

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

1. *Understand* the fundamentals of conventional and hybrid electric vehicle components.
2. *Describe* hybridization of power sources in hybrid electric vehicles.
3. *Apply* the principles of power management and fuel economy to optimize the PHEV performance
4. *Explain* the working principle of power electronics in hybrid vehicles.
5. *Describe* the different battery technologies and other energy storage systems.

UNIT–I:

Introduction: Fundamentals of vehicle, components of conventional vehicle and propulsion load, drive cycles and drive terrain; concept of electric vehicle and hybrid electric vehicle; history of hybrid vehicles, advantages and applications of electric and hybrid electric vehicles, different motors suitable for of electric and hybrid electric vehicles.

UNIT–II:

Architectures of Hybrid, Plug-in Hybrid, Fuel Cell and Electric Vehicles

Hybrid Electric Drive-trains: Architectures of HEVs, Series and parallel HEVs complex HEVs. Plug-in hybrid vehicle, constituents of PHEV, comparison of HEV and PHEV- Fuel Cell vehicles and its constituents.

Electric Drive-trains: Basic concept of electric traction, introduction to various electric drive-train topologies, power flow control in electric drive-train topologies.

UNIT–III:

Plug-in Hybrid Electric Vehicle: PHEVs and EREVs blended PHEVs, PHEV Architectures, equivalent electric range of blended PHEVs; Fuel economy of PHEVs, power management of PHEVs, end-of-life battery for electric power grid support, vehicle to grid technology(V2G), PHEV battery charging.

Applications:

- Optimizing fuel economy by managing the switch between electric and combustion power in PHEVs.
- Using PHEV batteries to support the grid during peak demand through Vehicle-to-Grid (V2G) technology.

UNIT–IV:

Power Electronics in HEVs: Rectifiers used in HEVs, voltage ripples, Buck converter used in HEVs, non- isolated bidirectional DC-DC converter, voltage source inverter, current source inverter, isolated bidirectional DC-DC converter, PWM rectifier in HEVs, EV and PHEV battery chargers.

UNIT–V:

Battery and Storage Systems: Energy storage parameters; lead acid, li-ion and Ni-MH batteries, ultracapacitors, flywheels- superconducting magnetic storage system; pumped hydroelectric energy storage; compressed Air energy storage-storage heat; energy storage as an economic resource.

Applications:

- Battery selection in EVs: Selecting Li-ion or Ni-MH batteries for EVs based on battery cost and performance.

- Supporting the power grid with pumped hydro or compressed air energy storage systems.

Text Books:

1. Ali Emadi, Advanced Electric Drive Vehicles, 1st Edition, CRC Press.
2. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, 2nd Edition, CRC Press, 2010.

Reference Books:

1. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2009.
2. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003.
3. H.Partab: Modern Electric Traction-DhanpatRai &Co,2007.

Web link:

1. https://archive.nptel.ac.in/courses/108/103/108103009/

Course code	Course Title	L	T	P	Credits
R23MEC-OE0005	Industrial Robotics **(Open Elective)**	3	0	0	3

Course Objectives:

The objectives of the course are

- To understand the Geometrical Configuration and Components of Industrial Robots (Anatomy)
- To analyze the factors influencing gripper selection and design.
- To grasp the concept of rotation matrices and their significance in robotics.
- To understand forward and inverse kinematics of robot manipulator
- To familiarize the students with the fundamentals of sensors and various drive systems.
- To develop Program Robot for applications in various fields.

Course Outcomes:

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

1. Understand the anatomy of robots including the components and structure. (L2)
2. Design the grippers considering grasping force, Engelberger-g-factors, and actuation mechanisms (L2)
3. Apply basic transformation and rotation matrices in robot kinematics (L3)
4. Explain the function of feedback components such as position sensors (potentiometers, resolvers, encoders) and velocity sensors. (L2)
5. Understand the use of robots in manufacturing, inspection and quality control applications. (L2)

Unit- I

Robotics: Introduction, classification with respect to geometrical configuration (Anatomy), Controlled system & chain type, Serial manipulator & Parallel Manipulator. Components of Industrial robotics, precession of movement, resolution, accuracy & repeatability,

Dynamic characteristics: speed of motion, load carrying capacity & speed of response, Sensors, Internal sensors: Position sensors, & Velocity sensors, External sensors: Proximity sensors, Tactile Sensors, & Force and Torque sensors.

Unit-II

Grippers & End effectors: Mechanical Gripper, Grasping force, Engelberger-g-factors, mechanisms for actuation, Magnetic gripper, vacuum cup gripper, considerations in gripper selection & design, specifications. Selection of gripper based on Application.

Applications:

1. Wall climbing robot
2. Vacuum cups

Unit- III

Motion Analysis:

Basic Rotation Matrices, Equivalent Axis and Angle, Euler Angles, Composite Rotation Matrices. Homogeneous transformations as applicable to rotation and translation.

Manipulator Kinematics- Assignment of frames, D-H Transformation Matrix, joint coordinates and world Coordinates, Forward and inverse kinematics.

Applications:

1. Robot trajectory generation by forward kinematics.
2. Welding robots by inverse kinematics by root multiplicity.

Unit-IV

Robot actuators and Feedback components: Actuators: Pneumatic, Hydraulic actuators, electric & stepper motors, comparison of Actuators, Feedback components: position sensors, potentiometers, resolvers, encoders, Velocity sensors, Tactile and Range sensors, Force and Torque sensors, End Effectors and Tools.

Applications:

1. Automated Assembly Lines in Automotive Manufacturing
2. Surgical Robotics (e.g., Da Vinci System)

Unit-V

Robot Programming & Applications: Material Transfer - Material handling, loading and unloading- Processing spot and continuous arc welding & spray-painting Assembly and Inspection. Robotic Programming Methods - Languages: Lead Through Programming, Textual Robotic Languages such as APT, MCL.

Applications:

1. Automated Car Body Assembly
2. Electronics Manufacturing (e.g., PCB Assembly)

Text Books

1. Industrial Robotics / Groover M P /Mc Graw Hill
2. Introduction to Robotics / John j.Craig / Pearson

References

1. Introduction to Industrial Robotics / Ramachandran Nagarajan / Pearson
2. Robot Dynamics and controls / Spony and Vidyasagar / John Wiley

Web Resources:

1. https://onlinecourses.nptel.ac.in/noc23_me143/preview
2. https://www.youtube.com/results?search_query=1.%09Robotics+Programming+in+Just+30+Days!+%7C+Industrial+Robotics+Programming+in+Bangalore+%7C+RVM+CAD
3. https://www.youtube.com/watch?v=QiFbrmJTib4&t=11s
4. https://www.youtube.com/watch?v=hL_GKapQd1k

Course code	Course Title	L	T	P	Credits
R23MEC-OE0006	Nano Materials **(Open Elective)**	3	0	0	3

Course objectives:

The objectives of the course are

- To understand the nano-structured materials and their applications.
- To learn about the nano-crystalline materials, their properties and defects.
- To understand various techniques of nanofabrication.
- To identify the tools to characterize nano materials.
- To analyze the applications of nano materials.

