III B.Tech I Semester (AI & DS)

S.No	Category	Course Code	Title	L	T	P	Credits
1	PC	23A3051T	Machine Learning	3	0	0	3
2	PC	23A3052T	Multi Agent Systems	3	0	0	3
3	PC	23A3053T	Data Mining and Data Warehousing	3	0	0	3
4	PC	23A0554T	Introduction to Quantum Technologies and Applications	3	0	0	3
5	PE	23A305AT 23A055BT 23A305BT 23A335CT	**Professional Elective-I** 1. Data Visualization 2. Soft computing 3. Internet of Things for AI Applications 4. Exploratory Data Analysis with Python	3	0	0	3
6	OE		**Open Elective- I**	3	0	0	3
7	PC	23A3051L	Machine Learning Lab	0	0	3	1.5
8	PC	23A3053L	Data Mining and Data Warehousing Lab	0	0	3	1.5
9	SEC	23A0555L	Full Stack Development-II	0	1	2	2
10	SEC	23A0556L	Tinkering Lab for Computer Engineers	0	0	2	1
11	INTERN	23A0557I	Evaluation of Community Service Internship	-	-	-	2
			Total	**18**	**1**	**10**	**26**

Open Elective – I

S.No.	Course Code	Course Name	Offered by the Dept.
1	23A015DT	Green Buildings	CIVIL
2	23A015ET	Construction Technology and Management	
3	23A025ET	Electrical Safety Practices and Standards	EEE
4	23A035FT	Sustainable Energy Technologies	ME
5	23A045DT	Electronic Circuits	ECE
6	23A045ET	Communication Systems	
7	23A055GT	Quantum Technologies and Applications	CSE & Allied
8	23AHS51T	Mathematics for Machine Learning and AI	Mathematics
9	23AHS52T	Materials Characterization Techniques	Physics
10	23AHS53T	Chemistry of Energy Systems	Chemistry
11	23AHS54T	English for Competitive Examinations	Humanities
12	23AHS56T	Entrepreneurship and New Venture Creation	

Note:

1. A student is permitted to register for Honours or a Minor in IV semester after the results of III Semester are declared and students may be allowed to take maximum two subjects per semester pertaining to their Minor from V Semester onwards.
2. A student shall not be permitted to take courses as Open Electives/Minor/Honours with content substantially equivalent to the courses pursued in the student's primary major.
3. A student is permitted to select a Minor program only if the institution is already offering a Major degree program in that discipline.

III B.Tech II Semester (AI & DS)

S.No	Category	Course Code	Title	L	T	P	Credits
1	PC	23A3061T	Big Data Analytics	3	0	0	3
2	PC	23A3062T	Deep Learning	3	0	0	3
3	PC	23A3063T	Computational Language Processing	2	0	2	3
4	PE	23A306AT 23A306BT 23A306CT 23A306DT	**Professional Elective-II** 1. Reinforcement learning 2. Recommender Systems 3. Predictive Modeling 4. AI for Finance	3	0	0	3
5	PE	23A306ET 23A306FT 23A306GT 23A306HT	**Professional Elective-III** 1. Introduction to Quantum Computing 2. Computer Vision 3. Cloud Computing for AI 4. Social Network Analysis	3	0	0	3
6	OE		**Open Elective – II**	3	0	0	3
7	PC	23A3062L	Deep Learning Lab	0	0	3	1.5
8	PC	23A3064L	Big data Analytics and Data Visualization Lab	0	0	3	1.5
9	SEC	23AHS65L	**Skill Enhancement course** Soft skills	0	1	2	2
10	MC	23AHS67T	**Audit Course** Technical Paper Writing & IPR	2	0	0	-
11	PC	23A0564L	Workshop	0	0	0	0
			Total	**19**	**1**	**06**	**23**

Open Elective – II

S.No.	Course Code	Course Name	Offered by the Dept.
1	23A016GT	Disaster Management	CIVIL
2	23A016HT	Sustainability In Engineering Practices	
3	23A026IT	Renewable Energy Sources	EEE
4	23A036KT	Automation and Robotics	ME
5	23A046GT	Digital Electronics	ECE
6	23AHS61T	Optimization Techniques for Engineers	Mathematics
7	23AHS66T	Mathematical Foundation of Quantum Technologies	
8	23AHS62T	Physics of Electronic Materials and Devices	Physics
9	23AHS63T	Chemistry of Polymers and Applications	Chemistry
10	23AHS64T	Academic Writing and Public Speaking	Humanities

IV B.Tech I Semester (AI & DS)

S.No	Course Code	Title	L	T	P	Credits
1	23A30701	Generative AI	3	0	0	3
2	23A52701a 23A52701b 23A52701c	**Management Course- II** 1.Business Ethics and Corporate Governance 2.E-Business 3.Management Science	2	0	0	2
3	23A30702a 23A30702b 23A30702c 23A30702d	**Professional Elective-IV** 1. Edge AI 2. Human Computer Interaction 3. Machine learning Operations 4. No SQL databases	3	0	0	3
4	23A30703a 23A30703b 23A30703c 23A30703d	**Professional Elective-V** 1. Data Wrangling 2. Drone Technology 3. Robotics 4. Mining Massive Data Sets	3	0	0	3
5		**Open Elective-III**	3	0	0	3
6		**Open Elective-IV**	3	0	0	3
7	23A05703	**Skill Enhancement Course** Prompt Engineering	0	1	2	2
8	23A52702	**Audit Course** Gender Sensitization	2	0	0	-
9	23A30704	Evaluation of Industry Internship	-	-	-	2
		Total	**19**	**1**	**02**	**21**

Open Elective – III

S.No	Course Code	Course Name	Offered by the Dept.
1	23A01704a	Building Materials and Services	CIVIL
2	23A01704b	Environmental Impact Assessment	
3	23A02704	Smart Grid Technologies	EEE
4	23A03704	3D Printing Technologies	ME
5	23A04503T	Microprocessors and Microcontrollers	ECE
6	23A54701	Wavelet transforms and its Applications	Mathematics
7	23A56701a	Smart Materials And Devices	Physics
8	23A56701b	Introduction to Quantum Mechanics	
9	23A51701	Green Chemistry And Catalysis For Sustainable Environment	Chemistry
10	23A52703	Employability Skills	Humanities

Open Elective – IV

S.No	Course Code	Course Name	Offered by the Dept.
1	23A01705a	Geo-Spatial Technologies	CIVIL
2	23A01705b	Solid Waste Management	
3	23A02705	Electric Vehicles	EEE
4	23A03705	Total Quality Management	ME
5	23A04704	Transducers and Sensors	ECE
6	23A32603	Introduction to Quantum Computing	CSE & Allied
7	23A54702	Financial Mathematics	Mathematics
8	23A56702	Sensors And Actuators For Engineering Applications	Physics
9	23A51702	Chemistry Of Nanomaterials and Applications	Chemistry
10	23A52704	Literary Vibes	Humanities

IV B.Tech II Semester (AI & DS)

S.No.	Course code	Title	Category	L	T	P	Credits
1	23A30801	Internship		-	-	-	4
2	23A30802	Project		-	-	-	8
Total				**-**	**-**	**-**	**12**

COURSES OFFERED FOR HONOURS DEGREE IN AI & DS

S. No	Code	Course Name	Contact Hours Per Week			Credits
			L	T	P	3
1	23A30H01	Advanced Machine Learning & Statistical Modeling	3	0	0	3
2	23A30H02	Scalable AI & Big Data	3	0	0	3
3	23A30H03	Advanced Deep Learning for Data Science Applications	3	0	0	3
4	23A30H04	Data Engineering & Cloud-based AI Pipelines	3	0	0	3
5	23A30H05	Ethics, Bias & Explainability in AI	3	0	0	3
6	23A30H06	Big Data & AI Analytics Lab	0	0	3	1.5
7	23A30H07	Data Science & Visualization Lab	0	0	3	1.5

III B.Tech I Semester

		L	T	P	C
23A3051T	**MACHINE LEARNING (Professional Core)**	**3**	**0**	**0**	**3**

Course Objectives: The objectives of the course are

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

,

Course Outcomes:

- CO1: Identify machine learning techniques suitable for a given problem. (L3)
- CO2: Solve real-world problems using various machine learning techniques. (L3)
- CO3: Apply Dimensionality reduction techniques for data preprocessing. (L3)
- CO4: Explain what is learning and why it is essential in the design of intelligent machines. (L2)
- CO5: Evaluate Advanced learning models for language, vision, speech, decision making etc. (L5)

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

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

UNIT-III: Models Based on Decision Trees: Decision Trees for Classification, Impurity Measures, Properties, Regression Based on Decision Trees, Bias–Variance Trade-off, Random Forests for Classification and Regression.
The Bayes Classifier: Introduction to the Bayes Classifier, Bayes‘ Rule and Inference, The Bayes Classifier and its Optimality, Multi-Class Classification | Class Conditional Independence and Naive Bayes Classifier (NBC)

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

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

Textbooks:

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

Reference Books:

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

III B.Tech I Semester

		L	T	P	C
23A3052T	**MULTI AGENT SYSTEMS (Professional Core)**	**3**	**0**	**0**	**3**

Course Objectives:

- To introduce the foundational concepts and architectures of intelligent agents and multi-agent systems.
- To understand agent communication, coordination, and negotiation strategies.
- To explore cooperation, teamwork, and distributed problem-solving in agent-based systems.
- To study real-world applications and design methodologies of multi-agent systems.
- To impart knowledge on formal models and game theory-based interactions in multi-agent environments.

Course Outcomes:

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

- Describe the architecture and functioning of individual intelligent agents. (Remembering)
- Analyze communication, coordination, and negotiation among multiple agents. (Analyzing)
- Apply distributed problem-solving approaches to real-world multi-agent systems. (Applying)
- Design multi-agent systems for practical applications using appropriate methodologies. (Creating)
- Evaluate the performance and scalability of multi-agent systems using game-theoretic approaches. (Evaluating)

UNIT I: Introduction to Intelligent Agents

Definition and Characteristics of Agents, Types of Agents: Reactive, Deliberative, Hybrid, Learning, Agent Architectures: Subsumption, BDI, Layered, Environments: Deterministic/Stochastic, Episodic/Sequential, Rationality and Autonomy, Simple Agent Programming Models.

UNIT II: Multi-Agent Systems Fundamentals

Definition and Properties of Multi-Agent Systems (MAS), Agent Communication Languages: KQML, FIPA ACL, Interaction Protocols: Contract Net, Auctions, Coordination Techniques: Blackboard, Mediator, Broker, Distributed Problem Solving (DPS) Concepts, Roles and Teamwork in MAS.

UNIT III: Cooperation, Negotiation, and Learning

Cooperative and Non-Cooperative Agents, Negotiation Techniques: Bidding, Bargaining, Argumentation, Game Theory: Basics and Applications in MAS, Reinforcement Learning in Multi-Agent Settings, Case Studies: Multi-Robot Coordination, Resource Allocation, Conflict Resolution and Consensus Building.

UNIT IV: Agent-Oriented Software Engineering

Agent-Based System Design Methodologies: Gaia, Tropos, Agent UML: Notations and Modeling, MAS Design Patterns and Best Practices, Ontologies and Semantic Web Integration, Middleware and Frameworks for MAS (JADE, SPADE), Scalability, Fault-Tolerance, and Deployment Challenges.

UNIT V: Advanced Topics and Applications

Emergence and Self-Organization in MAS, Swarm Intelligence and Distributed Optimization, Trust, Privacy, and Ethics in MAS, Real-Time and Embedded MAS Applications, MAS in Smart Grid, IoT, and Traffic Systems, Case Studies: Amazon Robotics, Autonomous Trading Agents.

Textbooks:

1. Michael Wooldridge, An Introduction to MultiAgent Systems, Wiley, 2nd Edition.
2. Gerhard Weiss, Multiagent Systems: A Modern Approach to Distributed Artificial Intelligence, MIT Press.

Reference Books:

1. Yoav Shoham and Kevin Leyton-Brown, Multiagent Systems: Algorithmic, Game-Theoretic, and Logical Foundations, Cambridge University Press.
2. Nikos Vlassis, A Concise Introduction to Multiagent Systems and Distributed Artificial Intelligence, Morgan & Claypool.
3. Mehdi Dastani et al., Programming Multi-Agent Systems, Springer.

Online Learning Resources:

1. NPTEL - Artificial Intelligence: Knowledge Representation and Reasoning
2. Coursera - Multi-Agent Systems by University of Washington
3. edX – Principles of AI Planning (covers agent-based modeling)
4. MIT OpenCourseWare – Multi-Agent Systems
5. YouTube – Multi-Agent Systems Lectures by Stanford, MIT

III B.Tech I Semester

		L	T	P	C
23A3053T	**DATA MINING AND DATA WAREHOUSING (Professional Core)**	**3**	**0**	**0**	**3**

Course Objectives:

- To introduce the fundamental concepts and architecture of data warehousing.
- To understand data preprocessing, transformation, and integration techniques.
- To explore data mining techniques such as classification, clustering, and association rules.
- To provide practical skills for applying data mining in real-world scenarios.
- To introduce tools and frameworks for data warehousing and mining, such as OLAP and WEKA.

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

- Understand data warehouse architecture and OLAP operations.
- Prepare and preprocess large datasets for mining applications.
- Apply classification, clustering, and association techniques effectively.
- Evaluate data mining results using proper metrics and validation methods.
- Utilize data mining tools for knowledge discovery in large datasets.

UNIT-I: Introduction to Data Warehousing and OLAP

Introduction to Data Warehousing: Concepts and Applications, Data Warehouse Architecture: Components and 3-Tier Architecture, ETL Process: Extraction, Transformation, Loading, OLAP: Multidimensional Data Model, OLAP Operations, Star, Snowflake, and Fact Constellation Schemas, Data Cubes and Roll-Up/Drill-Down Analysis

UNIT-II: Data Preprocessing and Data Understanding

Data Cleaning, Integration, and Transformation, Data Reduction Techniques and Feature Selection, Handling Missing, Noisy, and Inconsistent Data, Data Discretization and Normalization, Measures of Similarity and Dissimilarity, Exploratory Data Analysis and Visualization.

UNIT-III: Association Rule Mining and Classification

Basics of Association Rule Mining: Support, Confidence, Lift, Apriori Algorithm and FP-Growth Algorithm, Applications of Association Rule Mining, Classification Techniques: Decision Trees (ID3, C4.5), Bayesian Classifiers and Naïve Bayes, Rule-Based and Model-Based Classification.

UNIT-IV: Clustering and Advanced Mining Methods

Introduction to Clustering: Types and Applications, Partitioning Methods: K-Means, K-Medoids, Hierarchical Clustering: Agglomerative and Divisive, Density-Based Clustering: DBSCAN, OPTICS, Evaluation of Clustering Results, Outlier Detection and Handling.

UNIT-V: Data Mining Applications and Tools

Web Mining, Text Mining, and Spatial Data Mining, Temporal and Sequence Data Mining, Introduction to Big Data and Scalable Mining, Data Mining Tools: WEKA, RapidMiner, Orange, Case Studies: Business Intelligence, Fraud Detection, E-commerce, Ethical and Privacy Issues in Data Mining.

Textbooks:

1. Jiawei Han, Micheline Kamber, Jian Pei, Data Mining: Concepts and Techniques, 3rd Edition, Elsevier.
2. Paulraj Ponniah, Data Warehousing Fundamentals for IT Professionals, Wiley.
3. Pang-Ning Tan, Michael Steinbach, Vipin Kumar, Introduction to Data Mining, Pearson.

Reference Books:

1. Ralph Kimball, The Data Warehouse Toolkit: The Definitive Guide to Dimensional Modeling, Wiley.
2. Margaret H. Dunham, Data Mining: Introductory and Advanced Topics, Pearson.
3. Arun K. Pujari, Data Mining Techniques, Universities Press.

Online Learning Resources:

1. Coursera - Data Mining Specialization (University of Illinois)
2. Data Warehousing for Business Intelligence – Coursera (Duke University)
3. WEKA Data Mining Tutorials – University of Waikato
4. Data Mining and Analysis – Stanford Online
5. Khan Academy: Introduction to Data Mining

23A0554T	**INTRODUCTION TO QUANTUM TECHNOLOGIES AND APPLICATIONS** (Qualitative Treatment)	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Objectives (COBJ):

- Introduce fundamental quantum concepts like superposition and entanglement.
- Understand theoretical structure of qubits and quantum information.
- Explore conceptual challenges in building quantum computers.
- Explain principles of quantum communication and computing.
- Examine real-world applications and the future of quantum technologies.

Course Outcomes (CO):

- Explain core quantum principles in a non-mathematical manner.
- Compare classical and quantum information systems.
- Identify theoretical issues in building quantum computers.
- Discuss quantum communication and computing concepts.
- Recognize applications, industry trends, and career paths in quantum technology.

Unit 1: Introduction to Quantum Theory and Technologies

The transition from classical to quantum physics, Fundamental principles explained conceptually: Superposition, Entanglement, Uncertainty Principle, Wave-particle duality, Classical vs Quantum mechanics – theoretical comparison,Quantum states and measurement: nature of observation,Overview of quantum systems: electrons, photons, atoms,The concept of quantization: discrete energy levels,Why quantum? Strategic, scientific, and technological significance,A snapshot of quantum technologies: Computing, Communication, and Sensing,National and global quantum missions: India‘s Quantum Mission, EU, USA, China

Unit 2: Theoretical Structure of Quantum Information Systems

What is a qubit? Conceptual understanding using spin and polarization, Comparison: classical bits vs quantum bits, Quantum systems: trapped ions, superconducting circuits, photons (non-engineering view),Quantum coherence and decoherence – intuitive explanation, Theoretical concepts: Hilbert spaces, quantum states, operators – only interpreted in abstract,The role of entanglement and non-locality in systems, Quantum information vs classical information: principles and differences,Philosophical implications: randomness, determinism, and observer role

Unit 3: Building a Quantum Computer – Theoretical Challenges and Requirements

What is required to build a quantum computer (conceptual overview)?,Fragility of quantum systems: decoherence, noise, and control, Conditions for a functional quantum system: Isolation, Error management, Scalability, Stability, Theoretical barriers:

Why maintaining entanglement is difficult,Error correction as a theoretical necessity, Quantum hardware platforms (brief conceptual comparison),Superconducting circuits, Trapped ions, Photonics, Visionvs reality: what‘s working and what remains elusive,The role of quantum software in managing theoretical complexities

Unit 4: Quantum Communication and Computing – Theoretical Perspective

Quantum vs Classical Information, Basics of Quantum Communication, Quantum Key Distribution (QKD),Role of Entanglement in Communication,The Idea of the Quantum Internet – Secure Global Networking,Introduction to Quantum Computing,Quantum Parallelism (Many

States at Once),Classical vs Quantum Gates, Challenges: Decoherence and Error Correction,Real-World Importance and Future Potential

Unit 5: Applications, Use Cases, and the Quantum Future

Real-world application domains: Healthcare (drug discovery),Material science, Logistics and optimization, Quantum sensing and precision timing, Industrial case studies: IBM, Google, Microsoft, PsiQuantum,Ethical, societal, and policy considerations, Challenges to adoption: cost, skills, standardization,Emerging careers in quantum: roles, skillsets, and preparation pathways,Educational and research landscape – India's opportunity in the global quantum race

Textbooks:

1. Michael A. Nielsen, Isaac L. Chuang, *Quantum Computation and Quantum Information*, Cambridge University Press, 10th Anniversary Edition, 2010.
2. Eleanor Rieffel and Wolfgang Polak, *Quantum Computing: A Gentle Introduction*, MIT Press, 2011.
3. Chris Bernhardt, *Quantum Computing for Everyone*, MIT Press, 2019.

Reference Books:

1. David McMahon, *Quantum Computing Explained*, Wiley, 2008.
2. Phillip Kaye, Raymond Laflamme, Michele Mosca, *An Introduction to Quantum Computing*, Oxford University Press, 2007.
3. Scott Aaronson, *Quantum Computing Since Democritus*, Cambridge University Press, 2013.
4. **Alastair I.M. Rae**, *Quantum Physics: A Beginner's Guide*, Oneworld Publications, Revised Edition, 2005.
5. **Eleanor G. Rieffel, Wolfgang H. Polak**, *Quantum Computing: A Gentle Introduction*, MIT Press, 2011.
6. **Leonard Susskind, Art Friedman**, *Quantum Mechanics: The Theoretical Minimum*, Basic Books, 2014.
7. **Bruce Rosenblum, Fred Kuttner**, *Quantum Enigma: Physics Encounters Consciousness*, Oxford University Press, 2nd Edition, 2011.
8. **GiulianoBenenti, GiulioCasati, GiulianoStrini**, *Principles of Quantum Computation and Information, Volume I: Basic Concepts*, World Scientific Publishing, 2004.
9. **K.B. Whaley et al.**, *Quantum Technologies and Industrial Applications: European Roadmap and Strategy Document*, Quantum Flagship, European Commission, 2020.
10. **Department of Science & Technology (DST), Government of India**, *National Mission on Quantum Technologies & Applications – Official Reports and Whitepapers*, MeitY/DST Publications, 2020 onward.

Online Learning Resources:

- IBM Quantum Experience and Qiskit Tutorials
- Coursera – Quantum Mechanics and Quantum Computation by UC Berkeley
- edX – The Quantum Internet and Quantum Computers
- YouTube – Quantum Computing for the Determined by Michael Nielsen
- Qiskit Textbook – IBM Quantum

III B.Tech I Semester

23A305AT	**DATA VISUALIZATION (Professional Elective-I)**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Objectives:

- To understand the principles, techniques, and tools of data visualization.
- To develop the ability to transform data into visual insights using different types of charts and plots.
- To introduce the cognitive and perceptual foundations of effective data visualization.
- To apply tools and programming environments (like Python, Tableau, or Power BI) for creating interactive and dynamic visualizations.
- To analyze real-world datasets and effectively communicate data-driven findings visually.

Course Outcomes:

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

- CO1: Interpret different types of data and recognize the appropriate visualization methods.
- CO2: Design effective and interactive data visualizations using various tools.
- CO3: Apply visual encoding and perceptual principles in presenting complex data.
- CO4: Analyze and visualize real-world data sets using Python libraries and dashboards.
- CO5: Create visual stories and dashboards for effective communication of insights.

UNIT I: Introduction to Data Visualization & Perception

Introduction to Data Visualization, Importance and Scope of Data Visualization, Data Types and Sources, Visual Perception: Pre-attentive Processing, Gestalt Principles, Data-Ink Ratio, Data Density, Lie Factor, Visualization Process and Design Principles, Tools Overview: Tableau, Power BI, Python Libraries

UNIT II: Visualization Techniques for Categorical & Quantitative Data

Charts for Categorical Data: Bar Charts, Pie Charts, Column Charts, Charts for Quantitative Data: Histograms, Line Charts, Boxplots, Scatter Plots, Bubble Charts, Heatmaps, Choosing the Right Chart Type, Best Practices in Labeling, Coloring, and Scaling.

UNIT III: Multidimensional, Temporal and Hierarchical Data Visualization

Visualizing Multivariate Data: Parallel Coordinates, Radar Charts, Time-Series Visualization: Time Plots, Animation over Time, Geographic Data Visualization: Maps, Choropleths, Hierarchical Data: Treemaps, Sunburst Charts, Network and Graph Visualization.

UNIT IV: Data Visualization Using Python and Dashboards

Introduction to Matplotlib, Seaborn, and Plotly, Creating Static and Interactive Charts, Pandas Visualization Capabilities, Dashboards with Dash, Streamlit, Power BI, Case Studies: Real-world Dataset Visualization.

UNIT V: Storytelling with Data and Ethical Visualization

Storytelling and Narrative Techniques in Visualization, Dashboards and Reporting, Misleading Visualizations and Bias, Ethical Principles in Data Visualization, Final Project: Create a Storytelling Dashboard with Real Data.

Textbooks:

1. Tamara Munzner, Visualization Analysis and Design, CRC Press, 2014.
2. Nathan Yau, Data Points: Visualization That Means Something, Wiley, 2013.

Reference Books:

1. Alberto Cairo, The Truthful Art: Data, Charts, and Maps for Communication, New Riders, 2016.
2. Cole Nussbaumer Knaflic, Storytelling with Data: A Data Visualization Guide for Business Professionals, Wiley, 2015.
3. Claus O. Wilke, Fundamentals of Data Visualization, O'Reilly, 2019.
4. Rohan Chopra, Hands-On Data Visualization with Bokeh, Packt Publishing, 2019.

Online Learning Resources:

1. NPTEL: Data Visualization - IIT Madras
2. Coursera: Data Visualization with Python by IBM

III B.Tech I Semester

23A055BT	**SOFT COMPUTING (Professional Elective-I)**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Objectives:

- Understand the concepts of soft computing techniques and how they differ from traditional AI techniques.
- Introduce the fundamentals of fuzzy logic and fuzzy systems.
- Familiarize with artificial neural networks and their architectures.
- Learn genetic algorithms and their role in optimization.
- Explore hybrid systems integrating fuzzy logic, neural networks, and genetic algorithms.