Course Outcomes:

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

1. ***Explain*** nano-structured materials and their applications **(L2)**
2. ***Apply*** knowledge about the nano-crystalline materials, their properties and defects **(L3)**
3. ***Demonstrate*** various techniques of nanofabrication **(L2)**
4. ***Apply*** the tools to characterize nano materials **(L3)**
5. ***Analyze*** the applications of nano materials **(L4)**

UNIT–I

Introduction to Nanomaterials: History and Scope, Classification of Nano structured Materials, Distinction between nanomaterials and bulk materials, Classification of nanomaterials: 0D, 1D, 2D, 3D, Fascinating Nanostructures, and applications of nanomaterials, challenges and future prospects.

Learning outcomes:

At the end of this unit students will be able to:

1. ***Understand*** the fundamental concepts of nanomaterials and how they differ from bulk materials **(L2)**
2. ***Identify*** and describe various nanostructures (0D, 1D, 2D, 3D) and their unique properties at the nanoscale **(L2)**

Application:

Semiconductors , Nano sensors, Memory storage devices, Hydrogen fuel cells.

UNIT–II

Properties Of Nano Materials: Microstructure and Defects in Nano crystalline Materials: Dislocations, Twins, stacking faults and voids, Grain Boundaries, triple and declinations. Effect of Nano-dimensions on Materials Behaviour: Elastic properties, Melting Point, Diffusivity, Grain growth characteristics, enhanced solid solubility. Magnetic Properties: Soft magnetic nanocrystalline alloy, Permanent magnetic nanocrystalline materials, Giant Magnetic Resonance, Electrical Properties, Optical Properties, Thermal Properties and Mechanical Properties.

Application: high-density data storage and magnetic sensors

UNIT–III

Manufacturing Methods: Bottom-up approaches: Physical Vapour Deposition, Inert Gas Condensation, Laser Ablation, Chemical Vapour Deposition, Molecular Beam Epitaxy, Sol-gel method, Self-assembly. Top-down approaches: Mechanical alloying, Nano-lithography. Consolidation of Nano powders: Shock wave consolidation, Hot isostatic pressing, Cold isostatic pressing, Spark plasma sintering.

Application:

Bulk nanostructured alloys for aerospace and automotive applications

UNIT-IV

Characterization of Nanomaterials: X-Ray Diffraction (XRD), Small Angle X-ray scattering, Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), Atomic Force Microscopy (AFM), Scanning Tunneling Microscope (STM), Field Ion Microscope (FEM), Three-dimensional Atom Probe, Nano indentation.

Application:

Measures the hardness and elastic modulus of individual nanoparticles

UNIT-V

Applications of Nano Materials: Nano-electronics, Micro- and Nano electromechanical systems (MEMS/NEMS), Nano sensors, Nano catalysts, Food and Agricultural Industry, Cosmetic and Consumer Goods, Structure and Engineering, Automotive Industry, Water Treatment and the environment, Nano-medical applications, Textiles, Paints, Energy, Defense and Space Applications, Concerns and challenges of Nanotechnology.

Application:

Solar cells, Batteries and water purification systems

Textbooks

1. Charles. P. Poole Jr& Frank J. Owens, Introduction to Nanotechnology, Wiley-Inter science.
2. A.K. Bandyopadhyay, Nano Materials, New Age International Pvt Ltd Publishers.
3. T. Pradeep , Nano: The Essentials, McGraw Hill Education.

References

1. S.O. Pillai, Solid State Physics, New Age International Private Limited.
2. Charles Kittel, Introduction to solid state physics, Wiley & Sons (Asia) Pvt Ltd.

Web Sources References:

1. https://www.youtube.com/watch?v=oN1I09LpygE&list=PLMlC7Vx5awsenMs5y02xcW6i5NmdEIRGx&index=2
2. https://www.youtube.com/watch?v=jryDvx7VNxw&list=PLyqSpQzTE6M8682dGkNTN8936vSY4CbqZ&index=15
3. https://www.youtube.com/watch?v=mva_njonj2Y&list=PLbMVogVj5nJTdeiLvuGSB_AE8hloTAHWJ&index=3
4. https://www.youtube.com/watch?v=JffF6AqWCHE

Course code	Course Title	L	T	P	Credits
R23MEC-OE0007	AI and ML In Manufacturing **(Open Elective)**	3	0	0	3

Course Objectives:

The main objectives of this course are to:

- Introduce the fundamentals of Artificial Intelligence (AI) and its relevance to modern manufacturing systems.
- Enable students to understand and apply AI techniques like Machine Learning, Expert Systems, and Fuzzy Logic in industrial scenarios.
- Familiarize students with AI applications in predictive maintenance, quality control, process optimization, and robotics.
- Develop the ability to analyze manufacturing data using AI-based decision-making tools.
- Encourage innovation in smart manufacturing by integrating AI with Industry 4.0 technologies.

Course Outcomes:

After completing this course, the students will be able to:

1. Explain the role and benefits of Artificial Intelligence in modern manufacturing and Industry 4.0. (L2)
2. Apply machine learning algorithms to real-world problems like fault detection and predictive maintenance in manufacturing. (L3)
3. Develop expert systems to support manufacturing decision-making and diagnostics. (L6)
4. Analyze and implement fuzzy logic and neural network models for manufacturing process control. (L4)
5. Evaluate advanced AI applications in smart robotics, digital twins, and AI-driven production systems. (L5)

UNIT I:

Introduction to AI in Manufacturing: Definition and scope of AI in engineering, Evolution of AI and its relationship with automation, Traditional automation vs. AI-based decision-making, Role of AI in Industry 4.0 and Smart Factories, Cyber-Physical Systems (CPS) and AI, Benefits and limitations of AI in manufacturing, Case studies: AI in production lines, real-time process control

UNIT II:

Machine Learning for Manufacturing Systems: Overview of ML algorithms and relevance to manufacturing, Supervised, unsupervised, and reinforcement learning, Classification (SVM, Decision Trees, k-NN) and Regression models, Clustering techniques (K-means, Hierarchical) for pattern detection, Feature engineering and preprocessing of sensor data, Predictive maintenance using historical data, Intro to deep learning: CNN and RNN applications in fault detection, Tools: Python, Scikit-learn, TensorFlow, MATLAB

UNIT III:

Expert Systems and Knowledge Representation: Components of an expert system: knowledge base, inference engine, user interface, Rule-based reasoning and IF-THEN rule chaining, Certainty factors and decision trees, Knowledge acquisition methods: interviews, machine learning, simulations, Semantic networks, ontologies, and frames, AI-based troubleshooting and fault diagnostic systems, Case study: Expert systems in CNC, PLCs, and maintenance management

UNIT IV:

Fuzzy Logic and Neural Networks in Manufacturing : Fundamentals of fuzzy logic and fuzzy inference systems, Designing fuzzy rule-based controllers, Integration of fuzzy logic with PLCs and SCADA, Neural networks: architecture, activation functions, training algorithms, Backpropagation and real-time adaptation, Process optimization using neural networks and fuzzy hybrid models, Applications: welding control, casting defect prediction, tool wear monitoring

UNIT V:

AI Applications in Smart Manufacturing: Intelligent robotics and AI-based path planning, Machine vision systems and defect detection, Digital twins and virtual commissioning, AI in production planning and real-time scheduling, Role of AI in quality assurance and adaptive control, AI in smart inventory management and logistics, Ethical implications and challenges in AI implementation, Case studies: AI in aerospace, automotive, and healthcare manufacturing

Textbooks:

1. **Russell, Stuart J., and Peter Norvig**, *Artificial Intelligence: A Modern Approach*, Pearson Education, 3rd Edition, 2019.
2. **Dan W. Patterson**, *Introduction to Artificial Intelligence and Expert Systems*, PHI Learning, 2009.
3. **M. Gopal**, *Applied Machine Learning*, McGraw-Hill Education, 2018.
4. **Ramesh Babu**, *Artificial Intelligence in Mechanical and Industrial Engineering*, SciTech Publications, 2022 *(Indian Author)*

Reference Books:

1. **V.S. Janakiraman, K. Sarukesi, P. Gopalakrishnan**, *Foundations of AI and Expert Systems*, Macmillan India, 2019 *(Indian Author)*
2. **David Forsyth**, *Applied Machine Learning*, Springer, 2019.
3. **Donald A. Waterman**, *A Guide to Expert Systems*, Pearson, 2018.
4. **S. N. Sivanandam**, *Principles of Soft Computing*, Wiley India, 2nd Edition, 2011 *(covers fuzzy logic and neural networks)*

Online Resources:

Coursera – AI for Everyone (by Andrew Ng)
https://www.coursera.org/learn/ai-for-everyone
edX – Artificial Intelligence in Manufacturing (by RWTH Aachen University)
https://www.edx.org
MIT OpenCourseWare – Artificial Intelligence
https://ocw.mit.edu
Google AI – Research and Tools
https://ai.google
YouTube – AI in Industry by Analytics Vidhya / Siemens
https://www.youtube.com

Course code	Course Title	L	T	P	Credits
R23MEC-OE0008	Automation in Manufacturing **(Open Elective)**	3	0	0	3

Course Objectives:

The main objectives of this course are to:

- Understand the concept of automation and process control systems.
- Classify the automated flow lines and analyze automated flow lines
- Able to balance the operations on assembly line.
- Design automated material handling systems.
- Understand the level of automation in continuous and discrete manufacturing systems.

Course Outcomes:

1. ***Understand*** the characteristics of Automated Systems. (L2)
2. ***Illustrate*** operational aspects of flow lines.(L2)
3. ***apply*** the methods to balance the assembly line(L3)
4. ***Compare*** conventional and automated material transport, storage system.(L2)
5. ***Explain*** the level of automation in continuous and discrete manufacturing industries.(L2)

Unit-I

Introduction To Automation: Automated Manufacturing Systems, Computerized Manufacturing Support Systems, Reasons for Automation, Automation Principles and Strategies, levels of automation, Basic elements of an automated system, Types of production, pneumatic and hydraulic components, circuits, automation in foundry industries, automation in machine tools, mechanical feeding and tool changing and machine tool control. Economical and technological factors for automation. Barriers of automation in manufacturing industries.

Applications:

- Automated Material Handling System in Manufacturing
- Automation in Machine Tools for Precision Manufacturing

Unit-II

Automated Flow Lines: Methods of part transport, transfer mechanism, buffer storage, control function, design and fabrication considerations. Analysis of automated flow lines - General terminology and analysis of transfer lines without and with buffer storage, partial automation, implementation of automated flow lines.

Applications:

- Automated Conveyor Systems in Assembly Lines
- Buffer Storage in Automotive Manufacturing

Unit-III

Assembly Line Balancing: Assembly process and systems, assembly line, line balancing methods, ways of improving line balance, flexible assembly lines.

FMS: Types of FMS, components of FMS, Types of flexibility, types of FMS layouts, applications, scope for FMS in manufacturing today, group technology, hierarchy of computer control in FMS, economic justification of FMS planning, scheduling and control of FMS

Applications:

- Optimized Assembly Line Balancing in Electronics Manufacturing
- Flexible Manufacturing Systems (FMS) in Automotive Production

Unit-IV

Material Handling Systems: Introduction to Material Handling, Basic Principles, Material Transport equipment, analysis of material transport systems, Automated Guided Vehicle Systems, Generalized Theories Governing the Mechanical Design Parameters of Handling Systems storage systems–storage system performance and location strategies, Conventional storage methods and equipment, Automated Storage and Retrieval System (ASRS) and Its Types, Applications of ASRS,Engineering analysis of storage systems. ASRS and Industry 4.0

Automatic Identification Methods: Overview of Identification Methods, Barcode technology, Radio frequency identification, other AIDC technologies, benefits of AIDC.

Applications:

- Automated Storage and Retrieval System (ASRS) in Warehousing
- Radio Frequency Identification (RFID) in Supply Chain Management

Unit-V

Industrial Control Systems: Process industries Vs Discrete manufacturing industries, levels of automation in the two industries, variables and parameters in the two industries. Continuous Vs Discrete control –continuous control system, discrete control system.

Automated Inspection And Assembly: Fundamentals, inspection principles, types of inspection methods and equipment, Quality function deployment, Coordinate Measuring Machines, Machine Vision, Automated Assembly Systems, Design for Automated Assembly, and Quantitative Analysis of Assembly Systems, Multi- Station Assembly Machines, Single Station Assembly Machines.

Applications:

- Industrial Control Systems in Chemical Processing Plants
- Machine Vision-Based Automated Inspection in Automotive Manufacturing

Text Books:

1. M.P. Groover, Automation, Production systems and Computer Integrated Manufacturing,3/e, PHI
2. Learning.
3. Geoffrey Boothroyd, Assembly Automation and Product design, Taylor and Francis Publishers.

Reference Books:

1. Krishna Kant, Computer based industrial control, Prentice Hall of India.
2. Tiess Chiu chang and A. W. Richard, An introduction to automated process planning systems, Tata Mc Graw Hill.
3. Mikell P. Groover and Mitchell Weiss, Roger N. Nagel, Nicholas, G. Odrey, IndustrialRobotics, McGraw Hill.

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

Course Objectives:

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

Course Outcomes:

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

Unit I: **Hours:10**

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

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

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

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

Unit II: **Hours:10**

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

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

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

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

Unit III: **Hours:9**

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

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

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

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

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

Unit IV: **Hours:10**

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

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

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

Unit V: **Hours:09**

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

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

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

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

TEXT BOOKS:

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

REFERENCE BOOKS:

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

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

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

** For Entire Course, PO & PSO Mapping*

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

Course Objectives:

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

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

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

UNIT-I

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

UNIT –II

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

UNIT-III

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

UNIT-IV

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

UNIT-V

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

Text Books:

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

References:

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

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

Course Objectives

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

Course Outcomes:

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

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

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

UNIT–II: Process Management:

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

Multithreaded Programming: Overview, Multithreading models, Threading Issues.