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

- Understand the components and applications of soft computing.
- Apply fuzzy logic concepts to real-world problems.
- Build and train various neural network models.
- Implement genetic algorithms for problem-solving and optimization.
- Design hybrid systems using soft computing techniques.

UNIT I: Introduction to Soft Computing and Fuzzy Logic
Introduction to Soft Computing: Definition, Components, Differences with Hard Computing, Applications of Soft Computing, Fuzzy Logic: Crisp Sets vs Fuzzy Sets, Membership Functions, Fuzzy Set Operations, Fuzzy Rules and Fuzzy Reasoning, Fuzzy Inference Systems: Mamdani and Sugeno Models, Defuzzification Techniques.

UNIT II: Artificial Neural Networks – I
Introduction to Neural Networks: Biological Neurons vs Artificial Neurons, Architecture of Neural Networks: Feedforward, Feedback, Learning Rules: Hebbian, Delta, Perceptron Learning Rule, Single Layer Perceptron and its Limitations, Multi-Layer Perceptron: Backpropagation Algorithm, Applications of Neural Networks

UNIT III: Artificial Neural Networks – II
Hopfield Networks and Associative Memories, Radial Basis Function Networks, Self-Organizing Maps (SOM), Recurrent Neural Networks (RNNs) – Basic Concepts, Convolutional Neural Networks (CNNs) – Overview and Applications, Practical Use Cases in Image and Pattern Recognition,

UNIT IV: Genetic Algorithms and Optimization
Introduction to Genetic Algorithms, GA Operators: Selection, Crossover, Mutation, Fitness Function and Evaluation, Schema Theorem, Elitism, Applications in Function Optimization, Scheduling, and Robotics, Introduction to Particle Swarm Optimization (PSO).

UNIT V: Hybrid Systems and Advanced Topics
Hybrid Systems: Neuro-Fuzzy Systems, Fuzzy-GA, GA-ANN, ANFIS: Architecture and Learning, Case Studies on Hybrid Systems, Introduction to Deep Learning in Soft Computing, Real-World Applications: Forecasting, Control Systems, Medical Diagnosis, Image Processing.

Textbooks:

1. S. N. Sivanandam, S. N. Deepa, ―Principles of Soft Computing‖, Wiley India, 3rd Edition
2. Timothy J. Ross, ―Fuzzy Logic with Engineering Applications‖, Wiley, 4th Edition
3. S. Rajasekaran and G. A. Vijayalakshmi Pai, ―Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis and Applications‖, PHI

Reference Books:

1. Laurene Fausett, ―Fundamentals of Neural Networks: Architectures, Algorithms and Applications‖, Pearson
2. David E. Goldberg, ―Genetic Algorithms in Search, Optimization and Machine Learning‖, Pearson
3. Simon Haykin, ―Neural Networks and Learning Machines‖, Pearson, 3rd Edition
4. Bart Kosko, ―Neural Networks and Fuzzy Systems‖, Prentice Hall

Online Learning Resources:

1. NPTEL – Soft Computing by Prof. S. Sengupta (IIT Kharagpur)
2. Coursera – Neural Networks and Deep Learning (Andrew Ng)

III B.Tech I Semester

23A305BT	**INTERNET OF THINGSFOR AI APPLICATIONS (Professional Elective-I)**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Objectives:

- Understand the basics of Internet of Things and protocols.
- Discuss the requirement of IoT technology
- Introduce some of the application areas where IoT can be applied.
- Understand the vision of IoT from a global perspective, understand its applications, determine its market perspective using gateways, devices and data management

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

- Understand general concepts of Internet of Things.
- Apply design concept to IoT solutions
- Analyze various M2M and IoT architectures
- Evaluate design issues in IoT applications
- Create IoT solutions using sensors, actuators and Devices

UNIT I Introduction to IoT Lecture 8Hrs
Definition and Characteristics of IoT, physical design of IoT, IoT protocols, IoT communication models, IoT Communication APIs, Communication protocols, Embedded Systems, IoT Levels and Templates

UNIT II Prototyping IoT Objects using Microprocessor/Microcontroller Lecture 9Hrs
Working principles of sensors and actuators, setting up the board – Programming for IoT, Reading from Sensors, Communication: communication through Bluetooth, Wi-Fi.

UNIT III IoT Architecture and Protocols Lecture 8Hrs
Architecture Reference Model- Introduction, Reference Model and architecture, IoT reference Model, Protocols- 6LowPAN, RPL, CoAP, MQTT, IoT frameworks- Thing Speak.

UNIT IV Device Discovery and Cloud Services for IoT Lecture 8Hrs
Device discovery capabilities- Registering a device, Deregister a device, Introduction to Cloud Storage models and communication APIs Web-Server, Web server for IoT.

UNIT V UAV IoT Lecture 10Hrs
Introduction toUnmanned Aerial Vehicles/Drones, Drone Types, Applications: Defense, Civil, Environmental Monitoring; UAV elements and sensors- Arms, motors, Electronic Speed Controller(ESC), GPS, IMU, Ultra sonic sensors; UAV Software –Arudpilot, Mission Planner, Internet of Drones(IoD)- Case study FlytBase.

Textbooks:

1. Vijay Madisetti and ArshdeepBahga, ―Internet of Things (A Hands-on-Approach)‖, 1st Edition, VPT, 2014.
2. Handbook of unmanned aerial vehicles, *K Valavanis;George J Vachtsevanos,* New York, Springer, Boston, Massachusetts : Credo Reference, 2014. 2016.

Reference Books:

1. Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, ―From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence‖, 1st Edition, Academic Press, 2014.
2. ArshdeepBahga, Vijay Madisetti - Internet of Things: A Hands-On Approach, Universities Press, 2014.
3. The Internet of Things, Enabling technologies and use cases – Pethuru Raj, Anupama C. Raman, CRC Press.
4. Francis daCosta, ―Rethinking the Internet of Things: A Scalable Approach to Connecting Everything‖, 1st Edition, Apress Publications, 2013
5. Cuno Pfister, Getting Started with the Internet of Things, O"Reilly Media, 2011, ISBN: 9781-4493- 9357-1
6. DGCA RPAS Guidance Manual, Revision 3 – 2020
7. Building Your Own Drones: A Beginners' Guide to Drones, UAVs, and ROVs, John Baichtal

Online Learning Resources:

1. https://www.arduino.cc/
2. https://www.raspberrypi.org/
3. https://nptel.ac.in/courses/106105166/5
4. https://nptel.ac.in/courses/108108098/

III B.Tech I Semester

23A335CT	**EXPLORATORY DATA ANALYSIS WITH PYTHON (Professional Elective-I)**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Objectives:

- To introduce the principles and practices of Exploratory Data Analysis (EDA) using Python.
- To teach techniques for data cleaning, preprocessing, transformation, and visualization.
- To apply statistical techniques and visual methods to discover patterns and relationships.
- To gain experience using popular Python libraries such as NumPy, Pandas, Matplotlib, and Seaborn.
- To prepare datasets for further machine learning and predictive modeling.

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

- Understand and apply key concepts of EDA and data preprocessing. (Cognitive Level: Understand, Apply)
- Perform exploratory analysis using Python libraries and interpret results. (Cognitive Level: Apply, Analyze)
- Handle missing data, outliers, and categorical features effectively. (Cognitive Level: Apply)
- Create meaningful visualizations to support data-driven insights. (Cognitive Level: Analyze, Evaluate)
- Use EDA as a foundation for data science workflows. (Cognitive Level: Apply, Create)

UNIT I – Introduction to EDA and Python Environment

Introduction to Data Science and EDA, Importance of EDA in Data Science Life Cycle, Setting up Python Environment: Jupyter, Anaconda, VS Code, Introduction to NumPy and Pandas: Arrays, Series, DataFrames, Data loading, viewing, basic operations (info, describe, shape)

UNIT II – Data Wrangling and Preprocessing

Handling Missing Data (mean, median, drop, interpolation), Dealing with Duplicates, Outliers, and Anomalies, Encoding Categorical Variables (Label, One-hot), Data Transformation: Scaling, Normalization, Binning, Data Types Conversion and Data Type Casting.

UNIT III – Univariate and Bivariate Analysis

Measures of Central Tendency and Dispersion, Distribution Plots: Histograms, Boxplots, KDE, Bar Charts, Count Plots, Pie Charts, Bivariate Analysis: Scatter Plots, Pair Plots, Heatmaps, Correlation and Covariance Analysis

UNIT IV – Data Visualization Techniques

Visualization with Matplotlib and Seaborn, Customizing Plots: Titles, Legends, Labels, Themes, Advanced Visuals: Violin Plots, Strip Plots, Swarm Plots, Multivariate Visualization and Subplots, Plotly and Interactive Visualizations (basic overview)

UNIT V – EDA Case Studies and Real-Time Datasets

Step-by-step EDA on Sample Datasets (Titanic, Iris, Sales, etc.), Outlier Detection Techniques, Feature Engineering Techniques in EDA, EDA Report Generation using Python Notebooks, Preparing Data for Machine Learning Models

Textbooks:

1. Jake VanderPlas, Python Data Science Handbook: Essential Tools for Working with Data, O'Reilly, 2016.
2. Wes McKinney, Python for Data Analysis, 2nd Edition, O'Reilly, 2018.

Reference Books:

1. Joel Grus, Data Science from Scratch, O'Reilly, 2019.
2. Aurelien Geron, Hands-On Machine Learning with Scikit-Learn, Keras & TensorFlow, 2nd Edition, O'Reilly, 2019.
3. Allen B. Downey, Think Stats: Probability and Statistics for Programmers, O'Reilly, 2014.

Online Learning Resources:

1. NPTEL Course – Data Science for Engineers
2. Coursera – Applied Data Science with Python Specialization (University of Michigan)

III B.Tech I Semester

23A3051L	**MACHINE LEARNING LAB (Professional Core)**	**L**	**T**	**P**	**C**
		0	**0**	**3**	**1.5**

Course Objectives:

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

Software Required: Python/R/Weka

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

1. Compute Central Tendency Measures: Mean, Median, Mode Measure of Dispersion: Variance, Standard Deviation.
2. Apply the following Pre-processing techniques for a given dataset.
   a. Attribute selection
   b. Handling Missing Values
   c. Discretization
   d. Elimination of Outliers
3. Apply KNN algorithm for classification and regression
4. Demonstrate decision tree algorithm for a classification problem and perform parameter tuning for better results
5. Demonstrate decision tree algorithm for a regression problem
6. Apply Random Forest algorithm for classification and regression
7. Demonstrate Naïve Bayes Classification algorithm.
8. Apply Support Vector algorithm for classification
9. Demonstrate simple linear regression algorithm for a regression problem
10. Apply Logistic regression algorithm for a classification problem
11. Demonstrate Multi-layer Perceptron algorithm for a classification problem
12. Implement the K-means algorithm and apply it to the data you selected. Evaluate performance by measuring the sum of the Euclidean distance of each example from its class center. Test the performance of the algorithm as a function of the parameters K.
13. Demonstrate the use of Fuzzy C-Means Clustering
14. Demonstrate the use of Expectation Maximization based clustering algorithm

III B.Tech I Semester

23A3053L	**DATA MINING AND DATA WAREHOUSING LAB (Professional Core)**	**L**	**T**	**P**	**C**
		0	**0**	**3**	**1.5**

Course Objectives:

1. To enable students to construct and query data warehouses using OLAP operations.
2. To implement classification, clustering, and association rule mining algorithms.
3. To explore real-world datasets for data preprocessing and pattern discovery.
4. To develop hands-on experience with data mining tools and frameworks.
5. To evaluate the performance and accuracy of various mining techniques.

Course Outcomes:
After completion of this lab, students will be able to:

1. Design and implement a data warehouse schema and perform OLAP operations.
2. Preprocess raw datasets for mining tasks using suitable techniques.
3. Apply classification, clustering, and association rule mining on datasets.
4. Use tools such as WEKA, Python (Scikit-learn, pandas), or R for data mining.
5. Interpret, visualize, and evaluate results obtained from mining models.

List of Experiments:
2. Create a Star and Snowflake schema for a sample sales dataset using SQL
3. Perform OLAP operations (Roll-up, Drill-down, Slice, Dice, Pivot) using SQL
4. Import a CSV dataset and perform data cleaning, missing value handling, and normalization
5. Implement Apriori algorithm to find frequent itemsets and generate association rules
6. Use FP-Growth algorithm for mining frequent patterns from a retail dataset
7. Implement Naïve Bayes classifier and evaluate it using accuracy, precision, and recall
8. Build a Decision Tree using ID3 or C4.5 algorithm and visualize the result
9. Perform classification using K-Nearest Neighbors (KNN) and analyze the results
10. Apply K-Means clustering on a dataset and visualize cluster separation
11. Use Hierarchical clustering and dendrogram visualization
12. Perform Principal Component Analysis (PCA) on a high-dimensional dataset
13. Mini-project: Apply classification/clustering/association on a real-world dataset and present findings

Tools/Technologies to be used:

- Python (pandas, scikit-learn, matplotlib, seaborn)
- R / RStudio
- WEKA / Orange Data Mining Tool
- SQL for OLAP operations
- Jupyter Notebook / Google Colab

III B.Tech I Semester

23A0555L	**FULL STACK DEVELOPMENT-II (Skill Enhancement course)**	**L**	**T**	**P**	**C**
		0	**1**	**2**	**2**

Course Objectives: The main objectives of the course are to

- Make use of Modern- day JavaScript with ES6 standards for designing Dynamic web pages
- Building robust & responsive User Interfaces using popular JavaScript library **‗React.js'**. Building robust backend APIs using **‗Express. js'**
- Establishing the connection between frontend (React) User interfaces and backend APIs (Express) with Data Bases(My SQL)
- Familiarize students with GitHub for remote repository hosting and collaborative development.

Course Outcomes:

- CO1: Building fast and interactive UIs
- CO2: Applying Declarative approach for developing web apps
- CO3: Understanding ES6 features to embrace modern JavaScript
- CO4: Building reliable APIs with Express. Js
- CO5: Create and manage Git repositories, track changes, and push code to GitHub.

Experiments covering the Topics:

- Introduction to DOM (Document Object Model), Ecma Script (ES6) standards and features like Arrow functions, Spread operator, Rest operator, Type coercion, Type hoisting, String literals, Array and Object Destructuring.
- Basics of React. js like React Components, JSX, Conditional rendering
  Differences between Real DOM and Virtual DOM.
- Important React.js concepts like React hooks, Props, React forms, Fetch API, Iterative rendering using JavaScript map() function.
- JavaScript runtime environment node. js and its uses, Express. js and Routing, Micro-Services architecture and MVC architecture, database connectivity using (My SQL)
- Introduction to My SQL, setting up MySQL and configuring, Databases, My SQL queries, subqueries, creating My SQL driver for database connectivity to Express. js server.
- Introduction to Git and GitHub and upload project& team collaboration

Sample Experiments:

1. **Introduction to Modern JavaScript and DOM**
   - **a.** Write a JavaScript program to link JavaScript file with the HTML page
   - **b.** Write a JavaScript program to select the elements in HTML page using selectors
   - **c.** Write a JavaScript program to implement the event listeners
   - **d.** Write a JavaScript program to handle the click events for the HTML button elements
   - **e.** Write a JavaScript program to With three types of functions
     - **i.** Function declaration
     - **ii.** Function definition
     - **iii.** Arrow functions

2. **Basics of React. js**
    - **a.** Write a React program to implement a counter button using react class components
    - **b.** Write a React program to implement a counter button using react functional components
    - **c.** Write a React program to handle the button click events in functional component
    - **d.** Write a React program to conditionally render a component in the browser
    - **e.** Write a React program to display text using String literals
3. **Important concepts of React. js**
    - **a.** Write a React program to implement a counter button using React use State hook
    - **b.** Write a React program to fetch the data from an API using React use Effect hook
    - **c.** Write a React program with two react components sharing data using Props.
    - **d.** Write a React program to implement the forms in react
    - **e.** Write a React program to implement the iterative rendering using map() function.
4. **Introduction to Git and GitHub**

a. **Setup**
- Install Git on local machine.
- Configure Git (user name, email).
- Create GitHub account and generate a personal access token.

b. **Basic Git Workflow**
- Create a local repository using git init
- Create and add files → git add .
- Commit files → git commit -m "Initial commit"
- Connect to GitHub remote → git remote add origin <repo_url>
- Push to GitHub → git push -u origin main

c. **Branching and Collaboration**
- Create a branch → git checkout -b feature1
- Merge branch to main → git merge feature1
- Resolve merge conflicts (guided)

5. **Upload React Project to GitHub**

- Create a new React app using npx create-react-app myapp
- Initialize a git repo and push to GitHub
- Use .gitignore to exclude node_modules
- Create multiple branches: feature/navbar, feature/form
- Practice merge and pull requests (can use GitHub GUI)

6. **Introduction to Node. js and Express. js**
    - **a.** Write a program to implement the _hello world‘ message in the route through the browser using Express
    - **b.** Write a program to develop a small website with multiple routes using Express. js
    - **c.** Write a program to print the _hello world‘ in the browser console using Express. js
    - **d.** Write a program to implement the CRUD operations using Express. js
    - **e.** Write a program to establish the connection between API and Database using Express – My SQL driver

7. **Introduction to My SQL**
    - **a.** Write a program to create a Database and table inside that database using My SQL Command line client
    - **b.** Write a My SQL queries to create table, and insert the data, update the data in the table
    - **c.** Write a My SQL queries to implement the subqueries in the My SQL command line client
    - **d.** Write a My SQL program to create the script files in the My SQL workbench
    - **e.** Write a My SQL program to create a database directory in Project and initialize a database. sql file to integrate the database into API

8. *Team Collaboration Using GitHub*

    - Form groups of 2–3 students
    - Create a shared GitHub repo
    - Assign tasks and work in branches
    - Use Issues, Pull Requests, and Code Reviews
    - Document code with README.md

Textbooks:

1. Web Design with HTML, CSS, JavaScript and JQuery Set Book by Jon Duckett Professional JavaScript for Web Developers Book by Nicholas C. Zakas
2. John Dean, Web Programming with HTML5, CSS and JavaScript, Jones & Bartlett Learning, 2019.
3. Pro MERN Stack: Full Stack Web App Development with Mongo, Express, React, and Node, Vasan Subramanian, 2nd edition, APress, O'Reilly.
4. Learning PHP, MySQL, JavaScript, CSS & HTML5: A Step-by-Step Guide to Creating Dynamic Websites by Robin Nixon
5. AZAT MARDAN, Full Stack Java Script: Learn Back bone. js, Node.jsand Mongo DB.2015

Reference Books:

1. Full-Stack JavaScript Development by Eric Bush.
2. Programming the World Wide Web, 7th Edition, Robet W Sebesta, Pearson, 2013.
3. Tomasz Dyl ,KamilPrzeorski , MaciejCzarnecki, Mastering Full Stack React Web Development 2017

Online Learning Resources:

1. https://ict.iitk.ac.in/product/full-stack-developer-html5-css3-js-bootstrap-php-4/
2. https://www.w3schools.com/html
3. https://www.w3schools.com/css
4. https://www.w3schools.com/js/
5. https://www.w3schools.com/nodejs
6. https://www.w3schools.com/typescript
7. https://docs.github.com/
8. https://education.github.com/git-cheat-sheet-education.pdf

III B.Tech – I semester

		L	T	P	C
23A0556L	TINKERING LAB FOR COMPUTER ENGINEERS	**0**	**0**	**2**	**1**

The aim of tinkering lab for engineering students is to provide a hands-on learning environment where students can explore, experiment, and innovate by building and testing prototypes. These labs are designed to demonstrate practical skills that complement theoretical knowledge.

	Course objectives: The objectives of the course are to
1	**Encourage Innovation and Creativity**
2	**Provide Hands-on Learning and Impart Skill Development**
3	**Foster Collaboration and Teamwork**
4	**Enable Interdisciplinary Learning, Prepare for Industry and Entrepreneurship**
5	**Impart Problem-Solving mind-set**

These labs bridge the gap between academia and industry, providing students with the practical experience. Some students may also develop entrepreneurial skills, potentially leading to start-ups or innovation-driven careers. Tinkering labs aim to cultivate the next generation of engineers by giving them the tools, space, and mind-set to experiment, innovate, and solve real-world challenges.

List of experiments:

1) Make your own parallel and series circuits using breadboard for any application of your choice.
2) Design and 3D print a Walking Robot
3) Design and 3D Print a Rocket.
4) Temperature & Humidity Monitoring System (DHT11 + LCD)
5) Water Level Detection and Alert System
6) Automatic Plant Watering System
7) Bluetooth-Based Door Lock System
8) Smart Dustbin Using Ultrasonic Sensor
9) Fire Detection and Alarm System
10) RFID-Based Attendance System
11) Voice-Controlled Devices via Google Assistant
12) Heart Rate Monitoring Using Pulse Sensor
13) Soil Moisture-Based Irrigation
14) Smart Helmet for Accident Detection
15) Milk Adulteration Detection System
16) Water Purification via Activated Carbon
17) Solar Dehydrator for Food Drying
18) Temperature-Controlled Chemical Reactor
19) Ethanol Mini-Plant Using Biomass
20) Smart Fluid Flow Control (Solenoid + pH Sensor)

21) Portable Water Quality Tester
22) AI Crop Disease Detection
23) AI-based Smart Irrigation
24) ECG Signal Acquisition and Plotting
25) AI-Powered Traffic Flow Prediction
26) Smart Grid Simulation with Load Monitoring
27) Smart Campus Indoor Navigator
28) Weather Station Prototype
29) Firefighting Robot with Sensor Guidance
30) Facial Recognition Dustbin
31) Barcode-Based Lab Inventory System
32) Growth Chamber for Plants
33) Biomedical Waste Alert System
34) Soil Classification with AI
35) Smart Railway Gate
36) Smart Bin Locator via GPS and Load Sensors
37) Algae-Based Water Purifier
38) Contactless Attendance via Face Recognition

- **Note:** The students can also design and implement their own ideas, apart from the list of experiments mentioned above.
- **Note:** A minimum of 8 to 10 experiments must be completed by the students.

III B.Tech II Semester

23A3061T	**BIG DATA ANALYTICS (Professional Core)**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Objectives:

- To introduce the fundamental concepts and characteristics of Big Data.
- To equip students with knowledge of Hadoop, Spark, and distributed computing systems.
- To develop the ability to process, store, and analyze Big Data using modern tools.
- To implement various big data analytics techniques on real-world data.
- To apply big data tools and frameworks in domains such as finance, health, and e-commerce.

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

- Understand the characteristics, challenges, and tools of Big Data.
- Implement storage and retrieval mechanisms in HDFS and NoSQL databases.
- Develop MapReduce and Spark-based applications.
- Apply big data analytics techniques to process real-world large-scale datasets.
- Integrate big data platforms with machine learning and business intelligence solutions.

UNIT I: Introduction to Big Data and Hadoop Ecosystem
Definition, Characteristics of Big Data (Volume, Variety, Velocity, Veracity, Value), Types of Data: Structured, Semi-Structured, and Unstructured, Traditional vs Big Data Systems, Big Data Challenges and Benefits, Introduction to Hadoop: Architecture and Components, Hadoop Distributed File System (HDFS): Features, Design, Blocks, YARN and MapReduce Overview, Hadoop Ecosystem Components: Pig, Hive, HBase, Sqoop, Flume.

UNIT II: MapReduce Programming and Hadoop Tools
MapReduce Programming Model: Mapper, Reducer, Partitioner, InputSplit and RecordReader, Combiner, Writing MapReduce Programs in Java, Advanced MapReduce Concepts: Counters, Joins, Secondary Sort, Hive: Data Warehousing Concepts, HiveQL, Partitions, Buckets, Pig: Data Flow, Pig Latin Scripts, Data Import & Export with Sqoop, Real-Time Data Collection using Flume.

UNIT III: NoSQL Databases and HBase
Introduction to NoSQL Databases, Types of NoSQL: Key-Value, Document, Column, Graph, Differences between RDBMS and NoSQL, HBase Data Model: Column Families, Regions, Tables, HBase Architecture and Internals, HBase CRUD Operations using Java, Integration of HBase with Hadoop, Case Study: Big Data Storage in Social Media.

UNIT IV: Apache Spark and Big Data Analytics
Apache Spark: RDDs and DAG Execution Model, Spark Core and Spark SQL, DataFrames and Datasets in Spark, Spark Streaming: Architecture and DStreams, Spark MLlib: Machine Learning on Big Data, GraphX: Graph Processing in Spark, Performance Tuning and Optimization in Spark, Case Study: Building a Spark Application for Real-Time Analytics.

UNIT V: Applications and Case Studies in Big Data

Big Data in Healthcare: Predictive Analysis, Genomics, Big Data in Finance: Fraud Detection, Risk Analytics, Big Data in E-Commerce: Customer Behavior, Personalization, Sentiment Analysis using Big Data, Big Data for Smart Cities and IoT, Big Data and Cloud Computing Integration (AWS, GCP, Azure), Data Privacy, Security, and Ethical Issues – (E), Mini-Project: Design and Development of a Big Data Solution.