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

UNIT-III: Synchronization:

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

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

UNIT-IV: Memory Management:

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

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

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

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

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

Text Books:

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

References:

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

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

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

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

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

Course Objectives

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

Course Outcomes:

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

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

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

Learning Outcomes: Student will be able to

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

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

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

Learning Outcomes: Student will be able to

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

Unit III: Strings and Collections (10 Hours)

String: Methods, StringBuffer and StringBuilder, StringTokenizer

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

Learning Outcomes: Student will be able to

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

Unit IV: IO and Error Handling (10 Hours)

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

Learning Outcomes: Student will be able to

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

Unit V: Threads and GUI (8 Hours)

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

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

Learning Outcomes: Student will be able to

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

TEXT BOOKS:

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

REFERENCE BOOKS:

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

Weblinks:

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

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

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

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

Course Objectives:

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

Course Outcomes:

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

UNIT-I:

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

UNIT-II:

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

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

UNIT-III:

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

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

UNIT-IV:

Transaction Management and Concurrency Control:

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

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

UNIT-V:

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

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

Text Books:

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

References Books:

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

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

Course Objectives:

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

Course Outcomes:

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

Unit 1 (10 Hours)

Introduction to Unix:

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

Learning Outcomes: Student will be able to

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

Unit 2 (8 Hours)

Unix Utilities:

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

Learning Outcomes: Student will be able to

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

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

Unit 3 (10 Hours)

Introduction to Shells:

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

Filters:

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

Learning Outcomes: Student will be able to

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

Unit 4 (12 Hours)

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

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

Shell Programming:

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

Learning Outcomes: Student will be able to

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

Unit 5 (8 Hours)

File Management:

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

Learning Outcomes: Student will be able to

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

TEXT BOOKS:

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

REFERENCE BOOKS:

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

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

Cos	**PO1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO1 2**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	3	2	2	1	3				1		1	1	2	3	3
CO2	3	2	2	1	3				1		1	1	2	3	3
CO3	3	3	3	2	3				1		1	2	3	3	3
CO4	3	3	3	2	3				2		1	2	3	3	3
CO5	2	2	2	2	2				2		1	1	2	2	2

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

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

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

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

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

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

UNIT-4

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

Learning Outcomes:

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

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

UNIT-5

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

Applications: analyze the risks in any software project

Learning Outcomes:

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

1. Evaluate different Risk management techniques. (L5)

Text books:

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

Reference books:

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

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

COURSE OBJECTIVES:

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

COURSE OUTCOMES:

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

UNIT –I:

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

Learning Outcomes: Student should be able to

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

UNIT –II:

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

Learning Outcomes: Student should be able to

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

UNIT –III:

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

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

Learning Outcomes: Student should be able to

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

UNIT –IV:

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

Learning Outcomes: Student should be able to

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

UNIT –V

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

Learning Outcomes: Student should be able to

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

TEXT BOOKS:

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

REFERENCE BOOKS:

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

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

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

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

COURSE OBJECTIVES:

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

COURSE OUTCOMES:

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

UNIT-I:

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

Learning Outcomes:

After completion of this unit, student will be able to

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

UNIT-II:

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

Learning Outcomes:

After completion of this unit, student will be able to

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

UNIT -III:

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

Learning Outcomes:

After completion of this unit, student will be able to

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

UNIT –IV:

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

Learning Outcomes:

After completion of this unit, student will be able to

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

UNIT-V:

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

Learning Outcomes:

After completion of this unit, student will be able to

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

Text Books:

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

Reference Books:

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

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

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	2	2	2				1			2	2	1	2
CO2	2	3	2	1	2				1			2	2	1	1
CO3	3	2	2	1	2				1			2	2	1	1
CO4	3	3	2	2	2				1			2	2	1	3
CO5	3	2	3	1	2				1			2	2	1	2

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

Course Objectives:

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

Course Outcomes:

The students can

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

UNIT-I:

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

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

UNIT-II:

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

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

UNIT-III:

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

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

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

UNIT IV:

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

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

UNIT – V:

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

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

Text Books:

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

References:

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

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

Course Objective :

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

Course Outcomes :

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

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

UNIT-I:

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

UNIT-II:

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

UNIT-III:

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

UNIT-IV:

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

UNIT-V:

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

Text Book:

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

Reference Books:

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

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

Course Objectives:

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

Course Outcomes:

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

UNIT I: (10 Hours)

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

Learning Outcomes: Student will be able to

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

UNIT II: (09 Hours)

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

Learning Outcomes: Student will be able to

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

UNIT III: (11 Hours)

Bayesian learning: Bayes theorem, Byes theorem and concept learning, Maximum likelihood and least squared error hypotheses, Maximum likelihood hypotheses for predicting probabilities, Bayes optimal classifier, An example learning to classify text, Bayesian belief networks

Learning Outcomes: Student will be able to

- Calculate Bayes probability for any given data.
- Calculate Naïve Bayes probability.
- Distinguish the process of Bayes and Naïve Bayes probability calculation.

UNIT IV: (09 Hours)

Computational learning theory – 1: Probability learning an approximately correct hypothesis, Sample complexity for infinite Hypothesis spaces, The mistake bound model of learning- Instance- Based learning- Introduction.

Learning Outcomes: Student will be able to

- Understand Probability learning and Instance- Based learning.

UNIT V: (09 Hours)

Computational learning theory – 2: K- Nearest Neighbour Learning, Locally Weighted Regression, Radial Basis Functions, Case-Based Reasoning, Remarks on Lazy and Eager Learning

Learning Outcomes: Student will be able to

- Understand the concept of classification.
- Distinguish lazy Lazy and Eager Learning.

Contemporary Problems:

Explore Modern Tools- Altair Rapid Miner Tools- Scalability Issues- Regularity Complex-Black Box Problem

Text Books

1. Tom M. Mitchell, ―Machine Learning, McGraw-Hill Education (India) Private Limited, 2013.
2. Raschka, Sebastian and Mirjalili, Vahid, Python Machine Learning, 3rd Edition, Packt Publishing., 2019
3. Stephen Marsland- Machine Learning – An Algorithmic Perspective – Second Edition – Chap Man & Hall CRC Press, 2015

References

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

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

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

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

Course Objectives:

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

Course Outcomes:

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

UNIT - I: (8 Hours)

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

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

Learning Outcomes:student will be able to

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

UNIT-II: (10 Hours)

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

Learning Outcomes:student will be able to

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

UNIT-III: (12 Hours)

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

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

Learning Outcomes: student will be able to

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

UNIT-IV: (10 Hours)

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

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

Learning Outcomes: student will be able to

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

UNIT-V: (8 Hours)

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

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

Learning Outcomes: student will be able to

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

Text Books:

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

Reference Books:

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

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

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

** For Entire Course, PO & PSO Mapping*

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

Course Objectives:

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

Course Outcomes:

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

Unit 1 (10 Hours)

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

Learning Outcomes: Student will be able to

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

Unit 2 (8 Hours)

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

Learning Outcomes: Student will be able to

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

Unit 3 (10 Hours)

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

Learning Outcomes: Student will be able to

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

Unit 4 (12 Hours)

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

Learning Outcomes: Student will be able to

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

Unit 5 (8 Hours)

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

Learning Outcomes: Student will be able to

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

TEXT BOOKS:

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

REFERENCE BOOKS:

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

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

Course Objectives

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

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

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

Unit-I – Machine Learning Basics (8 Hours)

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

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

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

Unit – II: DeepNetworks (8 Hours)

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

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

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

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

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

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

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

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

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

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

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

Unit – V: Convolutional Networks (8 Hours)

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

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

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

Text Books: Ian Goodfellow and Yoshua Bengio and Aaron Courville," Deep Learning"MIT Press, 2017.
References Books:
1. Shai ShalevShwartz, Shai BenDavid"Understanding Machine Learning: From Theory to Algorithms" , Cambridge Press
2.Peter Harington " Machine Learning in Action", , 2012, Cengage.