Textbooks:

1. Tom White, **Hadoop: The Definitive Guide**, O'Reilly Media.
2. V. Srinivasa Subramanian, **Big Data Analytics**, Wiley India.
3. Anand Rajaraman and Jeffrey D. Ullman, **Mining of Massive Datasets**, Cambridge University Press.

Reference Books:

1. Chuck Lam, **Hadoop in Action**, Manning Publications.
2. Bill Franks, **Taming the Big Data Tidal Wave**, Wiley.
3. Alex Holmes, **Hadoop in Practice**, Manning Publications.
4. Michael Minelli, **Big Data, Big Analytics: Emerging Business Intelligence**, Wiley.

Online Learning Resources:

- Coursera – Big Data Specialization by UC San Diego
- edX – Big Data Analysis with Apache Spark (UC Berkeley)
- Udacity – Data Engineering Nanodegree

III B.Tech II Semester

		L	T	P	C
23A3062T	**DEEP LEARNING (Professional Core)**	**3**	**0**	**0**	**3**

Course Objectives:

- Demonstrate the major technology trends driving Deep Learning
- Build, train, and apply fully connected deep neural networks
- Implement efficient (vector zed) neural networks
- Analyse the key parameters and hyper parameters in a neural network's architecture

Course Outcomes:

After completion of the course, students will be able to

- Demonstrate the mathematical foundation of neural network
- Describe the machine learning basics
- Differentiate architecture of deep neural network
- Build a convolution neural network
- Build and train RNN and LSTMs

UNIT-I Lecture 8Hrs

Linear Algebra: Scalars, Vectors, Matrices and Tensors, Matrix operations, types of matrices, Norms, Eigen decomposition, Singular Value Decomposition, Principal Components Analysis. Probability and Information Theory: Random Variables, Probability Distributions, Marginal Probability, Conditional Probability, Expectation, Variance and Covariance, Bays' Rule, Information Theory. Numerical Computation: Overflow and Underflow, Gradient-Based Optimization, Constrained Optimization, Linear Least Squares.

UNIT- II Lecture 9Hrs

Machine Learning: Basics and Under fitting, Hyper parameters and Validation Sets, Estimators, Bias and Variance, Maximum Likelihood, Bayesian Statistics, Supervised and Unsupervised Learning, Stochastic Gradient Descent, Challenges Motivating Deep Learning. Deep Feed forward Networks: Learning XOR, Gradient-Based Learning, Hidden Units, Architecture Design, Back-Propagation and other Differentiation Algorithms.

UNIT-III Lecture 8Hrs

Regularization for Deep Learning: Parameter Norm Penalties, Norm Penalties as Constrained Optimization, Regularization and Under-Constrained Problems, Dataset Augmentation, Noise Robustness, Semi-Supervised Learning, Multi-Task Learning, Early Stopping, Parameter Tying and Parameter Sharing, Sparse Representations, Bagging and Other Ensemble Methods, Dropout, Adversarial Training, Tangent Distance, Tangent Prop and Manifold Tangent Classifier. Optimization for Training Deep Models: 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.

UNIT-IV Lecture 9Hrs

Convolution Networks: The Convolution Operation, Pooling, Convolution, Basic Convolution Functions, Structured Outputs, Data Types, Efficient Convolution Algorithms, Random or Unsupervised Features, Basis for Convolution Networks.

UNIT-V Lecture 8Hrs

Sequence Modelling: Recurrent and Recursive Nets: Unfolding Computational Graphs, Recurrent Neural Networks, Bidirectional RNNs, Encoder-Decoder Sequence-to-Sequence Architectures, Deep

Recurrent Networks, Recursive Neural Networks, Echo State Networks, LSTM, Gated RNNs, Optimization for Long-Term Dependencies, Auto encoders, Deep Generative Models.

Textbooks:

1. Ian Good fellow, Joshua Bagnio, Aaron Carville, ―Deep Learning‖, MIT Press,2016.
2. Josh Patterson and Adam Gibson, ―Deep learning: A practitioner's approach‖, O'Reilly Media, First Edition,2017.

Reference Books:

1. Fundamentals of Deep Learning, Designing next-generation machine intelligence algorithms, Nikhil Baume, O‘Reilly, Sheriff Publishers,2019.
2. Deep learning Cook Book, Practical recipes to get started Quickly, Douse Using, O‘Reilly, Sheriff Publishers, 2019

Online Learning Resources:

1. https://keras.io/datasets/
2. http://deeplearning.net/tutorial/deeplearning.pdf
3. https://arxiv.org/pdf/1404.7828v4.pdf
4. https://www.cse.iitm.ac.in/~miteshk/CS7015.html
5. https://www.deeplearningbook.org
6. https://nptel.ac.in/courses/106105215

III B.Tech II Semester

III B.Tech II Semester

		L	T	P	C
23A3063T	**COMPUTATIONAL LANGUAGE PROCESSING**	**3**	**0**	**0**	**3**

Course Objectives:

• Explain and apply fundamental algorithms and techniques in the area of natural language processing (NLP)
• Discuss approaches to syntax and semantics in NLP.
• Examine current methods for statistical approaches to machine translation.
• Teach machine learning techniques used in NLP.

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

• Understand the various NLP Applications and Organization of Natural language, able to learn and implement realistic applications using Python.
• Apply the various Parsing techniques, Bayes Rule, Shannon game, Entropy and Cross Entropy.
• Understand the fundamentals of CFG and parsers and mechanisms in ATN‘s.
• Apply Semantic Interpretation and Language Modelling.
• Apply the concept of Machine Translation and multilingual Information Retrieval systems and Automatic Summarization.

UNIT-I Introduction to Natural language Lecture 8Hrs

The Study of Language, Applications of NLP, Evaluating Language Understanding Systems, Different Levels of Language Analysis, Representations and Understanding, Organization of Natural language Understanding Systems, Linguistic Background: An outline of English Syntax.

UNIT-II Grammars and Parsing Lecture 9Hrs

Grammars and Parsing- Top-Down and Bottom-Up Parsers, Transition Network Grammars, Feature Systems and Augmented Grammars, Morphological Analysis and the Lexicon, Parsing with Features, Augmented Transition Networks, Bayees Rule, Shannon game, Entropy and Cross Entropy.

UNIT-III Grammars for Natural Language Lecture 8Hrs

Grammars for Natural Language, Movement Phenomenon in Language, Handling questions in Context Free Grammars, Hold Mechanisms in ATNs, Gap Threading, Human Preferences in Parsing, Shift Reduce Parsers, Deterministic Parsers.

UNIT-IV Semantic Interpretation Lecture 8Hrs

Semantic & Logical form, Word senses & ambiguity, The basic logical form language, Encoding ambiguity in the logical Form, Verbs & States in logical form, Thematic roles, Speech acts &embedded sentences, Defining semantics structure model theory. Language Modelling Introduction, n-Gram Models, Language model Evaluation, Parameter Estimation, Language Model Adaption, Types of Language Models, Language-Specific Modelling Problems, Multilingual and Cross lingual Language Modelling.

UNIT V Machine Translation Lecture9 Hrs

Survey: Introduction, Problems of Machine Translation, Is Machine Translation Possible, Brief History, Possible Approaches, Current Status. Anusaraka or Language Accessor: Background, Cutting the Gordian Knot, The Problem, Structure of Anusaraka System, User Interface, Linguistic Area, Giving up Agreement in Anusarsaka Output, Language Bridges.

Multilingual Information Retrieval: Introduction, Document Pre-processing, Monolingual Information Retrieval, CLIR, MLIR, Evaluation in Information Retrieval, Tools, Software and Resources.
Multilingual Automatic Summarization Introduction, Approaches to Summarization, Evaluation, How to Build a Summarizer, Competitions and Datasets.

Textbooks:

1. James Allen, Natural Language Understanding, 2nd Edition, 2003, Pearson Education.
2. Multilingual Natural Language Processing Applications: From Theory To Practice-Daniel M.Bikel and ImedZitouni, Pearson Publications.
3. Natural Language Processing, Apaninian perspective, AksharBharathi, Vineetchaitanya, Prentice–Hall of India.

Reference Books:

1. Charniack, Eugene, Statistical Language Learning, MIT Press, 1993.
2. Jurafsky, Dan and Martin, James, Speech and Language Processing, 2nd Edition, Prentice Hall, 2008.
3. Manning, Christopher and Henrich, Schutze, Foundations of Statistical Natural Language Processing, MIT Press, 1999.

Online Learning Resources:
https://nptel.ac.in/courses/106/105/106105158/
http://www.nptelvideos.in/2012/11/natural-language-processing.html

III B.Tech II Semester

23A306AT	**REINFORCEMENT LEARNING (Professional Elective -II)**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Objectives:

- To understand the foundational concepts of Reinforcement Learning (RL) and its mathematical formulations.
- To explore dynamic programming, Monte Carlo methods, and temporal-difference learning.
- To study the advanced function approximation methods using neural networks.
- To apply RL algorithms to real-world decision-making problems.
- To introduce policy gradient methods and deep reinforcement learning techniques.

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

- Explain the core principles of reinforcement learning and its interaction model.
- Apply tabular and approximate solution methods for prediction and control.
- Evaluate and compare Monte Carlo, TD, and policy gradient methods.
- Design reinforcement learning models for real-world environments.
- Integrate neural networks with reinforcement learning techniques.

UNIT I – Introduction to Reinforcement Learning
Introduction to Machine Learning and RL, Agent-environment interface, Goals and rewards, Returns: episodic and continuing tasks, Markov Decision Processes (MDP), Value functions: state-value and action-value functions.

UNIT II – Dynamic Programming and Monte Carlo Methods
Policy evaluation and improvement, Policy iteration and value iteration, Generalized policy iteration, Monte Carlo prediction and control, On-policy and off-policy MC methods.

UNIT III – Temporal-Difference Learning and Eligibility Traces
TD Prediction (TD(0)), SARSA and Q-Learning, Expected SARSA, n-step returns, Eligibility traces, TD(λ) methods.

UNIT IV – Function Approximation and Deep RL

Linear and non-linear function approximation, Feature construction, Deep Q Networks (DQN), Experience replay and fixed Q-targets, Double DQN and Dueling DQN, Challenges in deep RL

UNIT V – Policy Gradient and Actor-Critic Methods
Policy gradient theorem, REINFORCE algorithm, Variance reduction techniques, Actor-Critic architecture, Proximal Policy Optimization (PPO), Applications in Robotics and Games

Textbooks:

1. Richard S. Sutton and Andrew G. Barto, "Reinforcement Learning: An Introduction", 2nd Edition, MIT Press, 2018. **(Free online at http://incompleteideas.net/book/the-book-2nd.html)**

Reference Books:

1. Csaba Szepesvári, "Algorithms for Reinforcement Learning", Morgan & Claypool, 2010.
2. Marco Wiering and Martijn van Otterlo, "Reinforcement Learning: State-of-the-Art", Springer, 2012.
3. David Silver, Reinforcement Learning Lecture Series, University College London (UCL).
4. François-Lavet et al., "An Introduction to Deep Reinforcement Learning", Foundations and Trends® in Machine Learning, 2018.

Online Learning Resources:

1. NPTEL Online Course: https://nptel.ac.in/courses/106106143 – Reinforcement Learning by Prof. Balaraman Ravindran, IIT Madras
2. DeepMind & UCL Lectures (David Silver): https://www.davidsilver.uk/teaching/

III B.Tech II Semester

23A306BT	**RECOMMENDER SYSTEMS (Professional Elective-II)**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Objectives:

- To provide students with basic concepts and its application in various domain
- To make the students understand different techniques that a data scientist needs to know for analysing big data
- To design and build a complete machine learning solution in many application domains.

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

- Aware of various issues related to Personalization and Recommendations.
- Design and implement a set of well-known Recommender System approaches used in E commerce and Tourism industry.
- Develop new Recommender Systems for a number of domains especially, Education, Health-care.

UNIT-IAn Introduction to Recommender Systems, Neighborhood-Based Collaborative Filtering Lecture 8Hrs

Introduction, Goals of Recommender Systems, Basic Models of Recommender Systems, Domain Specific Challenges in Recommender Systems. Advanced Topics and Applications. Introduction, Key Properties of Ratings Matrices, Predicting Ratings with Neighborhood- Neighborhood-Based Collaborative Filtering: Based Methods, Clustering and Neighborhood-Based Methods, Dimensionality Reduction and Neighborhood Methods, Graph Models for Neighborhood-Based Methods, A Regression Modelling View of Neighborhood Methods.

UNIT-II Model-Based Collaborative Filtering, Content-Based Recommender Systems Lecture 9Hrs Introduction, Decision and Regression Trees, Rule-Based Collaborative Filtering, Naive Bayes Collaborative Filtering, Using an Arbitrary Classification Model as a Black-Box, Latent Factor Models, Integrating Factorization and Neighborhood Models. Content-Based Recommender Systems: Introduction, Basic Components of Content-Based Systems, Preprocessing and Feature Extraction, Learning User Profiles and Filtering, Content-Based Versus Collaborative Recommendations, Using Content-Based Models for Collaborative Filtering, Summary.

UNIT-III Knowledge-Based Recommender Systems, Ensemble Based and Hybrid Recommender Systems Lecture 9Hrs

Introduction, Constraint-Based Recommender Systems, Case-Based Recommenders, Persistent Personalization in Knowledge-Based Systems, Summary. Introduction, Ensemble Methods from the Classification Perspective, Weighted Hybrids, Switching Hybrids, Cascade Hybrids, Feature Augmentation Hybrids, Meta-Level Hybrids, Feature Combination Hybrids, Summary.

UNIT-IV Evaluating Recommender Systems, Context-Sensitive Recommender Systems Lecture 8Hrs

Introduction, Evaluation Paradigms, General Goals of Evaluation Design, Design Issues in Offline Recommender Evaluation, Accuracy Metrics in Offline Evaluation, Limitations of Evaluation Measures, Limitations of Evaluation Measures. Introduction, The Multidimensional Approach, Contextual Pre-filtering: A Reduction-Based Approach, Contextual Pre-filtering: A Reduction-Based Approach, Contextual Modelling.

UNIT-V Time- and Location-Sensitive Recommender Systems Lecture 8Hrs

Introduction, Temporal Collaborative Filtering, Discrete Temporal Models, Location-Aware Recommender Systems, Location-Aware Recommender Systems Location-Aware Recommender Systems, Summary.

Textbooks:
1. Charu C. Aggarwal, ―Recommender Systems‖, Springer,2016.

Reference Books:
1. Francesco Ricci, LiorRokach, ―Recommender Systems Handbook‖, 2nd ed., Springer, 2015 Edition

Online Learning Resources:
1. Recommendation System -Understanding The Basic Concepts (analyticsvidhya.com)
2. Recommender Systems | Coursera

III B.Tech II Semester

23A306CT	**PREDICTIVE MODELING (Professional Elective-II)**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Objectives:

- To introduce the fundamental concepts and techniques of predictive analytics.
- To apply statistical models and machine learning algorithms for prediction.
- To interpret model performance using evaluation metrics.
- To explore feature engineering, model tuning, and cross-validation.
- To implement predictive solutions for real-world business and research problems.

Course Outcomes:

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

- Understand the principles and importance of predictive analytics.
- Apply regression and classification models for predictive tasks.
- Perform data preprocessing, feature selection, and transformation.
- Evaluate and validate models using standard metrics.
- Design predictive solutions to solve domain-specific challenges.

UNIT I: Introduction to Predictive Analytics

Introduction to Predictive Analytics and Business Intelligence, Types of Predictive Models: Classification, Regression, Time Series, Supervised vs Unsupervised Learning, Predictive Modeling Workflow, Applications in Marketing, Finance, Healthcare, Challenges in Predictive Analytics.

UNIT II: Data Preparation and Feature Engineering

Data Cleaning: Handling Missing, Noisy, and Inconsistent Data, Feature Selection and Dimensionality Reduction (PCA, LDA), Feature Scaling: Normalization, Standardization, Encoding Categorical Variables, Feature Extraction and Construction, Dealing with Imbalanced Datasets.

UNIT III: Predictive Modeling with Regression and Classification

Linear Regression and Polynomial Regression, Logistic Regression for Binary Classification, Decision Trees and Random Forest, k-Nearest Neighbors (k-NN) and Naïve Bayes, Support Vector Machines (SVM), Model Selection and Comparison.

UNIT IV: Model Evaluation and Validation

Training, Testing, and Validation Sets, Cross-Validation Techniques (k-Fold, Stratified, LOOCV), Evaluation Metrics: Accuracy, Precision, Recall, F1 Score, ROC-AUC, Confusion Matrix and Classification Report, Bias-Variance Trade-off and Overfitting, Hyperparameter Tuning: Grid Search, Random Search.

UNIT V: Advanced Topics and Applications

Ensemble Learning: Bagging, Boosting (AdaBoost, XGBoost), Predictive Analytics with Time Series (ARIMA, Prophet), Deep Learning for Predictive Modeling (ANNs, LSTM), Use of Predictive Analytics in IoT, Retail, and Healthcare, Ethics and Privacy in Predictive Analytics, Building and Deploying End-to-End Predictive Systems.

Textbooks:

1. Dean Abbott, **Applied Predictive Analytics: Principles and Techniques for the Professional Data Analyst**, Wiley, 2014.
2. John D. Kelleher, Brendan Tierney, **Data Science: Predictive Analytics and Data Mining**, MIT Press, 2018.

Reference Books:

1. Galit Shmueli et al.**,Data Mining for Business Analytics: Concepts, Techniques, and Applications in R**, Wiley, 2017.
2. Eric Siegel, **Predictive Analytics: The Power to Predict Who Will Click, Buy, Lie, or Die**, Wiley, 2016.
3. Trevor Hastie, Robert Tibshirani, Jerome Friedman, **The Elements of Statistical Learning**, Springer, 2009.

Online Learning Resources:

1. https://www.coursera.org/specializations/predictive-analytics – Coursera Specialization
2. https://www.edx.org/course/data-science-and-machine-learning-capstone – edX Predictive Analytics Courses
3. https://www.kaggle.com/learn/intro-to-machine-learning – Kaggle Tutorials

III B.Tech II Semester

23A306DT	**AI FOR FINANCE (Professional Elective-II)**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Objectives:

1. To introduce the role of Artificial Intelligence (AI) in financial applications and decision-making.
2. To understand financial data types, sources, and processing methods.
3. To apply machine learning and deep learning models in various finance sectors.
4. To analyze risk, fraud detection, credit scoring, and portfolio management using AI.
5. To evaluate ethical and regulatory challenges in AI-enabled finance.

Course Outcomes:

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

1. Describe the fundamentals of AI techniques applicable to finance.
2. Analyze financial time series data using AI-based models.
3. Apply machine learning for fraud detection and credit risk analysis.
4. Build predictive models for stock prices, trading, and customer segmentation.
5. Evaluate the limitations and ethical implications of AI in financial systems.

UNIT I: Introduction to Finance and AI Applications

Introduction to Financial Markets and Instruments, Overview of AI Techniques in Finance, Types of Financial Data: Market, Transactional, Customer, Financial Statements and Key Indicators, AI Use Cases in Banking, Insurance, and Investment, FinTech and the Rise of Robo-Advisors.

UNIT II: Machine Learning in Finance

Supervised Learning for Credit Scoring, Unsupervised Learning for Customer Segmentation, Feature Engineering for Financial Data, Handling Imbalanced Datasets in Fraud Detection, Time Series Forecasting with Regression and ARIMA, Model Validation and Backtesting in Finance.

UNIT III: Deep Learning and NLP in Finance

Introduction to Deep Learning for Finance, Stock Price Prediction using LSTM and RNNs, Sentiment Analysis from Financial News and Tweets, NLP for Document Classification: Earnings Reports, Chatbots and Virtual Assistants in Banking, Reinforcement Learning for Portfolio Optimization.

UNIT IV: AI-Driven Financial Applications

Fraud Detection Systems using ML and DL, Credit Risk and Loan Default Prediction, AI in Algorithmic and High-Frequency Trading, Robo-Advisors: Architecture and Optimization, Blockchain and AI Integration for Financial Security, Case Studies: AI in Wealth Management & Insurance.

UNIT V: Ethics, Regulation, and Future of AI in Finance

Regulatory Frameworks in AI-based Finance, Explainability and Interpretability of Financial Models, Ethical Issues: Bias, Fairness, Transparency, Data Privacy and GDPR in Financial AI, Responsible AI Practices in Finance, Emerging Trends: Quantum AI, Decentralized Finance (DeFi).

Textbooks:

1. Yves Hilpisch, Artificial Intelligence in Finance: A Python-Based Guide, O'Reilly, 2020.
2. Yves Hilpisch, Python for Finance: Mastering Data-Driven Finance, O'Reilly, 2018.
3. Markus Loecher, Machine Learning for Finance, Packt Publishing, 2021.

Reference Books:

1. A. W. Lo, The Evolution of Technical Analysis, Wiley Finance, 2010.
2. Tony Guida, Big Data and Machine Learning in Quantitative Investment, Wiley, 2019.
3. Tucker Balch, AI for Trading – Georgia Tech Specialization, Coursera.

Online Learning Resources:

- Coursera: AI for Trading – by NYIF and Google Cloud
- edX: Artificial Intelligence in Finance – NYIF
- Udemy: Machine Learning and AI in Finance
- DataCamp: Financial Trading with Python
- YouTube: AI for Finance by Sentdex, Two Minute Papers, and DataProfessor

III B.Tech II Semester

23A306ET	**INTRODUCTION TO QUANTUM COMPUTING (Professional Elective-III)**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Objectives:

- To introduce the principles and mathematical foundations of quantum computation.
- To understand quantum gates, circuits, and computation models.
- To explore quantum algorithms and their advantages over classical ones.
- To develop the ability to simulate and write basic quantum programs.
- To understand real-world applications and the future of quantum computing in AI, cryptography, and optimization.

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

- Explain the fundamental concepts of quantum mechanics used in computing.
- Construct and analyze quantum circuits using standard gates.
- Apply quantum algorithms like Deutsch-Jozsa, Grover‘s, and Shor‘s.
- Develop simple quantum programs using Qiskit or similar platforms.
- Analyze applications and challenges of quantum computing in real-world domains.

UNIT I: Fundamentals of Quantum Mechanics and Linear Algebra

Classical vs Quantum Computation, Complex Numbers, Vectors, and Matrices, Hilbert Spaces and Dirac Notation, Quantum States and Qubits, Superposition and Measurement, Tensor Products and Multi-Qubit Systems.

UNIT II: Quantum Gates and Circuits

Quantum Logic Gates: Pauli, Hadamard, Phase, Controlled Gates and CNOT, Unitary Operations and Reversibility, Quantum Circuit Representation, Quantum Teleportation, Simulation of Quantum Circuits.

UNIT III: Quantum Algorithms and Complexity

Quantum Parallelism and Interference, Deutsch and Deutsch-Jozsa Algorithms, Grover‘s Search Algorithm, Shor‘s Factoring Algorithm, Quantum Fourier Transform, Complexity Classes: BQP, P, NP, and QMA.

UNIT IV: Quantum Programming and Simulation Platforms

Introduction to Qiskit and IBM Quantum Experience, Writing Quantum Circuits in Qiskit, Measuring Qubits and Results, Classical-Quantum Hybrid Programs, Noisy Intermediate-Scale Quantum (NISQ) Systems, Limitations and Current State of Quantum Hardware.

UNIT V: Applications and Future of Quantum Computing

Quantum Machine Learning: Basics and Models, Quantum Cryptography and Quantum Key Distribution, Quantum Algorithms in AI and Optimization, Quantum Advantage and Supremacy, Ethical and Societal Impact of Quantum Technologies, Future Trends and Research Directions.

Textbooks:

1. Michael A. Nielsen, Isaac L. Chuang, Quantum Computation and Quantum Information, Cambridge University Press, 10th Anniversary Edition, 2010.
2. Eleanor Rieffel and Wolfgang Polak, Quantum Computing: A Gentle Introduction, MIT Press, 2011.
3. Chris Bernhardt, Quantum Computing for Everyone, MIT Press, 2019.

Reference Books:

1. David McMahon, Quantum Computing Explained, Wiley, 2008.
2. Phillip Kaye, Raymond Laflamme, Michele Mosca, An Introduction to Quantum Computing, Oxford University Press, 2007.
3. Scott Aaronson, Quantum Computing Since Democritus, Cambridge University Press, 2013.

Online Learning Resources:

1. **IBM Quantum Experience and Qiskit Tutorials**
2. **Coursera – Quantum Mechanics and Quantum Computation by UC Berkeley**
3. edX – The Quantum Internet and Quantum Computers
4. **YouTube – Quantum Computing for the Determined by Michael Nielsen**
5. Qiskit Textbook – IBM Quantum

III B.Tech II Semester

23A306FT	**COMPUTER VISION (Professional Elective-III)**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Objectives:

The objective of this course is to understand the basic issues in computer vision and major approaches to address the methods to learn the Linear Filters, segmentation by clustering, Edge detection, Texture.