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

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C01	3	2	1	1	1							1			1
C02	3	2	1	1	1							1			1
C03	3	2	1	1	1							1			1
C04	3	2	1	1	1							1			1
C05	3	2	1	1	1							1			1

Subject Code	Subject Name	L	T	P	C
R23CSE-OE0016	**DevOps**	3	0	0	3

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

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

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

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

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

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

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

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

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

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

UNIT -IV:

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

Learning outcomes:

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

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

Learning outcomes:

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

Text Books:

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

Reference Books:

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

Web References :

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

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

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

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

Course Objective:

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

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

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

UNIT I

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

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

Learning Outcome:

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

UNIT –II

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

Learning Outcome:

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

UNIT –III

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

Learning Outcome:

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

UNIT –IV

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

Learning Outcome:

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

UNIT V

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

Learning Outcomes:

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

Text Books:

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

Reference Book:

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

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

Course Objectives:

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

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

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

Unit 1: Frontend Development

Introduction to Full-Stack Development

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

HTML & CSS Basics

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

JavaScript Basics

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

Unit 2: Backend Development

Java Servlets & JSP

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

Introduction to Hibernate

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

Unit 3: Database Development

SQL Basics

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

Hibernate Basics

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

Unit 4: Introduction to Frameworks

Spring & Spring Boot

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

Unit 5: REST APIs & Deployment

RESTful APIs

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

Deployment Basics

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

Project & Capstone

Mini Projects:

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

Tools:

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

Project & Deployment Tools

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

Full-Stack Capstone Project

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

CONTEMPORARY TOPICS:

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

APPLICATIONS:

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

TEXT BOOKS:

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

REFERENCE BOOKS:

1. "Web Programming and Internet Technologies"byUttam K. Roy, Published 2010, Oxford University Press.
2. "Java: The Complete Reference" By Herbert Schildt, Published 2023, McGraw Hill Education

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

Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO 3**
117.1	3	2	2	1	3				1		1	1	2	3	3
117.2	3	2	2	1	3				1		1	1	2	3	3
117.3	3	3	3	2	3				1		1	2	3	3	3
117.4	3	3	3	2	3				1		1	2	3	3	3
117.5	2	2	2	2	2				1		1	1	2	2	2
117*	3	2	2	2	3				1		1	1	2	3	3

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

Course Objectives:

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

Course Outcomes:

UNIT-I:

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

UNIT-II:

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

UNIT-III:

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

UNIT-IV:

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

UNIT-V:

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

Text Books:

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

References Books:

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

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

Course Objectives:

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

Course Outcomes:

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

Unit 1: Introduction.

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

Learning outcomes: Student should be able to

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

Unit 2: Security Needs.

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

Learning outcomes: Student should be able to

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

Unit 3: Cryptography Concepts.

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

Network Security & Web Security.

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

Learning outcomes: Student should be able to

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

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

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

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

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

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

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

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

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

Course Objectives:

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

Course Outcomes:

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

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

UNIT –I:

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

UNIT –II:

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

UNIT -III:

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

UNIT –IV:

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

UNIT -V:

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

Text Books:

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

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

Course Objectives:

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

Course Outcomes:

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

UNIT-I

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

Learning Outcomes: Students will be able to

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

UNIT-II

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

Learning Outcomes:Students will be able to

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

UNIT-III

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

Learning Outcomes:Studentswill beableto

- UnderstandandimplementHadoopComponents.
- UnderstandtheConceptofInteractingwiththeHadoopEcosystem.

UNIT-IV

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

Learning Outcomes: Student will be able to

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

UNIT-V

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

Outcomes: Students will be able to

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

Text Books :

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

Reference Books :

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

Software Links :

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

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

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

Course Objective:

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

Course Outcomes:

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

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

UNIT-I:

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

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

UNIT-II:

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

UNIT-III:

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

UNIT-IV:

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

UNIT-V:

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

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

Text Book:

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

References:

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

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

COURSE OBJECTIVES: To learn

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

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

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

UNIT – I Classes: 12

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

UNIT – II Classes: 14

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

UNIT – III Classes: 14

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

Keeping Track of Your Sounds - Testing and Evaluation

UNIT – IV Classes: 12

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

UNIT – V Classes: 08

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

Text Books:

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

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

Course Objectives:

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

Course Outcomes:

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

UNIT - 1

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

UNIT - 2

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

UNIT - 3

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

UNIT - 4

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

UNIT – 5

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

TEXT BOOKS:

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

REFERENCES:

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

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

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

Subject Code	Subject Name	L	T	P	C
R23CSS-OE0001	Operating Systems	3	0	0	3

Course Objectives:

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

Course Outcomes:

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

Unit: 1: Operating Systems Overview: Introduction: What Operating systems Do, Types of Operating systems, Computer system Architecture, Computer system organization, Operating system functions, Operating systems operations, Protection and Security.

Virtualization: Types of Virtualizations, Benefits, and Challenges.

System structure: Operating System Services, User and Operating - System Interface, System calls, Types of System Calls, Operating system debugging, System Boot.

Learning Outcomes: Student will be able to

- Understand operating system structure and functions.
- Understand operating system services and system calls
- Comprehend the basics of virtualization

Unit: 2: Process Management: Process Concept, Process Scheduling, Operations on Processes, Inter process Communication.

Multithreaded Programming: Overview, Multithreading models, Threading Issues.

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

Learning Outcomes: Student will be able to

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

Unit: 3: Synchronization: Process Synchronization, The Critical-Section Problem, Synchronization Hardware, Semaphores, Classic Problems of Synchronization, Monitors, Synchronization examples Principles of deadlock – System Model, Deadlock Characterization, Deadlock Prevention, Detection and Avoidance, Recovery form Deadlock, Concurrency in Distributed Systems, Consistency, and Replication.

Learning Outcomes: Student will be able to

- Analyze various solutions for process synchronization.
- Analyze the reasons for deadlocks and proposed solutions to detect, avoid, recovery from deadlocks.
- Understand concurrency issues in distributed systems

Unit: 4: Memory Management:

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

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

File system Interface and Introduction to Network Programming: - the concept of a file, Access Methods, OSI model, Unix standards, TCP and UDP & TCP connection establishment and Format, Buffer sizes and limitation, standard internet services, Protocol usage by common internet application.

Learning Outcomes: Student will be able to

- Demonstrate the ability to implement various memory management techniques
- Illustrate various demand paging techniques.
- Identify various file management and optimization techniques.

Unit: 5: Network Programming and OS Security:

Sockets: Address structures, value – result arguments, Byte ordering and manipulation function and related functions.

Elementary TCP sockets – Socket, connect, bind, listen,accept, fork and exec function, concurrent servers. Close function and related function.

Elementary UDP sockets: Introduction UDP Echo server function, lost datagram, summary of UDP example, Lack of flow control with UDP, determining outgoing interface with UDP.

OS Security - Security Policies, Intrusion Detection, and Prevention.

Learning Outcomes: Student will be able to

- Understand socket programming.
- Understand basics of UDP (L2), Comprehend OS security concepts

Text Books:

1. Silbers chatz A, Galvin PB, and Gagne G, Operating System Concepts, 9th edition, Wiley, 2013
2. Tanenbaum AS, Modern Operating Systems, 3rd edition, Pearson Education, 2008. (for Inter process Communication and File systems).

References:

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

Subject Code	Subject Name	L	T	P	C
R23CSS-OE0002	Red Hat Linux	3	0	0	3

Course Objectives:

- Master essential command-line tools for file manipulation, system access, and documentation in a RHEL environment.
- Implement core system administration tasks, including booting, process control, service control (systemd), and managing user/group accounts.
- Configure and manage local storage using partitions, filesystems (XFS/Ext4), and Logical Volume Management (LVM).
- Secure the system by configuring the firewall (firewalld), managing file permissions, and enforcing SE Linux policies.
- Perform network configuration, package management, and write basic Bash shell scripts for task automation.