Course Outcomes:

After completing the course, you will be able to:

- Identify basic concepts, terminology, theories, models and methods in the field of computer vision,
- Describe known principles of human visual system,
- Describe basic methods of computer vision related to multi-scale representation, edge detection and detection of other primitives, stereo, motion and object recognition,
- Suggest a design of a computer vision system for a specific problem.

UNIT-I LINEAR FILTERS **Lecture 8Hrs**

Introduction to Computer Vision, Linear Filters and Convolution, Shift Invariant Linear Systems, Spatial Frequency and Fourier Transforms, Sampling and Aliasing Filters as Templates, Technique: Normalized Correlation and Finding Patterns, Technique: Scale and Image Pyramids.

UNIT-II EDGE DETECTION **Lecture 9Hrs**

Noise- Additive Stationary Gaussian Noise, Why Finite Differences Respond to Noise, Estimating Derivatives - Derivative of Gaussian Filters, Why Smoothing Helps, Choosing a Smoothing Filter, Why Smooth with a Gaussian? Detecting Edges-Using the Laplacian to Detect Edges, Gradient-Based Edge Detectors, Technique: Orientation Representations and Corners.

UNIT-III TEXTURE **Lecture 9Hrs**

Representing Texture –Extracting Image Structure with Filter Banks, Representing Texture using the Statistics of Filter Outputs, Analysis (and Synthesis) Using Oriented Pyramids –The Laplacian Pyramid, Filters in the Spatial Frequency Domain, Oriented Pyramids, Application: Synthesizing Textures for Rendering, Homogeneity, Synthesis by Sampling Local Models, Shape from Texture, Shape from Texture for Planes.

UNIT-IV SEGMENTATION BY CLUSTERING **Lecture 8Hrs**

What is Segmentation, Human Vision: Grouping and Gestalt, Applications: Shot Boundary Detection and Background Subtraction. Image Segmentation by Clustering Pixels, Segmentation by Graph-Theoretic Clustering. The Hough Transform, Fitting Lines, Fitting Curves

UNIT-V RECOGNIZATION BY RELATIONS BETWEEN TEMPLATES **Lecture 8Hrs**

Finding Objects by Voting on Relations between Templates, Relational Reasoning Using Probabilistic Models and Search, Using Classifiers to Prune Search, Hidden Markov Models, Application: HMM and Sign Language Understanding, Finding People with HMM.

Text books:

1. David A. Forsyth, Jean Ponce, Computer Vision – A modern Approach, PHI, 2003.

Reference Books:

1. Geometric Computing with Clifford Algebras: Theoretical Foundations and Applications in Computer Vision and Robotics, Springer;1 edition,2001by Sommer.
2. Digital Image Processing and Computer Vision,1/e, by Sonka.

3. Computer Vision and Applications: Concise Edition (With CD) by Jack Academy Press, 2000.

Online Learning Resources:

https://nptel.ac.in/courses/106105216https://nptel.ac.in/courses/108103174

III B.Tech II Semester

23A306GT	**CLOUD COMPUTING FOR AI (Professional Elective-III)**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Objectives:

1. To introduce the concepts, models, and services of cloud computing and its role in AI.
2. To explore the architecture and deployment of AI applications on cloud platforms.
3. To equip students with skills in using cloud-based tools and services for AI/ML workloads.
4. To understand data storage, processing, and security in cloud for AI tasks.
5. To apply cloud computing principles to real-world AI-based solutions.

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

1. Explain cloud computing architecture, services, and deployment models.
2. Utilize cloud platforms (AWS, GCP, Azure) for training and deploying AI models.
3. Handle large-scale data storage and processing in the cloud environment.
4. Integrate AI workflows using serverless and container-based architectures.
5. Analyze challenges in security, cost, scalability, and performance of cloud-based AI systems.

UNIT I: Introduction to Cloud Computing and AI Integration
Basics of Cloud Computing: Characteristics, Models, and Services, Cloud Service Models: IaaS, PaaS, SaaS, Deployment Models: Public, Private, Hybrid, Community, AI and Cloud Convergence: Benefits and Challenges, Use Cases of AI in Cloud: NLP, Vision, Analytics, Overview of Cloud Providers for AI: AWS, Azure, GCP.

UNIT II: Storage, Computing, and Data Processing in the Cloud
Cloud Storage Services: S3, Blob, BigQuery, Virtualization and Elastic Computing, Distributed Computing with Hadoop and Spark, Data Ingestion and Processing Pipelines, Data Lakes and Warehousing in the Cloud, Cost Optimization for Storage and Compute Resources.

UNIT III: Cloud-based Machine Learning and Deep Learning
ML Services on AWS (SageMaker), Azure ML, GCP Vertex AI, Training and Deploying Models on Cloud, AutoML and Custom ML Model Workflows, GPUs/TPUs for Model Training, Experiment Tracking and Model Evaluation, Integration of Notebooks (Jupyter, Colab) with Cloud Storage.

UNIT IV: Advanced Cloud Concepts for AI Applications
Containers and Docker for AI Applications, Kubernetes and Cloud-native AI Workflows, Serverless Computing: AWS Lambda, Azure Functions, CI/CD Pipelines for AI Models in Cloud, Scaling AI Applications using Load Balancers and Auto-Scaling. Monitoring and Logging in Cloud for AI Workflows.

UNIT V: Security, Ethics, and Case Studies in Cloud AI
Security and Privacy in Cloud-based AI, Identity and Access Management (IAM) in Cloud, Cost Management and Billing for AI Services, Ethical Issues and Fairness in Cloud AI, Case Study: AI in Healthcare Cloud Solutions, Case Study: Real-Time Analytics in Financial Cloud Services.

Textbooks:

1. Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi, Mastering Cloud Computing, McGraw-Hill.
2. Judith Hurwitz et al., Cloud Computing for Dummies, Wiley.
3. Aurélien Géron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, O'Reilly.

Reference Books:

1. Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, Distributed and Cloud Computing, Morgan Kaufmann.
2. Tomasz Kajdanowicz et al., Practical Cloud AI, Springer.
3. Mark Wilkins, AI and Machine Learning for Coders in Cloud, Packt Publishing.

Online Learning Resources:

1. AWS Cloud Practitioner & Machine Learning Path – AWS Training
2. Google Cloud AI and ML Specialization – Coursera
3. Microsoft Azure AI Engineer Associate – Learn Portal

III B.Tech II Semester

23A306HT	**SOCIAL NETWORK ANALYSIS (Professional Elective-III)**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Objectives:

- To introduce the fundamentals and key concepts of social network theory and graph theory.
- To analyze the structure and properties of large-scale social networks.
- To apply centrality, influence, and community detection measures.
- To model information diffusion and network dynamics.
- To implement real-world social network analysis using tools and datasets.

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

- Understand basic network models and social network structures.
- Analyze key properties like centrality, clustering, and small-world effect.
- Apply community detection algorithms and influence maximization.
- Interpret diffusion models for viral marketing and information spread.
- Use tools such as Gephi, NetworkX, or SNAP for real-world SNA.

UNIT I: Introduction to Social Networks and Graph Theory
Basic Concepts: Graphs, Nodes, Edges, Directed/Undirected Graphs, Real-world Examples: Facebook, Twitter, LinkedIn, Adjacency Matrix and Graph Representation, Types of Social Networks: Ego, Bipartite, Multilayer, Degree Distribution, Path Length, and Connectivity, Random Graph Models: Erdős–Rényi and Watts-Strogatz.

UNIT II: Structural Properties of Networks
Network Centrality Measures: Degree, Closeness, Betweenness, Eigenvector Centrality and PageRank, Network Clustering and Community Detection Basics, Triadic Closure and Clustering Coefficient, Small-world Phenomenon and Milgram‘s Experiment, Homophily, Influence, and Structural Balance.

UNIT III: Community Detection and Subgroup Analysis
Girvan–Newman Algorithm and Modularity, Label Propagation and Louvain Method, Clique Detection and k-Core Decomposition, Overlapping Communities and Fuzzy Clustering, Cohesive Subgroups and Structural Equivalence, Evaluation Metrics: NMI, Modularity Score.

UNIT IV: Information Diffusion and Influence in Networks
Models of Diffusion: Linear Threshold and Independent Cascade, Influence Maximization and Viral Marketing, Contagion Models and Epidemic Spreading, Rumor Propagation and Cascade Models, Information Bottlenecks and Bridges, Measuring Influence and Reach.

UNIT V: Tools, Applications, and Ethics in SNA
SNA Tools: Gephi, Pajek, NetworkX, SNAP, Case Study: Twitter and Hashtag Analysis, LinkedIn Network Mining and Graph Features, Applications in Marketing, Security, and Epidemiology, Ethical Issues in Social Network Data Mining, Building and Visualizing Your Own Social Graph.

Textbooks:

1. Wasserman, S., & Faust, K., **Social Network Analysis: Methods and Applications**, Cambridge University Press, 1994.
2. Easley, D., & Kleinberg, J., **Networks, Crowds, and Markets: Reasoning About a Highly Connected World**, Cambridge University Press, 2010.
3. Newman, M., **Networks: An Introduction**, Oxford University Press, 2010.

Reference Books:

1. Borgatti, S. P., Everett, M. G., & Johnson, J. C., **Analyzing Social Networks**, SAGE Publications, 2018.
2. Barabási, A.-L., **Linked: How Everything Is Connected to Everything Else**, Basic Books, 2014.
3. Hansen, D., Shneiderman, B., & Smith, M. A., **Analyzing Social Media Networks with NodeXL**, Elsevier, 2020.

Online Learning Resources:

- Coursera – Social Network Analysis (University of Michigan)
- [YouTube – NetworkX and Gephi Tutorials (freeCodeCamp, TheNetNinja)]
- edX – Networks: Friends, Money, and Bytes (University of California, Berkeley)
- Khan Academy – Graph Theory

III B.Tech II Semester

23A3062L	**DEEP LEARNING LAB (Professional Core)**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Objective:
To provide hands-on experience in building, training, and evaluating deep learning models using popular frameworks such as TensorFlow and PyTorch. Students will implement neural networks, understand hyperparameter tuning, and explore deep learning architectures for real-world applications.

List of Experiments

1. Implement a basic Perceptron using Python and classify binary data.
2. Build and train a Multilayer Perceptron (MLP) using TensorFlow/Keras on the MNIST dataset.
3. Experiment with different activation functions (ReLU, sigmoid, tanh) and observe effects on learning.
4. Compare optimizers (SGD, Adam, RMSprop) on convergence and performance.
5. Implement Convolutional Neural Networks (CNN) for image classification on CIFAR-10 dataset.
6. Perform data augmentation techniques and evaluate improvements in model accuracy.
7. Implement Recurrent Neural Networks (RNN) and LSTMs for sentiment analysis on IMDB dataset.
8. Train a GAN (Generative Adversarial Network) to generate handwritten digits.
9. Use Transfer Learning (e.g., ResNet, VGG) for fine-tuning on a custom dataset.
10. Evaluate model using metrics such as precision, recall, F1-score, ROC curves.
11. Deploy a trained deep learning model using Flask or Streamlit for web-based inference.
12. Case Study: Develop an end-to-end solution (e.g., face mask detector, plant disease detection).

Textbooks

1. Ian Goodfellow, Yoshua Bengio, and Aaron Courville, **Deep Learning**, MIT Press, 2016.
2. François Chollet, **Deep Learning with Python**, Manning Publications, 2nd Edition, 2021.
3. Aurélien Géron, **Hands-On Machine Learning with Scikit-Learn, Keras & TensorFlow**, O'Reilly, 3rd Edition, 2022.

Reference Books

1. Nikhil Buduma, **Fundamentals of Deep Learning**, O'Reilly Media, 2017.
2. Josh Patterson and Adam Gibson, **Deep Learning: A Practitioner's Approach**, O'Reilly, 2017.
3. Michael Nielsen, **Neural Networks and Deep Learning** (Online Book).

III B.Tech II Semester

23A3064L	**BIG DATA ANALYTICS & DATA VISUALIZATION LAB (Professional Core)**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Objectives:

- To introduce foundational tools and platforms in big data analytics.
- To apply programming skills in Hadoop and Spark for processing big datasets.
- To build visualization pipelines using Python libraries and BI tools.
- To analyze and interpret data insights visually and statistically.
- To implement predictive modeling and visual communication of outcomes.

Course Outcomes (COs):

- CO1: Understand big data ecosystems and tools.
- CO2: Execute data analysis tasks using Hadoop and Spark.
- CO3: Perform data visualization using Python and BI platforms.
- CO4: Analyze patterns, trends, and correlations in large datasets.
- CO5: Create dashboards and interactive visual insights.

List of Experiments

1. Installation of Hadoop ecosystem and execution of basic HDFS commands
2. Word Count and File Processing using Hadoop MapReduce
3. Working with Hive: Table creation, loading data, and performing analytical queries
4. Data cleaning and transformation using PySpark DataFrames
5. Implementing MLlib algorithms (e.g., Classification/Clustering) on Spark
6. Connecting Spark with MongoDB/Cassandra for NoSQL-based Big Data processing
7. Visualizing data using Matplotlib and Seaborn for univariate and bivariate analysis
8. Creating interactive plots using Plotly and Dash
9. Exploratory Data Analysis (EDA) and feature analysis with Pandas and Seaborn
10. Real-time data ingestion (Twitter API or sensor data) and live visualization with Kafka + Spark Streaming
11. Developing a dashboard using Tableau/Power BI for insights from processed Big Data
12. Mini Project: End-to-end pipeline integrating Big Data processing and visualization using any real dataset

Tools/Software Required:

1. Hadoop, Hive, Spark (PySpark)
2. Python (Pandas, NumPy, Seaborn, Matplotlib, Plotly, Dash)
3. NoSQL: MongoDB / Cassandra
4. Tableau, Power BI, or Google Data Studio
5. Jupyter Notebooks, Anaconda
6. Kafka / Twitter API (for streaming)

III B.Tech II Semester

23AHS65L	**SOFT SKILLS (Common to All Branches of Engineering)**	**L**	**T**	**P**	**C**
		0	**1**	**2**	**2**

Course Objectives:

- To encourage all round development of the students by focusing on soft skills
- To make the students aware of critical thinking and problem-solving skills
- To enhance healthy relationship and understanding within and outside an organization
- To function effectively with heterogeneous teams

Course Outcomes (CO):

COs	**Statements**	**Blooms level**
CO1	List out various elements of soft skills	L1, L2,
CO2	cribe methods for building professional image	L1, L2
CO3	Apply critical thinking skills in problem solving	L3
CO4	Analyse the needs of an individual and team for well-being	L4
CO5	Assess the situation and take necessary decisions	L5
CO6	Create a productive work place atmosphere using social and work-life skills ensuring personal and emotional well-being	L6

SYLLABUS

UNIT – I	**Soft Skills & Communication Skills**	Lecture Hrs

Soft Skills - Introduction, Need - Mastering Techniques of Soft Skills – Communication Skills - Significance, process, types - Barriers of communication - Improving techniques

Activities:

Intrapersonal Skills- Narration about self- strengths and weaknesses- clarity of thought – self-expression – articulating with felicity

(The facilitator can guide the participants before the activity citing examples from the lives of the great, anecdotes and literary sources)

Interpersonal Skills- Group Discussion – Debate – Team Tasks - Book and film Reviews by groups - Group leader presenting views (non- controversial and secular) on contemporary issues or on a given topic.

Verbal Communication- Oral Presentations- Extempore- brief addresses and speeches- convincing- negotiating- agreeing and disagreeing with professional grace.

Non-verbal communication – Public speaking – Mock interviews – presentations with an objective to identify non- verbal clues and remedy the lapses on observation

UNIT – II	**Critical Thinking**	Lecture Hrs

Active Listening – Observation – Curiosity – Introspection – Analytical Thinking – Open-mindedness – Creative Thinking - Positive thinking – Reflection

Activities:

Gathering information and statistics on a topic - sequencing – assorting – reasoning – critiquing issues – placing the problem – finding the root cause - seeking viable solution – judging with rationale – evaluating the views of others - Case Study, Story Analysis

UNIT – III	**Problem Solving & Decision Making**	Lecture Hrs

Meaning & features of Problem Solving – Managing Conflict – Conflict resolution –

Team building - Effective decision making in teams – Methods & Styles

Activities:

Placing a problem which involves conflict of interests, choice and views – formulating the problem – exploring solutions by proper reasoning – Discussion on important professional, career and organizational decisions and initiate debate on the appropriateness of the decision.

Case Study & Group Discussion

UNIT – IV	**Emotional Intelligence & Stress Management**	Lecture Hrs

Managing Emotions – Thinking before Reacting – Empathy for Others – Self-awareness – Self-Regulation – Stress factors – Controlling Stress – Tips

Activities:

Providing situations for the participants to express emotions such as happiness, enthusiasm, gratitude, sympathy, and confidence, compassion in the form of written or oral presentations.

Providing opportunities for the participants to narrate certain crisis and stress –ridden situations caused by failure, anger, jealousy, resentment and frustration in the form of written and oral presentation, Organizing Debates

UNIT – V	**Corporate Etiquette**	Lecture Hrs

Etiquette- Introduction, concept, significance - Corporate etiquette - meaning, modern etiquette, benefits - Global and local culture sensitivity - Gender Sensitivity - Etiquette in interaction- Cell phone etiquette - Dining etiquette - Netiquette - Job interview etiquette -Corporate grooming tips - Overcoming challenges

Activities

Providing situations to take part in the Role Plays where the students will learn about bad and good manners and etiquette - Group Activities to showcase gender sensitivity, dining etiquette etc. - Conducting mock job interviews - Case Study - Business Etiquette Games

NOTE-:

1. The facilitator can guide the participants before the activity citing examples from the lives of the great, anecdotes, epics, scriptures, autobiographies and literary sources which bear true relevance to the prescribed skill.

2. Case studies may be given wherever feasible for example for Decision Making- The decision of King Lear.

Prescribed Books:

1. Mitra Barun K, *Personality Development and Soft Skills*, Oxford University Press, Pap/Cdr edition 2012
2. Dr Shikha Kapoor, *Personality Development and Soft Skills: Preparing for Tomorrow,* K I 2018 ,esuoH gnihsilbuP lanoitanretnI

Reference Books

1. Sharma, Prashant, *Soft Skills: Personality Development for Life Success*, BPB Publications 2018.

2. Alex K,*Soft Skills*S.Chand& Co, 2012 (Revised edition)

3. Gajendra Singh Chauhan& Sangeetha Sharma,*Soft Skills: An Integrated Approach to Maximise Personality*Published by Wiley, 2013

4. Pillai, Sabina & Fernandez Agna, *Soft Skills and Employability Skills,* Cambridge University Press, 2018

5. Dr. Rajiv Kumar Jain, Dr. Usha Jain,*Life Skills*(Paperback English)Publisher : Vayu Education of India, 2014

Online Learning Resources:

1. **https://youtu.be/DUlsNJtg2L8?list=PLLy_2iUCG87CQhELCytvXh0E_y-bOO1_q**
2. **https://youtu.be/xBaLgJZ0t6A?list=PLzf4HHlsQFwJZel_j2PUy0pwjVUgj7KlJ**
3. **https://youtu.be/-Y-R9hDl7lU**
4. **https://youtu.be/gkLsn4ddmTs**
5. **https://youtu.be/2bf9K2rRWwo**
6. **https://youtu.be/FchfE3c2jzc**
7. **https://www.businesstrainingworks.com/training-resource/five-free-business-etiquette-training-games/**
8. **https://onlinecourses.nptel.ac.in/noc24_hs15/preview**
9. **https://onlinecourses.nptel.ac.in/noc21_hs76/preview**

III B.Tech II Semester

		L	T	P	C
23AHS67T	**TECHNICAL REPORT WRITING & IPR**	**2**	**0**	**0**	**0**

Course Objectives:

1. To enable the students to practice the basic skills of research paper writing
2. To make the students understand the importance of IP and to educate them on the basic concepts of Intellectual Property Rights.
3. To practice the basic skills of performing quality literature review
4. To help them in knowing the significance of real life practice and procedure of Patents.
5. To enable them learn the procedure of obtaining Patents, Copyrights, & Trade Marks

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

COURSE OUTCOMES: At the end of the course, students will be able to		**Blooms Level**
CO1	Identify key secondary literature related to their proposed technical paper writing	L1, L2
CO2	Explain various principles and styles in technical writing	L1, L2
CO3	Use the acquired knowledge in writing a research/technical paper	L3
CO4	Analyse rights and responsibilities of holder of Patent, Copyright, Trademark, International Trademark etc.	L4
CO5	Evaluate different forms of IPR available at national & international level	L5
CO6	Develop skill of making search of various forms of IPR by using modern tools and techniques.	L3, L6

UNIT – I:

Principles of Technical Writing: styles in technical writing; clarity, precision, coherence andlogical sequence in writing-avoiding ambiguity- repetition, and vague language -highlighting your findings-discussing your limitations -hedging and criticizing -plagiarism and paraphrasing .

UNIT – II:

Technical Research Paper Writing: Abstract- Objectives-Limitations-Review of Literature-Problemsand Framing Research Questions- Synopsis

UNUNIT – III:

Process of research: publication mechanism: types of journals- indexing-seminars-conferences- proof reading –plagiarism style; seminar & conference paper writing;Methodology-discussion-results-citation rules.

UNIT – IV:

Introduction to Intellectual property: Introduction, types of intellectual property, International organizations, agencies and treaties, importance of intellectual property rights

Trade Marks: Purpose and function of trademarks, acquisition of trade mark rights, protectable matter, selecting and evaluating trade mark, trade mark registration processes.

UNIT – V:

Law of copy rights: Fundamentals of copy right law, originality of material, rights of reproduction, rights to perform the work publicly, copy right ownership issues, copy right registration, notice of copy right, international copy right law

Law of patents: Foundation of patent law, patent searching process, ownership rights and transfer.Patent law, intellectual property audits.

Textbooks:

1. Deborah. E. Bouchoux, Intellectual Property Rights, Cengage Learning India, 2013
2. Meenakshi Raman, Sangeeta Sharma. Technical Communication:Principles and practices.Oxford.

Reference Books:

1. R.Myneni, Law of Intellectual Property, 9th Ed, Asia law House, 2019.
2. Prabuddha Ganguli,Intellectual Property Rights Tata Mcgraw Hill, 2001
3. P.Naryan,Intellectual Property Law, 3rd Ed ,Eastern Law House, 2007.
4. Adrian Wallwork. English for Writing Research PapersSecond Edition. Springer Cham Heidelberg New York ,2016
5. Dan Jones, Sam Dragga, Technical Writing Style

Online Resources

1. **https://theconceptwriters.com.pk/principles-of-technical-writing/**
2. **https://www.ewh.ieee.org/soc/emcs/acstrial/newsletters/summer10/TechPaperWriting.html**
3. **https://www.ewh.ieee.org/soc/emcs/acstrial/newsletters/summer10/TechPaperWriting.html**
4. **https://www.manuscriptedit.com/scholar-hangout/process-publishing-research-paper-journal/**
5. **https://www.icsi.edu/media/website/IntellectualPropertyRightLaws&Practice.pdf**
6. **https://lawbhoomi.com/intellectual-property-rights-notes/**
7. **https://www.extension.purdue.edu/extmedia/ec/ec-723.pdf**

IV B.Tech I Semester

23A30701	**GENERATIVE AI (Professional Core)**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Objectives

- Introduce the fundamentals of Generative AI, including its principles, architecture, and evolution.
- Provide a deep understanding of Large Language Models (LLMs) and their application in natural language generation tasks.
- Develop practical knowledge of Prompt Engineering, including prompt tuning, prompt design, and performance evaluation.
- Explore applications of Generative AI across various domains including code generation, art synthesis, content generation, and interactive systems.
- Equip students with ethical, social, and safety considerations when designing and deploying generative AI applications.

Course Outcomes

- Demonstrate a strong understanding of the architecture and functioning of Generative AI models, including transformers and LLMs.
- Be capable of applying prompt engineering techniques to steer model behavior for desired outputs across various tasks.
- Design and fine-tune generative models for applications such as text generation, image creation, music synthesis, and conversational AI.
- Analyze and evaluate the effectiveness of prompts and generated content, using relevant metrics and methodologies.
- Apply ethical principles to ensure responsible development and deployment of generative AI systems.

UNIT I – Introduction to Generative AI(Cognitive Level: Understand, Remember)

Overview of AI and types of AI, What is Generative AI? Definitions and Concepts, Historical evolution of generative models, Types of generative models – GANs, VAEs, Autoregressive Models, Introduction to Transformers and LLMs, Applications and use cases of Generative AI, Challenges in Generative AI development, Introduction to text-to-image and image-to-text models.

UNIT II – Fundamentals of Prompt Engineering

Definition and significance of Prompt Engineering, Types of prompts: Zero-shot, One-shot, Few-shot, Techniques for effective prompt design, Prompt templates and chaining, Prompt tuning and parameter-efficient tuning, Evaluating prompt performance, Use of APIs for testing prompts (OpenAI, Cohere, Anthropic), Best practices and prompt libraries.

UNIT III – Working with Large Language Models (LLMs)

Overview of pre-trained LLMs: GPT, BERT, LLaMA, Claude, PaLM, Architectures and tokenization strategies, Fine-tuning vs. in-context learning, LLM-powered tools (ChatGPT, GitHub Copilot, Bard, Claude), Role of attention mechanism and transformer layers, Tools for model experimentation (Hugging Face, LangChain), Performance metrics for LLMs, Case studies of model adaptation and deployment.

UNIT IV – Applications of Generative AI
Text generation and summarization, Image and art generation (DALL·E, Midjourney, Stable Diffusion), Code generation and completion tools (Codex, Copilot), Music and video generation, Generative chatbots and customer service, Story generation and dialogue systems, Domain-specific applications (Legal, Healthcare, Education), Comparative study of generative models by task.

UNIT V – Ethics, Security & Responsible AI
Bias and fairness in LLMs and generative systems, Explainability and transparency in generative AI, Copyright and originality issues, Adversarial use of generative models – deepfakes, misinformation, AI safety protocols and red-teaming, Regulatory and policy frameworks for generative AI, Responsible prompt crafting and moderation.

Textbooks

1. **Deep Learning with Python** by François Chollet, Manning Publications
2. **Transformers for Natural Language Processing** by Denis Rothman, Packt
3. **Practical Generative AI** by Amit Shukla, BPB Publications

Reference Books

1. **Generative Deep Learning** by David Foster, O'Reilly
2. **Artificial Intelligence: A Guide for Thinking Humans** by Melanie Mitchell
3. **Machine Learning B.Techning** by Andrew Ng (available online)

Online Courses

1. Generative AI with Large Language Models – Coursera (AWS & DeepLearning.AI)
2. Prompt Engineering for ChatGPT – Coursera
3. Generative AI Fundamentals – Google Cloud Training

IV B.Tech I Semester

		L	T	P	C
23A52701a	**BUSINESS ETHICS AND CORPORATE GOVERNANCE Management Course- II**	**2**	**0**	**0**	**2**

COURSE OBJECTIVES : The objectives of this course are	
1	To make the student understand the principles of business ethics
2	To enable them in knowing about the ethics in management
3	To facilitate the student‘ role in corporate culture
4	To impart knowledge about the fair-trade practices
5	To encourage the student in knowing about the corporate governance

UNIT-I: Ethics

Introduction – Meaning – Nature, Scope, significance, Loyalty, and ethical behavior.. Value systems - Business Ethics - Types, Characteristics, Factors, Contradictions and Ethical Practices in Management -Corporate Social Responsibility – Issues of Management – Crisis Management.

LEARNING OUTCOMES:- After completion of this unit student will
- Understand the meaning of loyalty and ethical Behavior
- Explain various types of Ethics
- Analyze issues & crisis of management.

UNIT-II: ETHICS IN MANAGEMENT

Introduction- Ethics in production, finance, Human resource management and Marketing Management - The Ethical Value System – Universalism, Utilitarianism, Distributive Justice, Social Contracts, Individual Freedom of Choice, Professional Codes; Culture and Ethics – Ethical Values in different Cultures - Culture and Individual Ethics – professional ethics and technical ethics.

LEARNING OUTCOMES:- After completion of this unit student will
- Understand the meaning of Ethics in various areas of management
- Compare and contrast professional ethics and technical ethics
- Develop ethical values in self and organization

UNIT-III : CORPORATE CULTURE

Introduction - Meaning, definition, Nature, and significance – Key elements of corporate culture, shared values, beliefs and norms, rituals, symbols and language - Types of corporate culture, hierarchical culture, market driven culture – Organization leadership and corporate culture, leadership styles and their impact on culture, transformational leadership and culture change.

LEARNING OUTCOMES:- After completion of this unit student will
- Define corporate culture
- Understand the key elements of corporate culture
- Analyze organization leadership and corporate culture

UNIT- IV: LEGAL FRAME WORK

Law and Ethics -Agencies enforcing Ethical Business Behavior - Legal Impact – Environmental Protection, Fair Trade Practices, legal Compliances, Safeguarding Health and wellbeing of Customers – Corporate law, Securities and financial regulations, corporate governance codes and principles.

LEARNING OUTCOMES:- After completion of this unit student will

- Understand Law and Ethics
- Analyze Different fair trade practices
- Make use of Environmental Protection and Fair Trade Practices

UNIT -V: CORPORATE GOVERNANCE

Introduction - Meaning – Corporate governance code, transparency & disclosure -Role of auditors, board of directors and shareholders. Global issues, accounting and regulatory frame work - Corporate scams - Committees in India and abroad, corporate social responsibility. BoDs composition, Cadbury Committee - Various committees - Reports - Benefits and Limitations.

LEARNING OUTCOMES:- After completion of this unit student will

- Understand corporate governance code
- Analyze role of auditors, board of directors and shareholders in corporate governance
- Implementing corporate social responsibility in India.

Text books.

1. Murthy CSV: Business Ethics and Corporate Governance, HPH July 2017

2. Bholananth Dutta, S.K. Podder – Corporation Governance, VBH. June 2010

Reference books

1. Dr. K. Nirmala, KarunakaraReaddy. *Business Ethics and Corporate Governance*, HPH

2. H.R.Machiraju: *Corporate Governance*, HPH, 2013

3. K. Venkataramana, *Corporate Governance*, SHBP.

4. N.M.Khandelwal. *Indian Ethos and Values for Managers*

COURSE OUTCOMES: At the end of the course, students will be able to		**BTL**
CO1	Understand the Ethics and different types of Ethics.	L2
CO2	Understand business ethics and ethical practices in management	L2
CO3	Understand the role of ethics in management	L2
CO4	Apply the knowledge of professional ethics & technical ethics	L3
CO5	Analyze corporate law, ethics, codes & principles	L4
CO6	Evaluate corporate governance & corporate scams	L5

BTL = Bloom‘s Taxonomy Level

ONLINE RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc21_mg46/
2. https://archive.nptel.ac.in/courses/110/105/110105138/
3. https://onlinecourses.nptel.ac.in/noc21_mg54/
4. https://onlinecourses.nptel.ac.in/noc22_mg54/
5. https://archive.nptel.ac.in/courses/109/106/109106117/

IV B.Tech I Semester

23A52701b	E-BUSINESS Management Course- II	L	T	P	C
		2	0	0	2

Course Objectives: The Objectives of this course are	
1	To provide knowledge on emerging concept on E-Business related aspect.
2	To understand various electronic markets & business models.
3	To impart the information about electronic payment systems & banking.
4	To create awareness on security risks and challenges in E-commerce.
5	To the students aware on different e-marketing channels & strategies.

Unit-I: Electronic Business

Introduction – Nature, meaning, significance, functions and advantages - Definition of Electronic Business - Functions of Electronic Commerce (EC)-Advantages & Disadvantages of E-Commerce – E-Commerce and E-Business, Internet Services, Online Shopping- E-Commerce Opportunities for Industries.

Learning Outcomes: -After completion of this unit student

- Understand the concept of E-Business
- Contrast and compare E-Commerce & E-Business
- Evaluate opportunities of E-commerce for industry

Unit-II: Electronic Markets and Business Models

Introduction –E-Shops-E-Malls E-Groceries - Portals - Vertical Portals-Horizontal Portals - Advantages of Portals -Business Models- Business to Business (B2B)-Business to Customers(B2C) - Business to Government(B2G)-Auctions-B2B Portals in India

Learning Outcomes: -After completion of this unit student will

- Understand the concept of business models
- Contrast and compare Vertical portal and Horizontal portals
- Analyze the B2B,B2C and B2G model

Unit-III: Electronic Payment Systems:

Introduction to electronic payment systems (EPS) -Types of electronic payments - Credit/debit cards, e-wallets, UPI, and crypto currencies -Smart cards and digital wallets: Features and usage -Electronic Fund Transfer (EFT): Role in business transactions -Infrastructure requirements and regulatory aspects of e-payments

Learning Outcomes: -After completion of this unit student will

- Understand the Electronic payment system
- Contrast and compare EFT and smart cards
- Analyze debit card and credit cards

Unit-IV:E-Security

Security risks and challenges in electronic commerce - Cyber threats - Phishing, hacking, identity theft, and malware - Digital Signatures & Certificates - Security protocols over public networks (HTTP, SSL, TLS) -Firewalls in securing e-business platforms.

Learning Outcomes: -After completion of this unit student will

- Understand E-Security
- Contrast and compare security protocols and public network
- Evaluate on Digital signature

Unit-V:E-Marketing:

Introduction – Online Marketing – Advantages of Online Marketing – Internet Advertisement – Advertisement Methods – Conducting Online Market Research– – E-marketing planning: Online branding, social media marketing, and email marketing - E-business strategies: Digital advertising, content marketing, and analytics – E-Customer Relationship Management (eCRM) E-supply chain management (e-SCM)

Learning Outcomes: -After completion of this unit student will

- Understand the concept of online marketing
- Apply the knowledge of online marketing
- Compare e-CRM and e-SCM

Text Books:

1. Arati Oturkar&Sunil Khilari. *E-Business*. Everest Publishing House, 2022
2. P.T.S Joseph. *E-Commerce*, Fourth Edition, Prentice Hall of India, 2011

References:

1. Debjani, Kamalesh K Bajaj. E-Commerce, Second Edition Tata McGraw-Hill‘s, 2005
2. Dave Chaffey.E-Commerce E-Management, Second Edition, Pearson, 2012.
3. Henry Chan. E-Commerce Fundamentals and Application, RaymondLeathamWiley India 2007
4. S. Jaiswal. E-Commerce GalgotiaPublication Pvt Ltd., 2003.

COURSE OUTCOMES: At the end of the course student will be able to		**BTL**
CO1	Remember E-Business & its nature, scope and functions.	L1
CO2	Understand E-market-Models which are practicing by the organizations	L2
CO3	Apply the concepts of E-Commerce in the present globalized world.	L3
CO4	Analyze the various E-payment systems & importance of net banking.	L4
CO5	Evaluate market research strategies & E-advertisements.	L5
CO6	Understand importance of E-security & control	L2

BTL = Bloom‘s Taxonomy Level

Online Resources:

https://www.slideshare.net/fatimahAlkreem/e-businessppt-67935771

https://www.slideshare.net/VikramNani/e-commerce-business-models

https://www.slideshare.net/RiteshGoyal/electronic-payment-system

https://www.slideshare.net/WelingkarDLP/electronic-security

https://www.slideshare.net/Ankitha2404/emarketing-ppt

IV B.Tech I Semester

23A52701C	MANAGEMENT SCIENCE Management Course- II	L	T	P	C
		2	0	0	2

COURSE OBJECTIVES : The objectives of this course are	
1	To provide fundamental knowledge on Management, Administration, Organization & its concepts.
2	To make the students understand the role of management in Production
3	To impart the concept of HRM in order to have an idea on Recruitment, Selection, Training & Development, job evaluation and Merit rating concepts
4	To create awareness on identify Strategic Management areas & the PERT/CPM for better Project Management
5	To make the students aware of the contemporary issues in modern management

UNIT- IINTRODUCTION TO MANAGEMENT

Management - Concept and meaning - Nature-Functions - Management as a Science and Art and both. Schools of Management Thought - Taylor‘s Scientific Theory-Henry Fayol‘s principles - Elton Mayo‘s Human relations - **Organizational Designs** - Line organization - Line & Staff Organization - Functional Organization - Matrix Organization - Project Organization - Committee form of Organization - Social responsibilities of Management.

LEARNING OUTCOMES: At the end of the Unit, the students will be able to

- Understand the concept of management and organization
- Apply the concepts & principles of management in real life industry.
- Analyze the organization chart & structure of an enterprise.

UNIT - II OPERATIONS MANAGEMENT

Principles and Types of Plant Layout - Methods of Production (Job, batch and Mass Production), Work Study - Statistical Quality Control- **Material Management -** Objectives - Inventory-Functions - Types, Inventory Techniques - EOQ-ABC Analysis - **Marketing Management -** Concept - Meaning - Nature-Functions of Marketing - Marketing Mix - Channels of Distribution - Advertisement and Sales Promotion - Marketing Strategies based on Product Life Cycle.

LEARNING OUTCOMES: At the end of the Unit, the students will be able to

- Understand the core concepts of Operations Management
- Apply the knowledge of Quality Control, Work-study principles in real life industry.
- Evaluate Materials departments & Determine EOQ
- Analyze Marketing Mix Strategies for an enterprise.
- Create and design advertising and sales promotion

UNIT - IIIHUMAN RESOURCES MANAGEMENT (HRM)

HRM - Definition and Meaning – Nature - Managerial and Operative functions - Job Analysis - Human Resource Planning(HRP) - Employee Recruitment-Sources of Recruitment - Employee Selection - Process - Employee Training and Development - methods - Performance Appraisal Concept - Methods of Performance Appraisal – Placement - Employee Induction - Wage and Salary Administration.

LEARNING OUTCOMES: At the end if the Unit, the students will be able to

- Understand the concepts of HRM, Recruitment, Selection, Training & Development
- Analyze the need of training
- Evaluate performance appraisal
- Design the basic structure of salaries and wages

UNIT - IV STRATEGIC & PROJECT MANAGEMENT

Definition& Meaning - Setting of Vision - Mission - Goals - Corporate Planning Process - Environmental Scanning - Steps in Strategy Formulation and Implementation - SWOT Analysis - **Project Management -** Network Analysis - Programme Evaluation and Review Technique (PERT) - Critical Path Method (CPM) Identifying Critical Path - Probability of Completing the project within given time - Project Cost- Analysis - Project Crashing (Simple problems).

LEARNING OUTCOMES: At the end of the Unit, the students will be able to

- Understand Mission, Objectives, Goals & strategies for an enterprise
- Apply SWOT Analysis to strengthen the project
- Analyze Strategy formulation and implementation
- Evaluate PERT and CPM Techniques

UNIT - V CONTEMPORARY ISSUES IN MANAGEMENT

Customer Relations Management(CRM) - Total Quality Management (TQM) - Six Sigma Concept - Supply Chain Management(SCM) - Enterprise Resource Planning (ERP) - Performance Management – employee engagement and retention - Business Process Re-engineering and Bench Marking - Knowledge Management – change management –sustainability and corporate social responsibility.

LEARNING OUTCOMES At the end if the Unit, the students will be able to

- Understand modern management techniques
- Apply Knowledge in Understanding in TQM, SCM
- Analyze CRM, BPR
- Evaluate change management & sustainability

Text Books:

1. Frederick S. Hillier, Mark S. Hillier. Introduction to Management Science, October 26, 2023
2. A.R Aryasri, *Management Science*, TMH, 2019

References:

1. Stoner, Freeman, Gilbert.*Management*, Pearson Education, New Delhi, 2019.
2. Koontz & Weihrich, *Essentials of Management*, 6/e, TMH, 2005.
3. Thomas N.Duening & John M.Ivancevich, *Management Principles and Guidelines*, Biztantra.
4. Kanishka Bedi, Production and Operations Management, Oxford University Press, 2004.
5. Samuel C.Certo, *Modern Management*, 9/e, PHI, 2005.

COURSE OUTCOMES: At the end of the course, students will be able to		**BTL**
CO1	Remember the concepts & principles of management and designs of organization in a practical world	**L1**
CO2	Understand the knowledge of Work-study principles & Quality Control techniques in industry	**L2**
CO3	Apply the process of Recruitment & Selection in organization.	**L3**
CO4	Analyze the concepts of HRM & different training methods.	**L4**
CO5	Evaluate PERT/CPM Techniques for projects of an enterprise and estimate time & cost of project & to analyze the business through SWOT.	**L5**
CO6	Create awareness on contemporary issues in modern management & technology.	**L3**

BTL = Blooms Taxonomy Level

ONLINE RESOUECES:

1. https://www.slideshare.net/slideshow/introduction-to-management-and-organization-231308043/231308043
2. https://nptel.ac.in/courses/112107238
3. https://archive.nptel.ac.in/courses/110/104/110104068/
4. https://archive.nptel.ac.in/courses/110/105/110105069/
5. https://onlinecourses.nptel.ac.in/noc24_mg112/

IV B.Tech I Semester

23A30702a	**EDGE AI (Professional Elective-IV)**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Objectives:

- To introduce fundamental concepts and mathematical foundations of machine learning algorithms.
- To analyze and implement supervised, unsupervised, and reinforcement learning techniques.
- To explore real-time applications in healthcare, finance, security, and recommendation systems.
- To evaluate the performance of models using suitable metrics and tools.
- To familiarize students with practical use of machine learning libraries and frameworks.

Course Outcomes:

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

- Understand and differentiate various machine learning paradigms.
- Apply core machine learning algorithms to solve classification, regression, and clustering problems.
- Evaluate and improve model performance using statistical and algorithmic metrics.
- Develop real-time ML solutions using Python and relevant libraries.
- Analyze and implement ML solutions in applications like NLP, healthcare, and recommendation systems.

UNIT I: Introduction to Machine Learning & Data Preprocessing

Definition and types of Machine Learning (Supervised, Unsupervised, Reinforcement) – (R), Key Elements of ML: Features, Labels, Training and Testing – (U)**,** Data Preprocessing: Cleaning, Normalization, Feature Scaling – (U)**,** Handling Missing Data and Outliers – (U)**,** Feature Engineering and Dimensionality Reduction (PCA, LDA) – (U)**,** ML Pipeline and Workflow in Real-World Projects – (U)

UNIT II: Supervised Learning Algorithms

Linear Regression: Simple & Multiple – (A)**,** Logistic Regression: Binary & Multiclass Classification – (A)**,** Decision Trees and Random Forests – (A)**,** Support Vector Machines (SVM) – (A)**,** k-Nearest Neighbors (k-NN) – (A)**,** Model Evaluation Metrics: Accuracy, Precision, Recall, F1 Score – (U)

UNIT III: Unsupervised and Semi-Supervised Learning

Clustering: k-Means, Hierarchical, DBSCAN – (A)**,** Association Rule Learning: Apriori and FP-Growth – (A)**,** Gaussian Mixture Models and EM Algorithm – (A)**,** Dimensionality Reduction Techniques: t-SNE, PCA – (AN)**,** Semi-Supervised Learning: Self-Training, Co-Training – (AN)**,** Anomaly and Outlier Detection – (AN)

UNIT IV: Advanced Machine Learning & Optimization

Ensemble Learning: Bagging, Boosting, Stacking – (A)**,** Gradient Boosting, AdaBoost, XGBoost, LightGBM – (A)**,** Model Selection and Hyperparameter Tuning (Grid/Random Search, Cross-validation) – (E)**,** Bias-Variance Trade-off and Regularization (L1, L2) – (AN)**,** Bayesian Learning and Naive Bayes Classifier – (A)**,** Handling Imbalanced Data and Sampling Techniques – (E)

UNIT V: Applications of Machine Learning

Machine Learning in Healthcare (Disease Prediction, Diagnostics) – (A)**,** Financial Fraud Detection and Credit Scoring – (A)**,** Recommender Systems (Collaborative & Content-Based Filtering) – (AN)**,** Natural Language Processing (Text Classification, Sentiment Analysis) – (AN)**,** Image Classification and Object Detection – (A)**,** Building and Deploying ML Models using Flask/Streamlit – (C)

Textbooks:

1. Tom M. Mitchell, *Machine Learning*, McGraw Hill.
2. Aurélien Géron, *Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow*, O'Reilly.
3. Ethem Alpaydin, *Introduction to Machine Learning*, MIT Press.

Reference Books:

1. Peter Flach, *Machine Learning: The Art and Science of Algorithms*, Cambridge University Press.
2. Kevin P. Murphy, *Machine Learning: A Probabilistic Perspective*, MIT Press.
3. Shai Shalev-Shwartz and Shai Ben-David, *Understanding Machine Learning*, Cambridge University Press.
4. Christopher M. Bishop, *Pattern Recognition and Machine Learning*, Springer

Online Learning Resources:

- Coursera – Machine Learning by Andrew Ng (Stanford)
- edX – Machine Learning with Python by IBM
- Google AI – Machine Learning Crash Course
- Kaggle – Learn Machine Learning

IV B.Tech I Semester

23A30702b	**HUMAN-COMPUTER INTERACTION (Professional Elective-IV)**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Objectives:

- To understand the fundamentals of Human-Computer Interaction.
- To design user-centric interfaces and systems with usability and accessibility in mind.
- To explore cognitive models and interaction design processes.
- To develop knowledge in evaluation techniques and prototyping.
- To introduce the latest advancements in HCI including AR/VR, gesture, and voice-based interfaces.

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

- Understand the principles and concepts of Human-Computer Interaction.
- Apply design techniques to create usable, intuitive interfaces.
- Analyze and evaluate user interfaces through cognitive and empirical methods.
- Implement effective prototypes and interaction models.
- Explore emerging trends in multimodal and intelligent interfaces.

UNIT I: Introduction to HCI & Human Factors

Introduction to HCI: History, Importance, and Applications – (U), Human Factors: Perception, Cognition, and Memory – (U), Models of Human Behavior: Norman‘s Model, Fitts‘ Law – (U), Ergonomics and Accessibility in Design – (U), Visual, Auditory, and Haptic Modalities – (U), Interaction Styles: Command-line, WIMP, Direct Manipulation – (R), Principles of Good Design: Consistency, Feedback, Affordance – (U), Case Study: Bad vs Good Interface Design – (U)

UNIT II: Design Process and User-Centered Design

Design Thinking and User-Centered Design – (U), Requirement Gathering: Task Analysis, Personas, Scenarios – (A), Information Architecture: Navigation and Flow – (A), Interface Design Guidelines (Shneiderman, Nielsen) – (U), Storyboarding and Wireframing – (A), Low-Fidelity vs High-Fidelity Prototyping – (A), Interaction Design Patterns – (A), Case Study: Designing an ATM Interface – (AN)

UNIT III: Evaluation Techniques and Usability Testing

Types of Evaluation: Formative vs Summative – (U), Usability Metrics: Learnability, Efficiency, Memorability – (A), Cognitive Walkthrough and Heuristic Evaluation – (A), A/B Testing and Controlled Experiments – (A), Eye Tracking and Think-Aloud Protocols – (A), User Feedback: Surveys and Interviews – (A), Quantitative and Qualitative Data Analysis – (AN), Case Study: Usability Analysis of a Mobile App – (E)

UNIT IV: Interface Technologies and Prototyping Tools

Graphical User Interfaces (GUI) and Web Interfaces – (U), Mobile and Touch Interfaces – (U), Voice-Based Interfaces (VUI) and Chatbots – (A), Gesture-Based Interaction and Wearables – (U), Augmented and Virtual Reality Interfaces – (A), Rapid Prototyping Tools: Figma, Adobe XD, Axure – (A), HTML/CSS/JS for UI Prototyping – (A), Case Study: Building a Prototype for a Fitness App – (A)

UNIT V: Advanced Topics in HCI and Future Trends

Brain-Computer Interfaces (BCI) – (U), Multimodal Interaction: Combining Voice, Gesture, Gaze – (U), Intelligent Interfaces using AI – (U), Emotion Recognition and Affective Computing – (U), Ethics in HCI: Privacy, Bias, and Design for Inclusion – (E), Accessibility Standards: WCAG, ADA – (A), Gamification and Persuasive Design – (AN), Capstone Project: Designing an Inclusive Learning App – (C)

Textbooks:

1. Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale, ―Human-Computer Interaction‖, Pearson Education, 4th Edition.
2. Ben Shneiderman et al., ―Designing the User Interface: Strategies for Effective Human-Computer Interaction‖, Pearson.
3. Donald A. Norman, ―The Design of Everyday Things‖, Basic Books.

Reference Books:

1. Jenny Preece, Yvonne Rogers, Helen Sharp, ―Interaction Design: Beyond Human-Computer Interaction‖, Wiley.
2. Jeff Johnson, ―Designing with the Mind in Mind‖, Morgan Kaufmann.
3. Steven Krug, ―Don‘t Make Me Think‖, New Riders.

Online Learning Resources:

- Coursera: Human-Centered Design by UC San Diego (https://www.coursera.org/learn/human-computer-interaction)
- edX: HCI by Georgia Tech (https://www.edx.org/course/human-computer-interaction)

IV B.Tech I Semester

23A30702c	**MACHINE LEARNING OPERATIONS (Professional Elective-IV)**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Objectives:

- To introduce MLOps practices for streamlining the ML lifecycle.
- To understand versioning, reproducibility, automation, and deployment in ML.
- To provide knowledge of CI/CD pipelines in machine learning workflows.
- To integrate monitoring, governance, and retraining mechanisms in production ML systems.
- To explore MLOps platforms and tools like MLflow, Kubeflow, and TFX.

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

- Understand the end-to-end ML lifecycle from experimentation to deployment.
- Apply DevOps practices in ML system design and implementation.
- Utilize tools for tracking, testing, and automating ML workflows.
- Deploy and monitor scalable ML systems in cloud or hybrid environments.
- Implement robust and reproducible MLOps pipelines using industry-standard tools.