Course Outcomes:

1. Navigate and operate a Red Hat Enterprise Linux system entirely from the command line.
2. Manage local security policies, including users, groups, and file permissions.
3. Diagnose and troubleshoot boot process failures and service issues.
4. Apply proper file system management techniques, including creating and extending LVM.
5. Automate routine administrative tasks using shell scripting and scheduled utilities.

Unit 1: Essentials and System Access

Introduction to RHEL: Command Line Interface (CLI), Shell basics, using grep and regular expressions.
Getting Help: Utilizing man pages and system documentation.
File Management: Standard commands (ls, cp, mv), hard and soft links.
Text Editing and Remote Access: Using vim/nano for configuration; Secure Shell (ssh) usage.

Unit 2: Running Systems and Management

System Boot and Processes: Boot procedure, run levels, interrupting boot for recovery.
Process Control: Identifying, managing, and adjusting process priority (top, kill, nice).
Service Control: Managing system services and daemons using systemctl (systemd).
Package Management: Installing, updating, and removing software using dnf / yum (RPM).
User and Group Administration: Creating, modifying, and managing local users, groups, and password policies.

Unit 3: Storage Administration

Disk Partitioning: Understanding MBR/GPT and creating partitions.
Filesystems: Creating, mounting and managing XFS/Ext4 filesystems, and configuring /etc/fstab.
Logical Volume Management (LVM): PVs, VGs, LVs, creating, resizing, and extending logical volumes.
Network Storage: Basics of mounting **NFS** and **SMB/CIFS** shares.

Unit 4: Networking and Security

Basic Networking Configuration: Configuring IPv4/IPv6 addresses and network interfaces.
Firewall Management: Configuring network access restrictions using firewalld.
Security Contexts: Managing Access Control Lists (ACLs) for granular permissions.
SELinux: Introduction to SELinux modes, contexts, and troubleshooting access issues.
System Logging: Locating and interpreting system logs using journal ctl.

Unit 5: Automation and Advanced Topics

Archiving and Scheduling: Using **tar** and compression utilities; scheduling tasks with **cron** and at.
Bash Shell Scripting: Introduction, variables, conditional execution (if), loops, and processing script inputs/outputs.
Kernel and Updates: Managing kernel modules and performing system maintenance/updates.
Virtualization / Containers: Overview of enterprise virtualization and container concepts (e.g., Podman).

Text Books:

1. Red Hat RHCSA [RHEL Version] Cert Guide (Exam EX200), Sander van Vugt
2. UNIX and Linux System Administration Handbook, Evi Nemeth, Garth Snyder

Subject Code	Subject Name	L	T	P	C
R23CSS-OE0003	Cloud Computing	3	0	0	3

Course Objectives:

- To implement Virtualization
- To implement Task Scheduling algorithms
- Apply Map-Reduce concept to applications
- To build Private Cloud
- Broadly educate to know the impact of engineering on legal and societal issues involved

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

1. Interpret the key dimensions of the challenge of Cloud Computing
2. Examine the economics, financial, and technological implications for selecting cloud computing for own organization
3. Assessing the financial, technological, and organizational capacity of employers for actively initiating and installing cloud-based applications
4. Evaluate own organizations. needs for capacity building and training in cloud computing-related IT areas
5. Illustrate Virtualization for Data-Center Automation

UNIT I

Introduction: Network centric computing, Network centric content, peer-to .peer systems, cloud computing delivery models and services, Ethical issues, Vulnerabilities, Major challenges for cloud computing. Parallel and Distributed Systems: introduction, architecture, distributed systems, communication protocols, logical clocks, message delivery rules, concurrency, and model concurrency with Petri Nets.

UNIT II

Cloud Infrastructure: At Amazon, The Google Perspective, Microsoft Windows Azure, Open Source Software Platforms, Cloud storage diversity, Inter cloud, energy use and ecological impact, responsibility sharing, user experience, Software licensing, Cloud Computing : Applications and Paradigms: Challenges for cloud, existing cloud applications and new opportunities, architectural styles, workflows, The Zookeeper, HPC on cloud.

UNIT III

Cloud Resource virtualization: Virtualization, layering and virtualization, virtual machine monitors, virtual machines, virtualization- full and para, performance and security isolation, hardware support for virtualization, Case Study: Xen, vBlades, Cloud Resource Management and Scheduling: Policies and Mechanisms, Applications of control theory to task scheduling, Stability of a two-level resource allocation architecture, feedback control based on dynamic thresholds, coordination, resource bundling, scheduling algorithms, fair queuing, start time fair queuing, cloud scheduling subject to deadlines, Scheduling Map Reduce applications, Resource management and dynamic application scaling.

UNIT IV

Storage Systems: Evolution of storage technology, storage models, file systems and database, distributed file systems, general parallel file systems. Google file system. Apache Hadoop, Big Table, Megastore (text book 1), Amazon Simple Storage Service(S3) (Text book 2), Cloud Security: Cloud security risks, security . a top concern for cloud users, privacy and

privacy impact assessment, trust, OS security, Virtual machine security, Security risks.

UNIT V

Cloud Application Development: Amazon Web Services : EC2 – instances, connecting clients, security rules, launching, usage of S3 in Java, Cloud based simulation of a Distributed trust algorithm, Cloud service for adaptive data streaming (Text Book 1), Google: Google App Engine, Google Web Toolkit (Text Book 2), Microsoft: Azure Services Platform, Windows live, Exchange Online, Share Point Services, Microsoft Dynamics CRM (Text Book 2)

Text Books:

1. Cloud Computing, Theory and Practice,1st Edition, Dan C Marinescu, MK Elsevier publisher ,2013
2. Cloud Computing, A Practical Approach, 1st Edition, Anthony T Velte, Toby J Velte, Robert Elsenpeter, TMH,2017

Reference Books:

1. Mastering Cloud Computing, Foundations and Application Programming,1st Edition, Raj Kumar Buyya, Christen vecctiola, S Tammaraiselvi, TMH,2013
2. Essential of Cloud Computing, 1st Edition, K Chandrasekharan, CRC Press, 2014.
3. Cloud Computing, A Hands on Approach, ArshdeepBahga, Vijay Madisetti, Universities Press, 2014.

Subject Code	Subject Name	L	T	P	C
R23CSS-OE0004	Distributed Operating Systems	3	0	0	3

Course Objectives:

- To study the concepts and design principles of Distributed Operating Systems,
- To understand clock synchronization protocols and distributed file system implementation,
- To gain knowledge on communication, synchronization, and consistency models in distributed systems.

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

- Explain the architecture and components of distributed systems,
- Understand various synchronization and coordination mechanisms,
- Analyze consistency and fault tolerance issues,
- Describe distributed file systems and object-based distributed environments,
- Apply concepts of distributed systems in real-time applications.

Detailed Syllabus:

Unit I – Fundamentals of Distributed Systems

Introduction to distributed systems, Goals of distributed systems, Hardware and software concepts, Design issues, Network operating systems, Comparison between time-sharing, multiprocessor, and true distributed systems, System architectures for distributed systems.