UNIT I: Introduction to MLOps and ML Lifecycle

Introduction to MLOps: Principles and Need , Differences between DevOps and MLOps , ML Lifecycle: Data, Model, Code, Deployment , Roles and Responsibilities in MLOps Teams – (R), Experiment Tracking and Management , Data and Model Versioning , Reproducibility and Reusability , Case Study: MLOps in a Real-World Project ,

UNIT II: Data Engineering for MLOps

Data Ingestion Pipelines and Orchestration ,Data Validation and Profiling ,Feature Engineering and Feature Stores ,Handling Data Drift and Concept Drift ,Batch vs Streaming Data Processing ,DataOps for MLOps: Tools and Techniques ,Tools: Apache Airflow, TFX Data Validation ,Case Study: Building a Scalable Data Pipeline ,

UNIT III: Model Training, Tracking, and Versioning

Automated ML Training Pipelines , Model Tracking with MLflow, Weights & Biases , Model Version Control and Registry , Hyperparameter Tuning Automation , Training on Cloud Platforms (GCP, AWS, Azure ML) , Performance Metrics and Evaluation , Reproducibility Using Docker & Conda Environments , Case Study: Hyperparameter Tuning Pipeline ,

UNIT IV: CI/CD in Machine Learning

CI/CD Concepts and Pipelines for ML , Infrastructure as Code: Terraform, YAML , ML Testing: Data, Model, Pipeline, Integration , Model Validation and Bias Testing , Continuous Training and Automated Retraining , Tools: Jenkins, GitHub Actions, Kubeflow Pipelines , Containerization with Docker and Orchestration with Kubernetes , Case Study: Implementing End-to-End CI/CD for ML – (E)

UNIT V: Model Deployment, Monitoring, and Governance

Deployment Strategies: A/B Testing, Blue-Green , Model Serving: REST APIs, gRPC, TensorFlow Serving , Monitoring Models in Production: Accuracy, Drift , Logging, Alerts, and Rollbacks , Model Governance, Explainability and Fairness , Privacy and Security in ML Systems , Case Study: ML Monitoring using Prometheus and Grafana – (C), Capstone: Building an End-to-End MLOps Pipeline – (C)

Textbooks:

1. Mark Treveil, Alok Shukla – ―Introducing MLOps: How to Scale Machine Learning Projects with Continuous Delivery, Monitoring, and Governance‖, O'Reilly.
2. Emmanuel Raj – ―Machine Learning Engineering with MLOps‖, Packt Publishing.
3. Carl Osipov – ―MLOps Engineering at Scale‖, Wiley.

Reference Books:

1. Chip Huyen – ―Designing Machine Learning Systems‖, O'Reilly.
2. Andrew Ng – ―Machine Learning B.Techning‖ (Online Resource).
3. Chris Fregly & Antje Barth – ―Data Science on AWS‖, O'Reilly.

Online Learning Resources:

- Coursera: MLOps Specialization by DeepLearning.AI – *https://www.coursera.org/specializations/mlops*
- Google Cloud MLOps Resources – https://cloud.google.com/architecture/mlops-continuous-delivery-and-automation-pipelines-in-machine-learning
- AWS Machine Learning Ops Workshop – https://catalog.us-east-1.prod.workshops.aws/workshops/

IV B.Tech I Semester

23A30702d	**NoSQL DATABASE (Professional Elective-IV)**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Objectives:

1. To introduce the fundamental concepts and characteristics of Big Data.
2. To equip students with knowledge of Hadoop, Spark, and distributed computing systems.
3. To develop the ability to process, store, and analyze Big Data using modern tools.
4. To implement various big data analytics techniques on real-world data.
5. To apply big data tools and frameworks in domains such as finance, health, and e-commerce.

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

1. Understand the characteristics, challenges, and tools of Big Data.
2. Implement storage and retrieval mechanisms in HDFS and NoSQL databases.
3. Develop MapReduce and Spark-based applications.
4. Apply big data analytics techniques to process real-world large-scale datasets.
5. Integrate big data platforms with machine learning and business intelligence solutions.

UNIT I: Introduction to Big Data and Hadoop Ecosystem

Definition, Characteristics of Big Data (Volume, Variety, Velocity, Veracity, Value), Types of Data: Structured, Semi-Structured, and Unstructured, Traditional vs Big Data Systems, Big Data Challenges and Benefits, Introduction to Hadoop: Architecture and Components, Hadoop Distributed File System (HDFS): Features, Design, Blocks, YARN and MapReduce Overview, Hadoop Ecosystem Components: Pig, Hive, HBase, Sqoop, Flume.

UNIT II: MapReduce Programming and Hadoop Tools

MapReduce Programming Model: Mapper, Reducer, Partitioner, InputSplit and RecordReader, Combiner, Writing MapReduce Programs in Java, Advanced MapReduce Concepts: Counters, Joins, Secondary Sort, Hive: Data Warehousing Concepts, HiveQL, Partitions, Buckets, Pig: Data Flow, Pig Latin Scripts, Data Import & Export with Sqoop, Real-Time Data Collection using Flume.

UNIT III: NoSQL Databases and HBase

Introduction to NoSQL Databases, Types of NoSQL: Key-Value, Document, Column, Graph, Differences between RDBMS and NoSQL, HBase Data Model: Column Families, Regions, Tables, HBase Architecture and Internals, HBase CRUD Operations using Java, Integration of HBase with Hadoop, Case Study: Big Data Storage in Social Media.

UNIT IV: Apache Spark and Big Data Analytics

Apache Spark: RDDs and DAG Execution Model, Spark Core and Spark SQL, DataFrames and Datasets in Spark, Spark Streaming: Architecture and DStreams, Spark MLlib: Machine Learning on Big Data, GraphX: Graph Processing in Spark, Performance Tuning and Optimization in Spark, Case Study: Building a Spark Application for Real-Time Analytics.

UNIT V: Applications and Case Studies in Big Data

Big Data in Healthcare: Predictive Analysis, Genomics, Big Data in Finance: Fraud Detection, Risk Analytics, Big Data in E-Commerce: Customer Behavior, Personalization, Sentiment Analysis using Big Data, Big Data for Smart Cities and IoT, Big Data and Cloud Computing Integration (AWS, GCP, Azure), Data Privacy, Security, and Ethical Issues – (E), Mini-Project: Design and Development of a Big Data Solution.

Textbooks:

1. Tom White, Hadoop: The Definitive Guide, O'Reilly Media.
2. V. Srinivasa Subramanian, Big Data Analytics, Wiley India.
3. Anand Rajaraman and Jeffrey D. Ullman, Mining of Massive Datasets, Cambridge University Press.

Reference Books:

1. Chuck Lam, Hadoop in Action, Manning Publications.
2. Bill Franks, Taming the Big Data Tidal Wave, Wiley.
3. Alex Holmes, Hadoop in Practice, Manning Publications.
4. Michael Minelli, Big Data, Big Analytics: Emerging Business Intelligence, Wiley.

Online Learning Resources:

1. Coursera – Big Data Specialization by UC San Diego
2. edX – Big Data Analysis with Apache Spark (UC Berkeley)
3. Udacity – Data Engineering Nanodegree

IV B.Tech I Semester

23A30703a	**DATA WRANGLING (Professional Elective-V)**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Objectives:

- To introduce the fundamental techniques for acquiring, cleaning, transforming, and manipulating data.
- To enable students to handle real-world messy data for analysis and machine learning.
- To teach efficient use of libraries like Pandas, NumPy, and SQL for data wrangling.
- To promote understanding of handling missing values, outliers, and inconsistent formats.
- To expose students to automation, reproducibility, and workflow design in data preprocessing.

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

- Understand and apply core data wrangling techniques.
- Clean, transform, and reshape data using Python and SQL.
- Handle missing values, data inconsistencies, and outliers.
- Merge and join multiple datasets from different sources.
- Automate data pipelines and preprocessing workflows for analytics and ML.

UNIT I: Introduction to Data Wrangling and Data Acquisition

Introduction to Data Wrangling: Importance and Use Cases , Types of Data: Structured, Semi-Structured, Unstructured, Data Acquisition Techniques: APIs, Web Scraping, Reading Data from CSV, Excel, JSON, XML, Using Python libraries: pandas, requests, BeautifulSoup, Working with Databases using SQLAlchemy and pandas, Loading Large Datasets and Chunking, Exploratory Analysis Before Cleaning.

UNIT II: Handling Missing, Noisy, and Inconsistent Data

Identifying and Understanding Missing Data, Techniques for Imputing Missing Values, Handling Inconsistent Data: Dates, Texts, Units, Removing Duplicates and Irrelevant Data, Detecting and Treating Outliers, Normalization and Standardization Techniques, Regular Expressions for Text Cleaning, Visualizing Missing/Outlier Data.

UNIT III: Data Transformation and Feature Engineering

Data Type Conversion and Parsing, Feature Extraction from Text, Dates, and Strings, One-Hot Encoding, Label Encoding, Binning and Discretization, Data Aggregation and Grouping, Pivoting, Melting, and Reshaping Data, Handling Imbalanced Data, Creating Derived Features and Feature Selection.

UNIT IV: Data Integration, Joining, and Workflows

Merging and Joining Datasets (Inner, Outer, Left, Right), Concatenation and Appending DataFrames, Data Consistency and Referential Integrity, Resolving Schema Mismatches, Designing Reusable Data Wrangling Functions, Automating Workflows with Functions and Pipelines, Data Lineage and Documentation, Case Study: End-to-End Data Wrangling Pipeline.

UNIT V: Tools, Libraries, and Case Studies in Data Wrangling

Pandas and NumPy Advanced Techniques, Pyjanitor, Dask, and Polars for Efficient Wrangling, Using OpenRefine for Data Cleaning, SQL vs NoSQL in Data Wrangling, Real-world Wrangling Case Studies (Finance, Healthcare, Retail), Best Practices and Common Pitfalls in Data Wrangling, Reproducibility and Versioning in Data Pipelines, Final Capstone: Build and Evaluate a Clean Dataset for ML.

Textbooks:

1. M. Heydt – Data Wrangling with pandas, O'Reilly Media.
2. Hadley Wickham – R for Data Science (Data Wrangling Chapters), O'Reilly.
3. J. VanderPlas – Python Data Science Handbook, O'Reilly Media.

Reference Books:

1. Wes McKinney – Python for Data Analysis, O'Reilly.
2. Cathy O'Neil and Rachel Schutt – Doing Data Science, O'Reilly.
3. David Mertz – Cleaning Data for Effective Data Science, Packt.

Online Learning Resources:

- Data Wrangling with pandas (Datacamp): https://www.datacamp.com/courses/data-manipulation-with-pandas
- Coursera: Data Wrangling, Analysis and AB Testing with SQL – *https://www.coursera.org/learn/data-wrangling-analysis-abtesting*
- edX: Data Wrangling with R – https://online.rice.edu/courses/data-wrangling-r
- Real Python Tutorials on pandas: https://realpython.com/learning-paths/pandas/
- Kaggle Notebooks (Data Cleaning & Wrangling): https://www.kaggle.com/learn/pandas

IV B.Tech I Semester

23A30703b	**DRONE TECHNOLOGY (Professional Elective-V)**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Objectives

- Introduce the **fundamentals of Unmanned Aerial Vehicles** (UAVs), their classification, and working principles.
- Explain the **components, aerodynamics, and propulsion systems** essential for drone flight and control.
- Develop skills in **drone programming, control systems, and communication protocols**.
- Explore **applications of drones across industries**, such as agriculture, defense, surveillance, logistics, and mapping.
- Educate learners on **regulatory, safety, and ethical concerns** related to the use of drone technologies.

Course Outcomes :

- Understand and describe the **types, parts, and functioning of drones** and UAV systems.
- Design and evaluate **flight dynamics, control systems**, and navigation technologies used in drones.
- Demonstrate the ability to **program, assemble, and test drones** using open-source and commercial platforms.
- Apply drone technology to **solve real-world problems** in agriculture, disaster management, defense, and delivery systems.
- Exhibit awareness of **drone policy regulations, airspace restrictions, and privacy/security guidelines**.

UNIT I – Introduction to Drone Systems

History and evolution of UAVs, Classification of drones – fixed wing, rotary wing, hybrid, Key components of a drone – frame, ESC, flight controller, GPS, camera, etc., Introduction to drone subsystems – propulsion, navigation, payload, Basic flight physics and principles of lift, thrust, drag, UAV vs. traditional aircraft systems, Overview of global drone market and applications, Introduction to drone platforms (DJI, Ardupilot, PX4).

UNIT II – Drone Hardware and Aerodynamics

Airframe types and material selection, Brushless motors and electronic speed controllers (ESC), Propeller dynamics and thrust calculations, Battery technologies – Li-Po, Li-ion: specifications and management, Sensors – IMU, gyroscope, magnetometer, barometer, GPS and real-time positioning systems, Flight control boards – Ardupilot, Pixhawk, Naza, Aerodynamic challenges in drone flight and tuning PID parameters.

UNIT III – Drone Communication and Control System

Remote control and ground station basics, Telemetry and radio communication protocols (LoRa, WiFi, RF, LTE), First Person View (FPV) systems – components and latency issues, Drone programming and mission planning using Mission Planner, QGroundControl, Fail-safe, return-to-home, and geo-fencing functionalities, Integration of autopilot systems, Indoor and outdoor localization techniques, Introduction to swarm drone communication.

UNIT IV – Drone Applications and Emerging Use Cases

Drones in precision agriculture – spraying, mapping, crop monitoring, Disaster management and rescue operations, Aerial surveillance and security, Environmental monitoring and wildlife conservation, Logistics and delivery drones – case studies (Amazon, Zipline), Construction and infrastructure inspections, Cinematography and media production, AI integration in drones – object detection, tracking, anomaly alerts.

UNIT V – Safety, Regulations, and Future Trends

DGCA guidelines and certification requirements, International drone policies (FAA, EASA), UAV flight permissions and NPNT (No Permission, No Takeoff) protocol, Safety procedures and risk mitigation, Drone cybersecurity and data protection, Ethical concerns – surveillance, privacy, military applications, Future of drone technology – nano drones, delivery drones, flying taxis, Career opportunities and entrepreneurship in drone industry

Textbooks

1. **Unmanned Aircraft Systems: UAVS Design, Development and Deployment** *by Reg Austin, Wiley*
2. **Introduction to UAV Systems** *by Paul G. Fahlstrom and Thomas J. Gleason*
3. **Building Your Own Drones: A Beginners' Guide to Drones, UAVs, and** ROVs *by John Baichtal*

Reference Books

1. ***Small Unmanned Aircraft: Theory and Practice*** by Randal W. Beard and Timothy W. McLain
2. ***Drones (The MIT Press Essential Knowledge series)***by Andy Miah
3. ***FPV Flight Dynamics*** by Christian Mollica
4. DGCA Drone Training Manual (India) – Latest Version

IV B.Tech I Semester

23A30703c	**ROBOTICS (Professional Elective-V)**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Objectives:

- To introduce the fundamentals of robotics and its components.
- To understand the kinematics, dynamics, and control of robotic systems.
- To study various sensors, actuators, and robotic perception systems.
- To explore applications of AI in robotics, including motion planning and machine learning.
- To analyze real-world applications and ethical issues in robotics.

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

- Understand the structure and functions of robotic systems.
- Analyze robotic movements through kinematics and dynamics.
- Design motion planning and control algorithms.
- Integrate AI and machine learning in robotic tasks.
- Apply robotics to real-world domains and evaluate ethical implications.

UNIT I: Introduction to Robotics

Definition, classification, and types of robots – (U), Components of a robotic system – (U), History and evolution of robotics – (U), Sensors, actuators, controllers – (U), Degrees of freedom and configurations – (U), Power sources and drive systems – (A), End effectors and robotic grippers – (U), Introduction to ROS (Robot Operating System) – (A)

UNIT II: Kinematics and Dynamics of Robots

Coordinate frames and transformations – (A), Forward kinematics for robotic manipulators – (A), Inverse kinematics and solutions – (A), Jacobian matrix and velocity kinematics – (AN), Dynamics of manipulators using Lagrangian and Newton-Euler – (AN), Redundant robots and singularities – (E), Trajectory planning: Linear, polynomial, and spline paths – (A), Introduction to simulation tools (Gazebo, V-REP) – (A)

UNIT III: Sensors, Perception and Localization

Types of sensors: IR, ultrasonic, LIDAR, vision – (U), Sensor fusion and integration – (A), Robotic vision: Cameras, image formation, and filtering – (A), Object recognition and feature extraction – (AN), Mapping: Grid-based, topological, and semantic – (AN), SLAM (Simultaneous Localization and Mapping) – (AN), Localization algorithms: Kalman filter, particle filter – (A), Obstacle detection and avoidance – (A)

UNIT IV: Robotic Motion Planning and Control

Path planning algorithms: Dijkstra, A*, RRT – (A), Motion control: PID, adaptive and robust control – (A), Inverse dynamics and computed torque control – (AN), Trajectory tracking and motion stabilization – (A), Motion planning for mobile and humanoid robots – (AN), Collision detection and avoidance techniques – (A), Human-robot interaction and teleoperation – (A), Case study: Designing motion plan for an autonomous robot – (C)

UNIT V: AI and Applications in Robotics

Integration of AI in robotics – (AN), Machine learning for perception and control – (E), Reinforcement learning for robotic agents – (E), Deep learning in visual perception and grasping – (E), Applications in industrial, medical, military, and service robots – (AN), Ethical considerations and safety standards – (E), Autonomous navigation and decision-making – (C), Capstone task: Proposing a robotic system for a societal problem – (C)

Textbooks:

1. John J. Craig – Introduction to Robotics: Mechanics and Control
2. Saeed B. Niku – Introduction to Robotics: Analysis, Control, Applications
3. Mikell P. Groover – Industrial Robotics: Technology, Programming, and Applications

Reference Books:

1. Roland Siegwart, Illah Nourbakhsh, Davide Scaramuzza – Introduction to Autonomous Mobile Robots
2. Peter Corke – Robotics, Vision and Control
3. Richard D. Klafter – Robotic Engineering: An Integrated Approach

Online Courses:

- Coursera – Modern Robotics: Mechanics, Planning, and Control (Northwestern University) *https://www.coursera.org/specializations/modernrobotics*
- edX – Robotics MicroMasters (Columbia University) https://www.edx.org/micromasters/columbiax-robotics
- Udacity – Robotics Software Engineer Nanodegree https://www.udacity.com/course/robotics-software-engineer--nd209
- MIT OpenCourseWare – Robotics: Science and Systems https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-141-robotic-science-and-systems-i-fall-2020/

IV B.Tech I Semester

23A30703d	**MINING MASSIVE DATA SETS (Professional Elective-V)**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Objectives

- Introduce fundamental concepts and scalable algorithms used in mining massive datasets.
- Enable understanding of key techniques like clustering, classification, frequent itemset mining, and graph analysis on large-scale data.
- Familiarize students with distributed computing frameworks such as Hadoop and Spark.
- Provide practical insights into web and social network mining.
- Equip students with the ability to analyze massive datasets using real-world tools and platforms.

Course Outcomes

- Understand and explain the challenges involved in mining large-scale datasets.
- Apply efficient algorithms for clustering, classification, and association rule mining in big data environments.
- Analyze and implement scalable solutions using frameworks such as MapReduce, Hadoop, and Spark.
- Solve real-world problems involving link analysis, recommendation systems, and mining of web/social data.
- Critically evaluate algorithms based on scalability, efficiency, and effectiveness in large datasets.

UNIT I – Introduction to Massive Data and MapReduce Model

Types of Massive Data – Structured, Unstructured, and Semi-Structured, Challenges of Mining Massive Data Sets, Storage Systems – Distributed File Systems, HDFS, Introduction to MapReduce Programming Model, Designing MapReduce Algorithms, Matrix-Vector Multiplication by MapReduce, Workflow Management in Hadoop, Limitations of MapReduce.

UNIT II – Frequent Itemset and Association Rule Mining

Market Basket Model, A-Priori Algorithm – Scalable Variants, Handling Large Datasets in Frequent Pattern Mining, Park-Chen-Yu Algorithm, SON Algorithm, Multistage and Multihash Algorithms, PCY Algorithm and its Enhancements, Association Rules – Concepts and Evaluation, Finding Frequent Itemsets in Streaming Data

UNIT III – Clustering and Classification Techniques

Hierarchical and Partitional Clustering, K-Means Clustering and its Scalability, BFR and CURE Clustering Algorithms, Decision Trees and Rule-Based Classification, Naïve Bayes Classifier for Large Datasets, Logistic Regression and SVM for Massive Data, Parallel Clustering Techniques, Evaluation of Clustering Results

UNIT IV – Link Analysis and Mining of Web/Social Networks

Web Graph Structure and Crawling, PageRank and its Variants, Hubs and Authorities (HITS Algorithm), Link Spam Detection, Community Detection in Large Graphs, Mining Social Network Graphs, Recommendation Systems – User-Based and Item-Based Collaborative Filtering, Content-Based Filtering

UNIT V – Frameworks and Real-World Applications

Introduction to Apache Spark and RDDs, Spark MLlib for Data Mining, Streaming and Real-Time Data Analysis, Mining on Cloud Platforms (AWS, GCP, Azure), Case Study: E-commerce, Finance, and Healthcare, Scaling Algorithms to Petabyte-Level Data, Big Data Ethics and Governance, Research Trends in Mining Massive Data Sets

Textbooks

1. *"Mining of Massive Datasets"* by Jure Leskovec, Anand Rajaraman, and Jeffrey Ullman
2. *"Data Mining: Concepts and Techniques"* by Jiawei Han, Micheline Kamber, and Jian Pei
3. *"Big Data: Principles and Best Practices of Scalable Real-Time Data Systems"* by Nathan Marz and James Warren

Reference Books

1. *"Big Data Analytics with Spark"* by Mohammed Guller
2. *"Hadoop: The Definitive Guide"* by Tom White
3. *"Practical Machine Learning with Spark"* by Ajay Ohri
4. IEEE/ACM Journals and Conference Proceedings on Data Mining and Big Data

Online Courses

1. *Mining Massive Datasets – Stanford University (Coursera)*
2. *Big Data Analysis with Apache Spark – edX (BerkeleyX)*
3. *Data Mining Specialization – University of Illinois (Coursera)*

IV B.Tech I Sem

23A05703	**PROMPT ENGINEERING** **Skill Enhancement Course**	**L**	**T**	**P**	**C**
		0	**1**	**2**	**2**

Course Objective:

This course delves into prompt engineering principles, strategies, and best practices, a crucial aspect in shaping AI models' behaviour and performance. Understanding Prompt Engineering is a comprehensive course designed to equip learners with the knowledge and skills to effectively generate and utilize prompts in natural language processing (NLP) and machine learning (ML) applications. This course delves into prompt engineering principles, strategies, and best practices, a crucial aspect in shaping AI models' behaviour and performance.

Course Out comes:

- Under standing the fundamentals and evolution of prompt engineering.
- Gaining the ability to craft effective closed-ended, open-ended, and role-based prompts.
- Learning to probe and stress-test AI models for bias and robustness.
- Applying prompt optimization techniques and performance evaluation methods.
- Mitigating bias and promoting ethical prompting practices in NLP/ML systems.

Module 1: Introduction to Prompt Engineering

- *Lesson 1: Foundations of Prompt Engineering*
  - Overview of prompt engineering and its significance in NLP and ML.
  - Historical context and evolution of prompt-based approaches.

Module 2: Types of Prompts and Their Applications

- *Lesson 2: Closed-Ended Prompts*
  - Under standing and creating prompts for specific answers.
  - Applications in question- answering systems.
- *Lesson 3: Open-Ended Prompts*
  - Crafting prompts for creative responses.
  - Applications in language generation models.

Module 3: Strategies for Effective Prompting

- *Lesson 4: Probing Prompts*
  - Designing prompts to reveal model biases.
  - Ethical considerations in using probing prompts.
- *Lesson 5: Adversarial Prompts*
  - Creating prompts to stress-test models.
  - Enhancing robustness through adversarial prompting.

Module 4: Fine-Tuning and Optimizing with Prompts

- *Lesson 6: Fine-Tuning Models with Prompts*
  - Techniques for incorporating prompts during model training.
  - Balancing prompt influence and generalization.
- *Lesson 7: Optimizing Prompt Selection*
  - Methods for selecting optimal prompts for specific tasks.
  - Customizing prompts based on model behavior.

Module 5: Evaluation and Bias Mitigation

- *Lesson 8: Evaluating Prompt Performance*
  - Metrics and methodologies for assessing model performance with prompts.
  - Interpreting and analyzing results.
- *Lesson 9: Bias Mitigation in Prompt Engineering*
  - Strategies to identify and address biases introduced by prompts.
  - Ensuring fairness and inclusivity in prompt-based models.

Module 6: Real-World Applications and Case Studies

- *Lesson 10: Case Studies in Prompt Engineering*
- *Exploration of successful implementations and challenges in real-world scenarios.*
- *Guest lectures from industry experts sharing their experiences.*

Text books:

1. "Prompt Engineering in Action" – *Danny D. Sullivan*
2. "The Art of Prompt Engineering with Chat GPT: A Hands-On Guide" – *Nathan Hunter.*

Reference Books:

1. "Prompt Engineering in Practice" – *Michael F. Lewis*
2. "Mastering AI Prompt Engineering: The Ultimate Guide for Chat GPT Users" – *Adriano Damiao*
3. "Writing AI Prompts For Dummies" – *Stephanie Diamond and Jeffrey Allan*
4. "Prompt Engineering Guide" (Online Resource) – *promptingguide.ai*

Online Resource link :

https://www.udemy.com/course/understanding-prompt-engineering/?couponCode=NVDINCTA35TRT

IV B.Tech I Sem

23A52702	**GENDER SENSITIZATION** **Audit Course**	**L**	**T**	**P**	**C**
		0	**0**	**2**	**0**

Course Objectives:

- To enable students to understand the gender related issues, vulnerability of women and men
- To familiarize them about constitutional safeguard for gender equality
- To expose the students to debates on the politics and economics of work
- To help students reflect critically on gender violence
- To make them understand that gender identities and gender relations are part of culture as they shape the way daily life is lived in the family as well as wider community and the workplace.

Course Outcomes (CO):

COs	Statements	Blooms level
CO1	Understand the basic concepts of gender and its related terminology	L1, L2,
CO2	Identify the biological, sociological, psychological and legal aspects of gender.	L1, L2
CO3	Use the knowledge in understanding how gender discrimination works in our society and how to counter it.	L3
CO4	Analyzethe gendered division of labour and its relation to politics and economics.	L4
CO5	Appraise how gender-role beliefs and sharing behaviour are associated with more well-being in all culture and gender groups	L5
CO6	Develop students‘ sensibility with regard to issues of gender in contemporary India	L3

Unit-1 UNDERSTANDING GENDER

Introduction: Definition of Gender-Basic Gender Concepts and Terminology-Exploring Attitudes towards Gender-Construction of Gender-Socialization: Making Women, Making Men - Preparing for Womanhood. Growing up Male. First lessons in Caste.

Unit-2 GENDER ROLES AND RELATIONS

Two or Many? -Struggles with Discrimination-Gender Roles and Relations-Types of Gender Roles-Gender Roles and Relationships Matrix-Missing Women-Sex Selection and its Consequences-Declining Sex Ratio- Demographic Consequences-Gender Spectrum -

Unit-3 GENDER AND LABOUR

Division and Valuation of Labour-Housework: The Invisible Labor- ―My Mother doesn‘t Work.‖ ―Share the Load.‖-Work: Its Politics and Economics -Fact and Fiction- Unrecognized and Unaccounted work -Gender Development Issues-Gender, Governance and Sustainable Development-Gender and Human Rights-Gender and Mainstreaming

Unit-4 GENDER-BASED VIOLENCE

The Concept of Violence- Types of Gender-based Violence-Gender-based Violence from a Human Rights Perspective-Sexual Harassment - Domestic Violence - Different forms of violence against women - Causes of violence, impact of violence against women - Consequences of gender-based violence

Unit-5 GENDER AND CULTURE

Gender and Film-Gender and Electronic Media-Gender and Advertisement-Gender and Popular Literature- Gender Development Issues-Gender Issues-Gender Sensitive Language- Just Relationships

Prescribed Books

1. A.Suneetha, Uma Bhrugubanda, et al. *Towards a World of Equals: A Bilingual Textbook on Gender*‖, Telugu Akademi, Telangana, 2015.
2. Butler, Judith. *Gender Trouble: Feminism and the Subversion of Identity.* UK Paperback Edn. March 1990

Reference Books

1. Wtatt, Robin and Massood, Nazia, *Broken Mirrors: The dowry Problems in India,*London : Sage Publications, 2011
2. Datt, R. and Kornberg, J.(eds), *Women in Developing Countries, Assessing Strategies for Empowerment,* London: Lynne Rienner Publishers, 2002
3. Brush, Lisa D., *Gender and Governance*, New Delhi, Rawat Publication, 2007
4. Singh, Direeti, *Women and Politics World Wide*, New Delhi, Axis Publications, 2010
5. Raj Pal Singh, Anupama Sihag, *Gender Sensitization: Issues and Challenges* (English, Hardcover), Raj Publications, 2019
6. A.Revathy& Murali, Nandini, *A Life in Trans Activism*(Lakshmi Narayan Tripathi). The University of Chicago Press, 2016

Online Resources:

1. Understanding Gender

chrome-extension://kdpelmjpfafjppnhbloffcjpeomlnpah/https://www.arvindguptatoys.com/arvindgupta/kamla-gender1.pdf

https://onlinecourses.swayam2.ac.in/nou24_hs53/preview

2. Gender Roles and Relations

https://www.plannedparenthood.org/learn/gender-identity/sex-gender-identity/what-are-gender-roles-and-stereotypes

https://www.verywellmind.com/understanding-gender-roles-and-their-effect-on-our-relationships-7499408

https://onlinecourses.swayam2.ac.in/cec23_hs29/preview

3. Gender and Labour

https://www.economicsobservatory.com/what-explains-the-gender-division-of-labour-and-how-can-it-be-redressed

https://onlinecourses.nptel.ac.in/noc23_mg67/preview

4. **GENDER-BASED VIOLENCE**
https://eige.europa.eu/gender-based-violence/what-is-gender-based-violence?language_content_entity=en

https://www.worldbank.org/en/topic/socialsustainability/brief/violence-against-women-and-girls

https://onlinecourses.swayam2.ac.in/nou25_ge38/preview

5. **GENDER AND CULTURE**
https://gender.study/psychology-of-gender/culture-impact-gender-roles-identities/

https://sociology.iresearchnet.com/sociology-of-culture/gender-and-culture/

https://archive.nptel.ac.in/courses/109/106/109106136/

Abdulali Sohaila. ―I Fought For My Life…and Won.‖Available online (at: http://www.thealternative.in/lifestyle/i-fought-for-my-lifeand-won-sohaila-abdulal/

OPEN ELECTIVES

III B.Tech I Semester

Course Code	**GREEN BUILDINGS**	L	T	P	C
23A015DT	**(OPEN ELECTIVE - I)**	3	0	0	3

Course Objectives :

The objectives of this course are to make the student:

1. **To understand** the fundamental concepts of green buildings, their necessity, and sustainable features.
2. **To analyze** green building concepts, rating systems, and their benefits in India.
3. **To apply** green building design principles, energy efficiency measures, and renewable energy sources.
4. **To evaluate** air conditioning systems, HVAC designs, and energy modeling for sustainable buildings.
5. **To assess** material conservation strategies, waste management, and indoor environmental quality in green buildings.

Course Outcomes (COs)

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

1. **Understand** the importance of green buildings, their necessity, and sustainable features.
2. **Analyze** various green building practices, rating systems, and their impact on environmental sustainability.
3. **Apply** principles of green building design to enhance energy efficiency and incorporate renewable energy sources.
4. **Evaluate** HVAC systems, energy-efficient air conditioning techniques, and their role in sustainable building design.
5. **Assess** material conservation techniques, waste reduction strategies, and indoor air quality management in green buildings.

CO - PO Articulation Matrix

Course Outcomes	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**
CO -1	3	-	-	-	-	2	3	-	-	-	-	-	3	3
CO -2	-	3	-	-	2	-	3	-	-	-	-	2	3	3
CO -3	-	-	3	3	3	-	3	-	-	-	-	-	3	3
CO -4	-	-	3	3	3	-	3	-	-	-	-	-	3	3
CO -5	-	-	-	-	-	3	3	3	2	-	-	-	-	3

UNIT – I

Introduction to Green Building– Necessity of Green Buildings, Benefits of Green Buildings, Green Building Materials and Equipment in India, Key Requisites for Constructing A Green Building, Important Sustainable Features for Green Buildings.

UNIT – II

Green Building Concepts and Practices– Indian Green Building Council, Green Building Movement in India, Benefits Experienced in Green Buildings, Launch of Green Building Rating Systems, Residential Sector, Market Transformation; Green Building Opportunities and Benefits: Opportunities of Green Buildings, Green Building Features, Material and

Resources, Water Efficiency, Optimum Energy Efficiency, Typical Energy-Saving Approaches in Buildings, LEED India Rating System, and Energy Efficiency.
UNIT – III
Green Building Design– Introduction, Reduction in Energy Demand, Onsite Sources and Sinks, Maximizing System Efficiency, Steps to Reduce Energy Demand and Use Onsite Sources and Sinks, Use of Renewable Energy Sources, Eco-Friendly Captive Power Generation for Factories, Building Requirements.
UNIT – IV
Air Conditioning– Introduction, CII Godrej Green Business Centre, Design Philosophy, Design Interventions, Energy Modeling, HVAC System Design, Chiller Selection, Pump Selection, Selection of Cooling towers, Selection of Air Handling Units, Pre-Cooling of Fresh Air, Interior Lighting Systems, Key Features of The Building, Eco-Friendly Captive Power Generation for Factories, Building Requirements.
UNIT – V
Material Conservation– Handling of Non-Process Waste, Waste Reduction During Construction, Materials With Recycled Content, Local Materials, Material Reuse, Certified Wood, Rapidly Renewable Building Materials and Furniture. Indoor Environment Quality and Occupational Health– Air Conditioning, Indoor Air Quality, Sick Building Syndrome, tobacco Smoke.
TEXT BOOKS:
1. Handbook on Green Practices published by Indian Society of Heating Refrigerating and Air conditioning Engineers, 2009. 2. Green Building Hand Book by tom woolley and Sam kimings, 2009.
REFRENCE BOOKS:
1. Complete Guide to Green Buildings by Trish riley **2.** Standard for the design for High Performance Green Buildings by Kent Peterson, 2009 3. Energy Conservation Building Code –ECBC-2020, published by BEE
Online Learning Resources:
https://archive.nptel.ac.in/courses/105/102/105102195/

III B.Tech – I Semester

Course Code	**CONSTRUCTION TECHNOLOGY AND MANAGEMENT (OPEN ELECTIVE – I)**	L	T	P	C
23A015ET		3	0	0	3

Course Objectives:

The objectives of this course are to make the student :

1. To understand project management fundamentals, organizational structures, and leadership principles in construction.
2. To analyze manpower planning, equipment management, and cost estimation in civil engineering projects.
3. To apply planning, scheduling, and project management techniques such as CPM and PERT.
4. To evaluate various contract types, contract formation, and legal aspectsin construction management.
5. To assess safety management practices, accident prevention strategies, and quality management systemsin construction.

Course Outcomes (COs):

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

1. Understand (Cos)project management fundamentals, organizational structures, and leadership principles in construction.
2. Analyze manpower planning, equipment management, and cost estimationin civil engineering projects.
3. Apply planning, scheduling, and project management techniques such as CPM and PERT.
4. Evaluate various contract types, contract formation, and legal aspectsin construction management.
5. Assess safety management practices, accident prevention strategies, and quality management systems in construction.

CO – PO Articulation Matrix

Course Outcomes	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**
CO -1	3	-	-	-	-	2	-	2	2	-	-	-	3	3
CO -2	-	3	-	-	2	-	-	-	-	-	-	2	3	3
CO -3	-	-	3	3	3	-	-	-	-	2	-	-	3	3
CO -4	-	-	3	3	3	-	-	2	-	-	-	-	3	3
CO -5	-	-	-	-	-	3	3	3	2	-	-	-	-	3

UNIT – I

Introduction: Project forms, Management Objectives and Functions; Organizational Chart of A Construction Company; Manager's Duties and Responsibilities; Public Relations; Leadership and Team - Work; Ethics, Morale, Delegation and Accountability.

UNIT – II

Man and Machine: Man-Power Planning, Training, Recruitment, Motivation, Welfare Measures and Safety Laws; Machinery for Civil Engineering., Earth Movers and Hauling Costs, Factors Affecting Purchase, Rent, and Lease of Equipment, and Cost Benefit Estimation.

UNIT – III		
Planning, Scheduling andProject Management: Planning Stages, Construction Schedules and Project Specification, Monitoring and Evaluation; Bar-Chart, CPM, PERT, Network-formulation and Time Computation.		
UNIT – IV		
Contracts: Types of Contracts, formation of Contract – Contract Conditions – Contract forLabour, Material, Design, Construction – Drafting of Contract Documents Based On IBRD/ MORTH Standard Bidding Documents – Construction Contracts – Contract Problems – Arbitration and Legal Requirements Computer Applications in Construction Management: Software for Project Planning, Scheduling and Control.		
UNIT – V		
Safety Management – Implementation and Application of QMS in Safety Programs, ISO 9000 Series, Accident Theories, Cost of Accidents, Problem Areas in Construction Safety, Fall Protection, Incentives, Zero Accident Concepts, Planning for Safety, Occupational Health and Ergonomics.		
TEXT BOOKS:		
1. Construction Project Management, SK. Sears, GA. Sears, RH. Clough, John Wiley and Sons, 6th Edition, 2016. 2. Construction Project Scheduling and Control by Saleh Mubarak, 4th Edition, 2019 3. Pandey, I.M (2021) Financial Management 12th edition. Pearson India Education Services Pvt. Ltd.		
REFRENCE BOOKS:		
1. Brien, J.O. andPlotnick, F.L., CPMin Construction Management, Mcgraw Hill, 2010. 2. Punmia, B.C., andKhandelwal, K.K., Project Planning and control with PERT and CPM, Laxmi Publications, 2002. 3. Construction Methods and Management: Pearson New International Edition 8 th Edition Stephens Nunnally. 4. Rhoden, M and Cato B, Construction Management andOrganisational Behaviour, Wiley-Blackwell, 2016.		
Online Learning Resources:		
https://archive.nptel.ac.in/courses/105/104/105104161/ **https://archive.nptel.ac.in/courses/105/103/105103093/**		

III B.Tech I Semester

L	T	P	C
3	0	0	3

23A025ET ELECTRICAL SAFETY PRACTICES AND STANDARDS
(Open Elective-I)

Course Outcomes:

CO1: Understanding the Fundamentals of Electrical Safety -L2
CO2: Identifying and Applying Safety Components -L3
CO3: Analyzing Grounding Practices and Electrical Bonding
CO4: Applying Safety Practices in Electrical Installations and Environments- L4
CO5: Evaluating Electrical Safety Standards and Regulatory Compliance -L5

UNIT I IntroductionToElectricalSafety:
Fundamentals ofElectricalsafety-ElectricShock-physiologicaleffects of electric current-Safetyrequirements–Hazardsofelectricity-Arc-Blast-Causesforelectricalfailure.

UNIT II Safety Components:
Introduction to conductors and insulators- voltage classification -safety against over voltages- safety againststaticelectricity-Electricalsafetyequipment‘s-Fireextinguishersforelectricalsafety.

UNIT III Grounding:
General requirements for grounding and bonding- Definitions- System grounding-Equipment grounding -The Earth-Earthingpractices-Determiningsafeapproachdistance-Determiningarchazardcategory.

UNIT IVSafetyPractices:
Generalfirstaid-Safetyinhandlinghandheldelectricalappliancestools-Electricalsafetyintrain stations-swimmingpools,externallightinginstallations,medicallocations-Casestudies.

UNIT V Standards For Electrical Safety:
Electricity Acts- Rules & regulations- Electrical standards-NFPA 70 E-OSHA standards-IEEE standards-National Electrical Code 2005 – National Electric Safety code NESC-Statutory requirements from electricalinspectorate

TEXTBOOKS:

1. MassimoA.G.Mitolo,―ElectricalSafetyofLow-VoltageSystems‖,McGrawHill,USA,2009.
2. MohamedEl-Sharkawi,―ElectricSafety-PracticeandStandards‖,CRCPress,USA,2014

REFERENCES:

1. KennethG.Mastrullo, RayA.Jones,―TheElectricalSafetyProgramBook‖,Jones andBartlettPublishers,London, 2nd Edition, 2011.
2. PalmerHickman,―ElectricalSafety-RelatedWorkPractices‖,Jones&BartlettPublishers,London,2009.
3. FordhamCooper,W.,―ElectricalSafetyEngineering‖,ButterworthandCompany,London,1986.
4. JohnCadick,MaryCapelli-Schellpfeffer,DennisK.Neitzel,―ElectricalSafetyHandbook,McGraw-Hill,NewYork,USA, 4th edition, 2012.

III B.Tech – I Sem **L T P C**
3 0 0 3

23A03505 SUSTAINBLE ENERGY TECHNOLOGIES
(Open Elective-I)

Course objectives: Theobjectives of the courseareto	
1	demonstrate the importance the impact of solar radiation, solar PVmodules
2	understand the principles of storage in PV systems
3	discuss solar energy storage systems and their applications.
4	get knowledge in wind energy and bio-mass
5	gain insights in geothermal energy, ocean energy and fuel cells.

COURSE OUTCOMES On successful completion of this course the student will be able to		
CO1	Illustrate the importance of solar radiation and solar PV modules.	L1, L2
CO2	Discuss the storage methods in PV systems	L2,L3
CO3	Explain the solar energy storage for different applications	L2,L3
CO4	Understand the principles of wind energy, and bio-mass energy.	L2, L3
CO5	Attain knowledge in geothermal energy, ocean energy and fuel cells.	L1, L2,L3, L4

UNIT – 1

SOLAR RADIATION: Role and potential of new and renewable sources, the solar energy option, Environmental impact of solar power, structure of the sun, the solar constant, sun-earth relationships, coordinate systems and coordinates of the sun, extraterrestrial and terrestrial solar radiation, solar radiation on titled surface, instruments for measuring solar radiation and sun shine, solar radiation data, numerical problems.

SOLAR PV MODULES AND PV SYSTEMS:

PV Module Circuit Design, Module Structure, Packing Density, Interconnections, Mismatch and Temperature Effects, Electrical and Mechanical Insulation, Lifetime of PV Modules, Degradation and Failure, PV Module Parameters, Efficiency of PV Module, Solar PV Systems-Design of Off Grid Solar Power Plant. Installation and Maintenance.

UNIT – 2

STORAGE IN PV SYSTEMS:

Battery Operation, Types of Batteries, Battery Parameters, Application and Selection of Batteries for Solar PV System, Battery Maintenance and Measurements, Battery Installation for PV System.

UNIT – 3

SOLAR ENERGY COLLECTION: Flat plate and concentrating collectors, classification of concentrating collectors, orientation.

SOLAR ENERGY STORAGE AND APPLICATIONS: Different methods, sensible, latent heat and stratified storage, solar ponds, solar applications- solar heating/cooling technique, solar distillation and drying, solar cookers, central power tower concept and solar chimney.

UNIT – 4

WIND ENERGY: Sources and potentials, horizontal and vertical axis windmills, performance characteristics, betz criteria, types of winds, wind data measurement.

BIO-MASS: Principles of bio-conversion, anaerobic/aerobic digestion, types of bio-gas digesters, gas yield, utilization for cooking, bio fuels, I.C. engine operation and economic aspects.

UNIT – 5

GEOTHERMAL ENERGY: Origin, Applications, Types of Geothermal Resources, Relative Merits

OCEAN ENERGY: Ocean Thermal Energy; Open Cycle & Closed Cycle OTEC Plants, Environmental Impacts, Challenges

FUEL CELLS: Introduction, Applications, Classification, Different Types of Fuel Cells Such as Phosphoric Acid Fuel Cell, Alkaline Fuel Cell, PEM Fuel Cell, MC Fuel Cell.

Text Books:

1. Solar Energy – Principles of Thermal Collection and Storage/Sukhatme S.P. and J.K.Nayak/TMH

2. Non-Conventional Energy Resources- Khan B.H/ Tata McGraw Hill, New Delhi, 2006

References:

1. Principles of Solar Engineering - D.Yogi Goswami, Frank Krieth& John F Kreider / Taylor &Francis

2. Non-Conventional Energy - Ashok V Desai /New Age International (P) Ltd

3. Renewable Energy Technologies -Ramesh & Kumar /Narosa

4. Non-conventional Energy Source- G.D Roy/Standard Publishers

Online Learning Resources:

https://nptel.ac.in/courses/112106318

https://youtube.com/playlist?list=PLyqSpQzTE6M-ZgdjYukayF6QevPv7WE-r&si=-mwIa2X-SuSiNy13

https://youtube.com/playlist?list=PLyqSpQzTE6M-ZgdjYukayF6QevPv7WE-r&si=Apfjx6oDfz1Rb_N3

https://youtu.be/zx04Kl8y4dE?si=VmOvp_OgqisILTAF

III B.Tech I Sem **L – T – P – C**
3 – 0 – 0 – 3

23A045DT **ELECTRONIC CIRCUITS**
(Open Elective –I)

Course Objectives:

1. To understand semiconductor diodes, their characteristics and applications.
2. To explore the operation, configurations, and biasing of BJTs.
3. To study the operation, analysis, and coupling techniques of BJT amplifiers.
4. To learn the operation, applications and uses of feedback amplifiers and oscillators.
5. To analyze the characteristics, configurations, and applications of operational amplifiers.

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

1. Understand semiconductor diodes, their characteristics and applications.
2. Explore the operation, configurations, and biasing of BJTs.
3. Gain knowledge about the operation, analysis, and coupling techniques of BJT amplifiers.
4. Learn the operation, applications and uses of feedback amplifiers and oscillators.
5. Analyze the characteristics, configurations, and applications of operational amplifiers.

UNIT-I

Semiconductor Diode and Applications: Introduction, PN junction diode – structure, operation and VI characteristics, Half-wave, Full-wave and Bridge Rectifiers with and without Filters, Positive and Negative Clipping and Clamping circuits (Qualitative treatment only).

Special Diodes: Zener and Avalanche Breakdowns, VI Characteristics of Zener diode, Zener diode as voltage regulator, Construction, operation and VI characteristics of Tunnel Diode, LED, Varactor Diode, Photo Diode .

UNIT-II

Bipolar Junction Transistor (BJT): Principle of Operation, Common Emitter, Common Base and Common Collector Configurations, Transistor as a switch and Amplifier, Transistor Biasing and Stabilization - Operating point, DC & AC load lines, Biasing - Fixed Bias, Self Bias, Bias Stability, Bias Compensation using Diodes.

UNIT-III

Single stage amplifiers: Classification of Amplifiers - Distortion in amplifiers, Analysis of CE, CC and CB configurations with simplified hybrid model.

Multistage amplifiers: Different Coupling Schemes used in Amplifiers - RC coupled amplifiers, Transformer Coupled Amplifier, Direct Coupled Amplifier; Multistage RC coupled BJT amplifier (Qualitative treatment only).

UNIT-IV

Feedback amplifiers: Concepts of feedback, Classification of feedback amplifiers, Effect of feedback on amplifier characteristics, Voltage Series, Voltage Shunt, Current Series and Current Shunt Feedback Configurations (Qualitative treatment only).

Oscillators: Classification of oscillators, Condition for oscillations, RC Phase shift Oscillators, Generalized analysis of LC Oscillators-Hartley and Colpitts Oscillators, Wien Bridge Oscillator.

UNIT-V

Op-amp: Classification of IC'S, basic information of Op-amp, ideal and practical Op-amp, 741 op-amp and its features, modes of operation-inverting, non-inverting, differential.

Applications of op-amp : Summing, scaling and averaging amplifiers, Integrator, Differentiator, phase shift oscillator and comparator.

TEXT BOOKS:

1. Electronics Devices and Circuits, J.Millman and Christos. C. Halkias, 3rd edition, Tata McGraw Hill, 2006.
2. Electronics Devices and Circuits Theory, David A. Bell, 5th Edition, Oxford University press. 2008.

REFERENCE BOOKS:

1. Electronics Devices and Circuits Theory, R.L.Boylestad, LousisNashelsky and K.Lal Kishore, 12th edition, 2006, Pearson, 2006.
2. Electronic Devices and Circuits, N.Salivahanan, and N.Suresh Kumar, 3rd Edition, TMH, 2012
3. Microelectronic Circuits, S.Sedra and K.C.Smith, 5th Edition, Oxford University Press.

III B.Tech I Sem

23A05505a	JAVA PROGRAMMING (Open Elective-I)	L	T	P	C
		3	0	0	3

Course Objectives: The main objective of the course is to Identify Java language components and how they work together in applications

- Learn the fundamentals of object-oriented programming in Java, including defining classes, invoking methods, using class libraries.
- Learn how to extend Java classes with inheritance and dynamic binding and how to use exception
- handling in Java applications
- Understand how to design applications with threads in Java
- Understand how to use Java apisfor program development

Course Outcomes: After completion of the course, students will be able to
CO1: Analyze problems, design solutions using OOP principles, and implement them efficiently in Java.
CO2: Design and implement classes to model real-world entities, with a focus on attributes, behaviors, and relationships between objects
CO3: Demonstrate an understanding of inheritance hierarchies and polymorphic behaviour, including method overriding and dynamic method dispatch.
CO4: Apply Competence in handling exceptions and errors to write robust and fault-tolerant code.
CO5: Perform file input/output operations, including reading from and writing to files using Java I/O classes, graphical user interface (GUI) programming using JavaFX.