Unit II – Communication in Distributed Systems

Basics of communication systems, Layered protocols, ATM models, Client–Server model, Blocking and non-blocking primitives, Buffered and unbuffered communication, Reliable and unreliable primitives, Message passing, Remote Procedure Call (RPC).

Unit III – Synchronization and Processes

Clock synchronization, Mutual exclusion in distributed systems, Election algorithms, Atomic transactions, Deadlock handling, Processes and threads in distributed systems, System models, Processor allocation, Process scheduling in distributed systems.

Unit IV – Consistency, Replication, and Fault Tolerance

Data-centric and client-centric consistency models, Replica management, Consistency protocols, Fault tolerance in distributed systems, Process resilience, Distributed commit protocols, Reliable client–server communication.

Unit V – Distributed Object-Based Systems and File Systems

Distributed object-based systems, Object-oriented architecture, Processes and communication in object-based systems, Synchronization in object environments, Consistency and replication in object-based systems, Distributed file system design and implementation.

Reference Books:

- Andrew S. Tanenbaum, *Distributed Operating Systems*, Pearson Education, Reprint, 2011,
- Andrew S. Tanenbaum and Maarten Van Steen, *Distributed Systems – Principles and Paradigms*, 2nd Edition, PHI, 2007,
- Pradeep K. Sinha, *Distributed Operating Systems – Concepts and Design*, PHI, 2007.

Subject Code	Subject Name	L	T	P	C
R23CIT-OE0001	Basics of Computer Networks	3	0	0	3

Course Objectives:

1. understand the contemporary technologies in network protocols and network architecture
2. To acquire the knowledge on design principles of network infrastructure. the basics Physical layer and their functionality.
3. Understand the functionalities of the Data Link Layer and their protocols.
4. Understand the functionalities of the Network Link Layer and routing Algorithms.
5. Analyze different protocols in Application Layer

Course Outcomes:

1. Analyze different types of network topologies, various Reference models.[L2]
2. Analyze network performance metrics and data transmission Techniques.[L4]
3. Analyze different data link layer framing techniques and Link Layer Protocols.[L4]
4. Analyze the medium access techniques and different routing algorithms.[L4]
5. Understand various Application layer protocols.[L2]

Unit 1: **10-Hours**

Introduction: Components of a Data Communication system, Dataflow **,** Network Topologies Categories of Networks: LAN, MAN,WAN. Reference models- The OSI Reference Model- the TCP/IP Reference Model, Networking and Internet working Devices.

Learning Outcomes: Student will be able to

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

Applications:

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

Unit 2: **9-Hours**

Physical Layer:

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

Multiplexing: frequency division multiplexing, wave length division multiplexing, synchronous time division multiplexing, statistical time division multiplexing, switching techniques.

Learning Outcomes: Studentwill be able to

- Understand the Basics of physical functionality .(L2).
- Analyze different types of Multiplexing Techniques. (L4).
- Analyze the Network performance Evaluation metrics . (L4).

Applications:

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

Unit 3: **10- Hours**

Data Link Layer: Design issues, Framing, flow control, error control, error detection and correction, CRC. **Data Link Layer protocols**: simplex protocol, Simplex stop and wait, Simplex protocol for Noisy Channel. Sliding window protocols. HDLC configuration and transfer modes, HDLC frame format, control field

Learning Outcomes: Student will be able to

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

Applications: Error correction and detecting procedures on binary data.

Unit 4: **10- Hours**

Random Access: ALOHA protocols, Carrier sense multiple access (CSMA), CSMA with Collision Detection, CSMA with Collision Avoidance

Network Layer: Routing algorithm, shortest path routing, Flooding, distance vector routing, Link state routing Algorithms, IPv4 address, subnetting, Congestion Control Algorithms.

Learning Outcomes: Student will be able to

- Understand random access protocols in data link layer and their functions. (L2)
- Analyze the static and dynamic routing Algorithms. (L4)
- Analyze the IPv4 Addressing ,sub netting.(L4)

Applications: setting up the routes for data packets to take, checking to see if a server in another network is up and running, and addressing and receiving IP packets from other networks.

UNIT –5 : **09-Hours**

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

Application layer: File Transfer(FTP), WWW: 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).

Learning Outcomes: Student will be able to

- Understand the functions of Transport Layer protocols.(L2)
- Analyze the various protocols in application layer .(L4)

Applications: Users can forward several emails and it also provides a storage facility, allows users to access, retrieve and manage files in a remote computer layer provides access to global information about various services.

Text Books:

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

Reference Books:

1. Computer Networks, Mayank Dave, CENGAGE
2. Larry L. Peterson and Bruce S. Davie, "Computer Networks - A Systems Approach" (5th ed), Morgan Kaufmann/ Elsevier, 2011

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

SNO	PO 1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO3
Cxx.1	3	3	2	1	3				3			1		2	3
Cxx.2	3	3	2	1					3			1		2	3
Cxx.3	3	3	2	1					3					2	3
Cxx.4	3	3	2	1	3				3			1		2	3
Cxx.5	3	1	1	1	3				3			1		2	3
Cxx.*	3	3	2	1	3				3			1		2	3

** For Entire Course, PO & PSO Mapping*

Subject Code	Subject Name	L	T	P	C
R23CIT-OE0002	Cryptography & Network Security	3	0	0	3

Course Objectives:

- Classical systems, symmetric block ciphers (DES, AES, other contemporary symmetric ciphers) are Introduced.
- Introduction to Public- key cryptography (RSA, discrete logarithms) is provided.
- Algorithms for factoring and discrete logarithms, cryptographic protocols, hash functions, authentication, key management, key exchange, signature schemes are learnt.
- An overview of e-mail and web security is provided.
- An overview of viruses, firewalls and system security is provided.

Course Outcomes:

1. Understand the basics of Cryptography, the goals, services and mechanisms.
2. Analyze the Symmetric Encryption Algorithms.
3. Analyze the Asymmetric Cryptographic Algorithms.
4. Understand the Digital signature Schemes.
5. Understand the email security and system security.

UNIT- I

Basic Principles Security Goals, Cryptographic Attacks, Services and Mechanisms, Mathematics of Cryptography

Learning Outcomes: Student will be able to

- Understand what is meant by Cryptography.(L1)
- Understand the goals, mechanisms and services of Cryptography.(L1)

UNIT- II

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

Learning Outcomes: Student will be able to

- Understand symmetric key Cryptography (L2)
- Analyze the various algorithms of Symmetric key Cryptography (L3)

UNIT- III

Asymmetric Encryption Mathematics of Asymmetric Key Cryptography, Asymmetric Key Cryptography

Learning Outcomes: Student will be able to

- Understand symmetric key Cryptography (L1)
- Analyze the various algorithms of Asymmetric key Cryptography(L2)

UNIT- IV

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

Learning Outcomes: Student will be able to

- Understand about Digital Signature and the security schemes.(L1)
- Understand the Hash functions and its importance.(L2)

UNIT -V

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

Learning Outcomes: Student will be able to

- Understand email-security.(L1)
- Understand the mechanisms of Transport Layer Security.(L1)
- Understandabout system security.(L2)

Text Books:

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

Reference Books:

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

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

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

**For Entire Course, PO & PSO Mapping*

Subject Code	Subject Name	L	T	P	C
R23CIT-OE0003	Mobile Computing	3	0	0	3

Course Objectives:

- To understand the fundamentals of mobile communication
- To understand the architecture of various Wireless Communication Networks
- To understand the significance of different layers in mobile system Course Contents
- To understand the mobility supported protocols
- To apply the mobility support in real time

Course Outcomes:

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

UNIT- I

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

Learning Outcomes: Student will be able to

1. Understand the basic concepts of wireless networks (L2)
2. Understand the fundamentals of cellular system(L2)

UNIT-II

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

Learning Outcomes: Student will be able to

1. Understand the MAC layer functionalities (L2)
2. apply the strategy of subscriber and service data management(L3)

UNIT-III

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

Learning Outcomes: Student will be able to

1. Understand the wireless LAN functionalities(L2)
2. Understand the the various protocols in WLAN(L2)

UNIT-IV

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

Learning Outcomes: Student will be able to

1. Understand the working of mobile network layer (L2)
2. Understand the concepts of mobile transport layer(L2)

UNIT-V

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

Learning Outcomes: Student will be able to

1. Understand the working functionality of wireless protocols(L2)
2. Apply the wireless markup language in real time (L3)

Text Books:

1. Jochen Schiller, "Mobile Communication", Second Edition, Pearson Education, 2008.
2. "Mobile Computing: Principles and Practices" by Asoke K. Talukder, Roopa R. Yavagal

Reference Books:

1. William Stallings, "Wireless Communications and Networks", Second Edition, Pearson Education, 2004.
2. C. Siva Ram Murthy, B. S. Manoj, "Adhoc Wireless Networks: Architectures and Protocols", Second Edition, Pearson Education, 2008.

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

COs	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	3	3	2	2	2				1		1	2	3	1	2
CO2	3	3	2	2	2				1			2	3	1	2
CO3	3	3	2		2			1			1	2	3	1	2
CO4	3	3	2		2			1	1			2	3	1	2
CO5	3	3	2		2			1	1		1	2	3	1	2
CO*	3	3	2	2	2				1			2	3	1	2

**For Entire Course, PO & PSO Mapping*

Subject Code	Subject Name	L	T	P	C
R23CIT-OE0004	Wireless Sensor Networks	3	0	0	3

Course Objectives:

- Define WSN and Dynamic modulation scaling.
- Explore working of the MAC protocols
- Demonstrate Routing and Data gathering protocols
- Illustrate working of Embedded OS.
- Explore a wide range of WSN applications in different sectors

Course Outcomes:

1. Understand the basics, characteristics and challenges of Wireless Sensor Network
2. Apply the knowledge to identify appropriate physical and MAC layer protocol
3. Apply the knowledge to identify the suitable routing algorithm based on the network and user requirement
4. Analysis of OS used in Wireless Sensor Networks and build basic modules
5. Analyze specific WSN application using a case study approach

Unit-I – CHARACTERISTICS OF WSN (8 Hours)

Characteristic requirements for WSN – Challenges for WSNs – WSN vsAdhoc Networks – Sensor node architecture – Commercially available sensor nodes –Imote, IRIS, Mica Mote, EYES nodes, BTnodes, TelosB, Sunspot -Physical layer and transceiver design considerations in WSNs, Energy usage profile, Choice of modulation scheme, Dynamic modulation scaling, Antenna considerations.

Learning Outcomes:

- Identify and explain the key characteristics
- Differentiate between Wireless Sensor Networks (WSNs) and Ad-hoc Networks
- Understand the role and functionalities of each component within the sensor node.

Unit – II: MEDIUM ACCESS CONTROL PROTOCOLS (10 Hours)

Fundamentals of MAC protocols – Low duty cycle protocols and wakeup concepts – Contention based protocols – Schedule-based protocols – SMAC – BMAC – Traffic adaptive medium access protocol (TRAMA) – The IEEE 802.15.4 MAC protocol.

Learning Outcomes:

- Describe the main challenges of MAC protocols in wireless sensor networks (WSNs)
- Understand the concept of low duty cycle operation and its importance
- Evaluate the performance characteristics of contention-based protocols, including throughput, latency, and energy efficiency

Unit – III: ROUTING AND DATA GATHERING PROTOCOLS (10 Hours)

Routing Challenges and Design Issues in Wireless Sensor Networks, Flooding and gossiping – Data centric Routing – SPIN – Directed Diffusion – Energy aware routing – Gradient-based routing –Rumor Routing – COUGAR – ACQUIRE – Hierarchical Routing – LEACH, PEGASIS – Location Based Routing – GF, GAF, GEAR, GPSR – Real Time routing Protocols – TEEN, APTEEN, SPEED, RAP – Data aggregation - data aggregation operations – Aggregate Queries in Sensor Networks – Aggregation Techniques – TAG, Tiny DB.

Learning Outcomes:

- Identify the key routing challenges in WSNs compared to traditional wired networks
- Analyze popular hierarchical routing protocols
- Analyze location-based routing protocols, Real-Time Routing Protocols

Unit – IV: EMBEDDED OPERATING SYSTEMS (10 Hours)

Operating Systems for Wireless Sensor Networks – Introduction – Operating System Design Issues – Examples of Operating Systems – TinyOS – Mate – MagnetOS – MANTIS – OSPM – EYES OS – SenOS – EMERALDS – PicOS – Introduction to Tiny OS – NesC – Interfaces and Modules – Configurations and Wiring – Generic Components – Programming in Tiny OS using NesC, Emulator TOSSIM.

Learning Outcomes:

- Understand the role and importance of operating systems in managing the resources and functionalities of Wireless Sensor Networks.
- Compare and contrast prominent WSN operating systems like TinyOS, Mate, MagnetOS, MANTIS, OSPM, EYES OS, SenOS, EMERALDS, and PicOS.
- Understand the strengths and weaknesses of each operating system in terms of features, resource management, and suitability.

Unit – V: APPLICATIONS OF WSN (10 Hours)

WSN Applications – Home Control – Building Automation – Industrial Automation – Medical Applications – Reconfigurable Sensor Networks – Highway Monitoring – Military Applications – Civil and Environmental Engineering Applications – Wildfire Instrumentation – Habitat Monitoring – Nanoscopic Sensor Applications – Case Study: IEEE 802.15.4 LR-WPANs Standard – Target detection and tracking – Contour/edge detection – Field sampling

Learning Outcomes:

- Identify the key characteristics of Wireless Sensor Networks (WSNs) that make them suitable for various applications.
- Analyze a specific WSN application through a Case Study
- Develop a basic understanding of common data analysis techniques used with WSN data

Text Books:

1. Wireless Sensor Networks Technology, Protocols, and Applications, KazemSohraby, Daniel Minoli and TaiebZnati, John Wiley & Sons, 2007
2. Protocols and Architectures for Wireless Sensor Network, Holger Karl and Andreas Willig John Wiley & Sons, Ltd ,2005

References Books:

1. A survey of routing protocols in wireless sensor networks , K. Akkaya and M. Younis, Elsevier
2. Ad Hoc Network Journal, Vol. 3, no. 3, pp. 325--349
3. TinyOS Programming , Philip Levis
4. Wireless Sensor Network Designs , Anna Ha´c , John Wiley & Sons Ltd

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

CO	**PO1**	**PO2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	3	2	2	1	3								2		
CO2	3	2	2	1	3								2		
CO3	3	2	2	1	3								2		
CO4	3	3	2	1	3								2		
CO5	3	3	2	1	3								2		