Unit – I: Object Oriented Programming: Basic concepts, Principles, Program Structure in Java: Introduction, Writing Simple Java Programs, Elements or Tokens in Java Programs, Java Statements, Command Line Arguments, User Input to Programs, Escape Sequences Comments, Programming Style. Data Types, **Variables, and Operators :**Introduction, Data Types in Java, Declaration of Variables, Data Types, Type Casting, Scope of Variable Identifier, Literal Constants, Symbolic Constants, Formatted Output with printf() Method, Static Variables and Methods, Attribute Final, **Introduction to Operators**, Precedence and Associativity of Operators, Assignment Operator (=), Basic Arithmetic Operators, Increment (++) and Decrement (- -) Operators, Ternary Operator, Relational Operators, Boolean Logical Operators, Bitwise Logical Operators.
Control Statements: Introduction, if Expression, Nested if Expressions, if–else Expressions, Ternary Operator?:, Switch Statement, Iteration Statements, while Expression, do–while Loop, for Loop, Nested for Loop, For–Each for Loop, Break Statement, Continue Statement.

Unit II:Classes and Objects: Introduction, Class Declaration and Modifiers, Class Members, Declaration of Class Objects, Assigning One Object to Another, Access Control for Class Members, Accessing Private Members of Class, Constructor Methods for Class, Overloaded Constructor Methods, Nested Classes, Final Class and Methods, Passing Arguments by Value and by Reference, Keyword this.

Methods: Introduction, Defining Methods, Overloaded Methods, Overloaded Constructor Methods, Class Objects as Parameters in Methods, Access Control, Recursive Methods, Nesting of Methods, Overriding Methods, Attributes Final and Static.

Unit III: Arrays: Introduction, Declaration and Initialization of Arrays, Storage of Array in Computer Memory, Accessing Elements of Arrays, Operations on Array Elements, Assigning Array to Another Array, Dynamic Change of Array Size, Sorting of Arrays, Search for Values in Arrays, Class Arrays, Two-dimensional Arrays, Arrays of Varying Lengths, Three-dimensional Arrays, Arrays as Vectors.
Inheritance: Introduction, Process of Inheritance, Types of Inheritances, Universal Super ClassObject Class, Inhibiting Inheritance of Class Using Final, Access Control and Inheritance, Multilevel Inheritance, Application of Keyword Super, Constructor Method and Inheritance, Method Overriding, Dynamic Method Dispatch, Abstract Classes, Interfaces and Inheritance.
Interfaces: Introduction, Declaration of Interface, Implementation of Interface, Multiple Interfaces, Nested Interfaces, Inheritance of Interfaces, Default Methods in Interfaces, Static Methods in Interface, Functional Interfaces, Annotations.

Unit IV: Packages and Java Library: Introduction, Defining Package, Importing Packages and Classes into Programs, Path and Class Path, Access Control, Packages in Java SE, Java.lang Package and its Classes, Class Object, Enumeration, class Math, Wrapper Classes, Auto-boxing and Autounboxing, Java util Classes and Interfaces, Formatter Class, Random Class, Time Package, Class Instant (java.time.Instant), Formatting for Date/Time in Java, Temporal Adjusters Class, Temporal Adjusters Class.
Exception Handling: Introduction, Hierarchy of Standard Exception Classes, Keywords throws and throw, try, catch, and finally Blocks, Multiple Catch Clauses, Class Throwable, Unchecked Exceptions, Checked Exceptions.
Java I/O and File: Java I/O API, standard I/O streams, types, Byte streams, Character streams, Scanner class, Files in Java(Text Book 2)

Unit V: String Handling in Java: Introduction, Interface Char Sequence, Class String, Methods for Extracting Characters from Strings,Comparison, Modifying, Searching; Class String Buffer.
Multithreaded Programming: Introduction, Need for Multiple Threads Multithreaded Programming for Multi-core Processor, Thread Class, Main Thread Creation of New Threads, Thread States, Thread Priority-Synchronization, Deadlock and Race Situations, Inter thread Communication - Suspending, Resuming, and Stopping of Threads. Java Database Connectivity: Introduction, JDBC Architecture, Installing MySQL and MySQL Connector/J, JDBC Environment Setup, Establishing JDBC Database Connections, ResultSet Interface
Java FX GUI: Java FX Scene Builder, Java FX App Window Structure, displaying text and image, event handling, laying out nodes in scene graph, mouse events (Text Book 3)

Learning Resources:
Textbooks:

1. JAVA one step ahead, Anitha Seth, B.L.Juneja, Oxford.
2. Joy with JAVA, Fundamentals of Object Oriented Programming, DebasisSamanta, MonalisaSarma, Cambridge, 2023.
3. JAVA 9 for Programmers, Paul Deitel, Harvey Deitel, 4th Edition, Pearson.

Reference Books:

1. The complete Reference Java, 11thedition, Herbert Schildt,TMH

2. Introduction to Java programming, 7th Edition, Y Daniel Liang, Pearson

Online Learning Resources:

1. *https://nptel.ac.in/courses/106/105/106105191/*
2. *https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_012880464547618816347 _shared/overv*iew

III B.Tech I Sem

23A05505b	FUNDAMENTALS OF ARTIFICIAL INTELLIGENCE (Open Elective-I)	L	T	P	C
		3	0	0	3

Course Objectives:

- To learn the distinction between optimal reasoning Vs. human like reasoning.
- To understand the concepts of state space representation, exhaustive search, heuristic
- search together with the time and space complexities.

- To learn different knowledge representation techniques.
- To understand the applications of AI, namely game playing, theorem proving, and machine learning.

Course Outcomes:

- Learn the distinction between optimal reasoning Vs human like reasoning and formulate an efficient problem space for a problem expressed in natural language. Also select a search algorithm for a problem and estimate its time and space complexities.
- Apply AI techniques to solve problems of game playing, theorem proving, and machine learning.
- Learn different knowledge representation techniques.
- Understand the concepts of state space representation, exhaustive search, heuristic search together with the time and space complexities.
- Comprehend the applications of Probabilistic Reasoning and Bayesian Networks.
- Analyze Supervised Learning Vs. Learning Decision Trees

UNIT - I

Introduction to AI - Intelligent Agents, Problem-Solving Agents,

Searching for Solutions - Breadth-first search, Depth-first search, Hill-climbing search, Simulated annealing search, Local Search in Continuous Spaces.

UNIT-II

Games - Optimal Decisions in Games, Alpha–Beta Pruning, Defining Constraint Satisfaction Problems, Constraint Propagation, Backtracking Search for CSPs, Knowledge-Based Agents, **Logic-** Propositional Logic, Propositional Theorem Proving: Inference and proofs, Proof by resolution, Horn clauses and definite clauses.

UNIT-III

First-Order Logic - Syntax and Semantics of First-Order Logic, Using First Order Logic, Knowledge Engineering in First-Order Logic. Inference in First-Order Logic: Propositional vs. First-Order Inference, Unification, Forward Chaining, Backward Chaining, Resolution.

Knowledge Representation: Ontological Engineering, Categories and Objects, Events.

UNIT-IV

Planning - Definition of Classical Planning, Algorithms for Planning with State Space Search, Planning Graphs, other Classical Planning Approaches, Analysis of Planning approaches. Hierarchical Planning.

UNIT-V

ProbabilisticReasoning:

Acting under Uncertainty, Basic Probability Notation Bayes‘ Rule and Its Use, Probabilistic Reasoning, Representing Knowledge in an Uncertain Domain, The Semantics of Bayesian Networks, Efficient Representation of Conditional Distributions, Approximate Inference in Bayesian Networks, Relational and First- Order Probability.

TEXT BOOK:

1. Artificial Intelligence: A Modern Approach, Third Edition, Stuart Russell and Peter Norvig, Pearson Education.

REFERENCE BOOKS:

1. Artificial Intelligence, 3rd Edn., E. Rich and K. Knight (TMH)
2. Artificial Intelligence, 3rd Edn., Patrick Henny Winston, Pearson Education.
3. Artificial Intelligence, Shivani Goel, Pearson Education.
4. Artificial Intelligence and Expert systems – Patterson, Pearson Education.

23A055DT	**QUANTUM TECHNOLOGIES AND APPLICATIONS** **Open Elective – I**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Objectives:

- To introduce the fundamentals of quantum mechanics relevant to quantum technologies.
- To explain key quantum phenomena and their role in enabling novel technologies.
- To explore applications in quantum computing, communication, and sensing.
- To encourage understanding of emerging quantum-based technologies and innovations.

Syllabus

UNIT I: Fundamentals of Quantum Mechanics (7 Hours)

- Classical vs Quantum Paradigm
- Postulates of Quantum Mechanics
- Wavefunction and Schrödinger Equation (Time-independent)
- Quantum states, Superposition, Qubits
- Measurement, Operators, and Observables
- Entanglement and Non-locality

UNIT II: Quantum Computing

- Qubits and Bloch Sphere
- Quantum Logic Gates: Pauli, Hadamard, CNOT, and Universal Gates
- Quantum Circuits
- Basic Algorithms: Deutsch-Jozsa. Gover‘s, Shor‘s (conceptual)
- Error Correction and Decoherence

UNIT III: Quantum Communication and Cryptography (7 Hours)

- Teleportation & No-Cloning
- BB84 Protocol
- Quantum Networks & Repeaters
- Classical vs Quantum Cryptography
- Challenges in Implementation

UNIT IV: Quantum Sensors and Metrology

- Quantum Sensing: Principles and Technologies
- Quantum-enhanced Measurements
- Atomic Clocks, Gravimeters
- Magnetometers, NV Centers
- Industrial Applications
-

UNIT V: Quantum Materials and Emerging Technologies

- Quantum Materials: Superconductors, Topological Insulators
- Quantum Devices: Qubits, Josephson Junctions
- National Quantum Missions (India, EU, USA, China)
- Quantum Careers and Industry Initiatives

Textbooks and References

Primary Textbooks:

- "Quantum Computation and Quantum Information" by Michael A. Nielsen and Isaac L. Chuang (Cambridge University Press)

• "Quantum Mechanics: The Theoretical Minimum" by Leonard Susskind and Art Friedman (Basic Books)
Supplementary Reading:
• "Quantum Computing for Everyone" by Chris Bernhardt (MIT Press)
• "Quantum Physics: A Beginner‘s Guide" by Alastair I.M. Rae
• "An Introduction to Quantum Computing" by Phillip Kaye, Raymond Laflamme, and Michele Mosca
• IBM Quantum Experience and Qiskit Documentation (https://qiskit.org/)

Course Outcomes
• Understand key quantum mechanical concepts and phenomena.
• Comprehend the structure and function of quantum algorithms and circuits.
• Explore applications in quantum communication and cryptography.
• Appreciate the role of quantum technologies in modern engineering systems.

III B.Tech I Sem

L	T	P	C
3	0	0	3

23AHS51T MATHEMATICS FOR MACHINE LEARNING AND AI

(Open Elective 1)

Course Objectives:

- To provide a strong mathematical foundation for understanding and developing AI/ML algorithms.
- To enhance the ability to apply linear algebra, probability, and calculus in AI/ML models.
- To equip students with optimization techniques and graph-based methods used in AI applications.
- To develop critical problem-solving skills for analysing mathematical formulations in AI/ML.

Course Outcomes:

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

COs	Statements	Blooms level
CO1	Apply linear algebra concepts to ML techniques like PCA and regression.	L3 (Apply)
CO2	Analyze probabilistic models and statistical methods for AI applications.	L4 (Analyze)
CO3	Implement optimization techniques for machine learning algorithms.	L3 (Apply)
CO4	Utilize vector calculus and transformations in AI-based models.	L3 (Apply)
CO5	Develop graph-based AI models using mathematical representations.	L5 (Evaluate)

Course Articulation Matrix:

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

• **3** = Strong Mapping, **2** = Moderate Mapping, **1** = Slight Mapping, **-** = No Mapping

UNIT I: Linear Algebra for Machine Learning(08)

Review of Vector spaces, basis, linear independence, Vector and matrix norms, Matrix factorization techniques, Eigenvalues, eigenvectors, diagonalization, Singular Value Decomposition (SVD) and Principal Component Analysis (PCA).

UNIT II: Probability and Statistics for AI(08)

Probability distributions: Gaussian, Binomial, Poisson. Bayes‘ Theorem, Maximum Likelihood Estimation (MLE), and Maximum a Posteriori (MAP).Entropy and Kullback-Leibler (KL) Divergence in AI, Cross entropy loss, Markov chains.

UNIT III: Optimization Techniques for ML(08)

Multivariable calculus: Gradients, Hessians, Jacobians. Constrained optimization: Lagrange multipliers and KKT conditions.Gradient Descent and its variants (Momentum, Adam) Newton‘s method, BFGS method.

UNIT IV: Vector Calculus & Transformations(08)

Vector calculus: Gradient, divergence, curl. Fourier Transform & Laplace Transform in ML applications.

UNIT V: Graph Theory for AI(08)

Graph representations: Adjacency matrices, Laplacian matrices. Bayesian Networks & Probabilistic Graphical Models. Introduction to Graph Neural Networks (GNNs).

Textbooks:

1. Mathematics for Machine Learning by Marc Peter Deisenroth, A. Aldo Faisal, Cheng Soon Ong, Cambridge University Press, 2020.
2. Pattern Recognition and Machine Learningby Christopher Bishop, Springer.

Reference Books:

1. Gilbert Strang, Linear Algebra and Its Applications, Cengage Learning, 2016.
2. Jonathan Gross, Jay Yellen, Graph Theory and Its Applications, CRC Press, 2018.

Web References:

- MIT– Mathematics for Machine Learning https://ocw.mit.edu
- Stanford CS229 – Machine Learning Course https://cs229.stanford.edu/

DeepAI – Mathematical Foundations for AI https://deepai.org

III B.Tech I Sem

23AHS52T	**MATERIALS CHARACTERIZATION TECHNIQUES** (Common to all branches) (Open Elective-Interdisciplinary) **(Open Elective-I)**	Credits 3-0-0:3

COURSE OBJECTIVES	
1	To provide exposure to different characterization techniques.
2	To explain the basic principles and analysis of different spectroscopic techniques.
3	To elucidate the working of Scanning electron microscope - Principle, limitations and applications.
4	To illustrate the working of the Transmission electron microscope (TEM) - SAED patterns and its applications.
5	To educate the uses of advanced electric and magnetic instruments for characterization.

UNIT I Structure analysis by Powder X-Ray Diffraction 9H

Introduction, Bragg's law of diffraction, Intensity of Diffracted beams, Factors affecting Diffraction, Intensities, Structure of polycrystalline Aggregates, Determination of crystal structure, Crystallite size by Scherer and Williamson-Hall (W-H) Methods, Small angle X-ray scattering (SAXS) (in brief).

UNIT II Microscopy technique -1 –Scanning Electron Microscopy (SEM) 9H

Introduction, Principle, Construction and working principle of Scanning Electron Microscopy, Specimen preparation, Different types of modes used (Secondary Electron and Backscatter Electron), Advantages, limitations and applications of SEM.

UNIT III Microscopy Technique -2 - Transmission Electron Microscopy (TEM) 9H

Construction and Working principle, Resolving power and Magnification, Bright and dark fields, Diffraction and image formation, Specimen preparation, Selected Area Diffraction, Applications of Transmission Electron Microscopy, Difference between SEM and TEM, Advantage and Limitations of Transmission Electron Microscopy

UNIT IV Spectroscopy techniques 9H

Principle, Experimental arrangement, Analysis and advantages of the spectroscopic techniques – (i) UV-Visible spectroscopy (ii) Raman Spectroscopy, (iii) Fourier Transform infrared (FTIR) spectroscopy, (iv) X-ray photoelectron spectroscopy (XPS).

UNIT V Electrical & Magnetic Characterization techniques 9H

Electrical Properties analysis techniques (DC conductivity, AC conductivity) Activation Energy, Effect of Magnetic field on the electrical properties (Hall Effect). Magnetization measurement by induction method, Vibrating sample Magnetometer (VSM) and SQUID.

Textbooks:

1. Material Characterization: Introduction to Microscopic and Spectroscopic Methods – Yang Leng – John Wiley & Sons (Asia) Pvt. Ltd. 2013.
2. Microstructural Characterization of Materials - David Brandon, Wayne D Kalpan, John Wiley & Sons Ltd., 2008

Reference Books:

1. Fundamentals of Molecular Spectroscopy – IV Ed. – Colin Neville BanwellandElaine M. McCash, Tata McGraw-Hill, 2008.
2. Elements of X-ray diffraction – Bernard Dennis Cullity& Stuart R Stocks, Prentice Hall , 2001 – Science.
3. Practical Guide to Materials Characterization: Techniques and Applications - Khalid Sultan – Wiley – 2021.
4. **Materials Characterization Techniques -**Sam Zhang, Lin Li, Ashok Kumar -CRC Press - 2008

NPTEL courses link :

1. **https://nptel.ac.in/courses/115/103/115103030/**
2. **https://nptel.ac.in/content/syllabus_pdf/113106034.pdf**
3. **https://nptel.ac.in/noc/courses/noc19/SEM1/noc19-mm08/**

	Course Outcomes	Blooms Level
CO1	Analyze the crystal structure and crystallite size by various methods	L1,L2, L3, L4
CO2	Analyze the morphology of the sample by using a Scanning Electron Microscope	L1,L2, L4
CO3	Analyze the morphology and crystal structure of the sample by using Transmission Electron Microscope	L1,L2, L3
CO4	Explain the principle and experimental arrangement of various spectroscopic techniques	L1,L2
CO5	Identify the construction and working principle of various Electrical & Magnetic Characterization technique	L1,L2

Course Articulation Matrix:

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

1-Slightly, 2-Moderately, 3-Substantially.

III B.Tech I Sem

Course Code	Title of the Subject	L	T	P	C
23AHS53T	**CHEMISTRY OF ENERGY SYSTEMS**	3		-	3

COURSE OBJECTIVES	
1	To make the student understand basic electrochemical principles such as standard electrode potentials, emf and applications of electrochemical principles in the design of batteries.
2	To understand the basic concepts of processing and limitations of Fuel cells & their applications.
3	To impart knowledge to the students about fundamental concepts of photo chemical cells, reactions and applications
4	Necessarily of harnessing alternate energy resources such as solar energy and its basic concepts.
5	To impart knowledge to the students about fundamental concepts of hydrogen storage in different materials and liquification method.

COURSE OUTCOMES	
CO1	➢ Solve the problems based on electrode potential, Describe the Galvanic Cell ➢ Differentiate between Lead acid and Lithium ion batteries, Illustrate the electrical double layer
CO2	➢ Describe the working Principle of Fuel cell, Explain the efficiency of the fuel cell ➢ Discuss about the Basic design of fuel cells, Classify the fuel cell
CO3	➢ Differentiate between Photo and Photo electrochemical Conversions, Illustrate the photochemical cells, Identify the applications of photochemical reactions, ➢ Interpret advantages of photoelectron catalytic conversion.
CO4	➢ Apply the photo voltaic technology, Demonstrate about solar energy and prospects ➢ Illustrate the Solar cells, Discuss about concentrated solar power
CO5	➢ Differentiate Chemical and Physical methods of hydrogen storage, Discuss the metal organic frame work, Illustrate the carbon and metal oxide porous structures ➢ Describe the liquification methods.

Mapping between Course Outcomes and Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

UNIT-1: Electrochemical Systems: Galvanic cell, Nernst equation, standard electrode potential, application of EMF, electrical double layer, polarization, Batteries- Introduction ,Lead-acid ,Nickel- cadmium, Lithium ion batteries and their applications**.**

UNIT-2: Fuel Cells: Fuel cell- Introduction, Basic design of fuel cell, working principle, Classification of fuel cells, Polymer electrolyte membrane (PEM) fuel cells, Solid-oxide fuel cells (SOFC), Fuel cell efficiency and applications.

UNIT-3: Photo and Photo electrochemical Conversions: Photochemical cells Introduction and applications of photochemical reactions, specificity of photo electrochemical cell, advantage of photoelectron catalytic conversions and their applications.

UNIT-4: Solar Energy: Introduction and prospects, photovoltaic (PV) technology, concentrated solar power (CSP), Solar cells and applications. .

UNIT-5: Hydrogen Storage: Hydrogen storage and delivery: State-of-the art, Established technologies, Chemical and Physical methods of hydrogen storage, Compressed gas storage, Liquid hydrogen storage, Other storage methods, Hydrogen storage in metal hydrides, metal organic frameworks (MOF), Metal oxide porous structures, hydrogel , and Organic hydrogen carriers.

Text books

1. Physical chemistry by Ira N. Levine
2. Essentials of Physical Chemistry, Bahl and Bahl and Tuli.
3. Inorganic Chemistry, Silver and Atkins

Reference Books:

1. Fuel Cell Hand Book 7th Edition, by US Department of Energy (EG&G technical services And corporation)
2. Hand book of solar energy and applications by ArvindTiwari and Shyam.
3. Solar energy fundamental, technology and systems by Klaus Jagar et.al.
4. Hydrogen storage by Levine Klebonoff

III B.Tech I Sem

Course Code	**ENGLISH FOR COMPETITIVE EXAMINATIONS**	L	T	P	C
23AHS54T	**(Open Elective-I)** (Common to All Branches of Engineering)	3	0	0	3

Course Objectives:

1. To enable the students to learn about the structure of competitive English
2. To understand the grammatical aspects and identify the errors
3. To enhance verbal ability and identify the errors
4. To improve word power to answer competitive challenges
5. To make them ready to crack competitive exams

Course Outcomes (CO): Blooms Level

By the end of the program students will be able to

- Identify the basics of English grammar and its importance L1, L2
- Explain the use of grammatical structures in sentences L1, L2
- Demonstrate the ability to use various concepts in grammar and vocabulary and their applications in everyday use and in competitive exams L3
- Analyze an unknown passage and reach conclusions about it. L4
- Choose the appropriate form of verbs in framing sentences L5
- Develop speed reading and comprehending ability thereby perform better in competitive exams L3

UNIT - I	**GRAMMAR-1**	Lecture Hrs

Nouns-classification-errors-Pronouns-types-errors-Adjectives-types-errors-Articles-definite-indefinite-Degrees of Comparison-Adverbs-types- errors-Conjunctions-usage-

Prepositions-usage-Tag Questions, types-identifying errors- Practice

UNIT - II	**GRAMMAR-2**	Lecture Hrs

Verbs-tenses- structure-usages- negatives- positives- time adverbs-Sequence of tenses--If Clause-Voice-active voice and passive voice- reported Speech-Agreement- subject and verb-Modals-Spotting Errors-Practices

UNIT - III	**VERBAL ABILITY**	Lecture Hrs

Sentence completion-Verbal analogies-Word groups-Instructions-Critical reasoning-Verbal deduction-Select appropriate pair-Reading Comprehension-Paragraph-Jumbles-Selecting the proper statement by reading a given paragraph.

UNIT - IV	**READING COMPREHENSION AND VOCUBULARY**	Lecture Hrs
Competitive Vocabulary :Word Building – Memory techniques-Synonyms, Antonyms, Affixes-Prefix &Suffix-One word substitutes-Compound words-Phrasal Verbs-Idioms and Phrases-Homophones-Linking Words-Modifiers-Intensifiers - Mastering Competitive Vocabulary- Cracking the unknowing passage-speed reading techniques- Skimming & Scanning-types of answering–Elimination methods		
UNIT - V	**WRITING FOR COMPETITIVE EXAMINATIONS**	Lecture Hrs
Punctuation- Spelling rules- Word order-Sub Skills of Writing- Paragraph meaning-salient features-types - Note-making, Note-taking, summarizing-precise writing- Paraphrasing-Expansion of proverbs-Essay writing-types		

Textbooks:

1. **Wren & Martin, *English for Competitive Examinations,* S.Chand & Co, 2021**
2. *Objective English for Competitive Examination***,** Tata McGraw Hill, New Delhi, 2014.

Reference Books:

1. Hari Mohan Prasad, *Objective English for Competitive Examination,* Tata McGraw Hill, New Delhi, 2014.
2. Philip Sunil Solomon, *English for Success in Competitive Exams*, Oxford 2016
3. Shalini Verma , *Word Power Made Handy*, S Chand Publications
4. Neira, Anjana Dev & Co. *Creative Writing: A Beginner's Manual.* Pearson Education India, 2008.
5. Abhishek Jain,Vocabulary Learning Techniques Vol.I&II,RR Global Publishers 2013.
6. Michel Swan, *Practical English Usage*,Oxford,2006.

Online Resources

1. **https://www.grammar.cl/english/parts-of-speech.htm**
2. **https://academicguides.waldenu.edu/writingcenter/grammar/partsofspeech**
3. **https://learnenglish.britishcouncil.org/grammar/english-grammar-reference/active-passive-voice**
4. **https://languagetool.org/insights/post/verb-tenses/**
5. **https://www.britishcouncil.in/blog/best-free-english-learning-resources-british-council**
6. **https://www.careerride.com/post/social-essays-for-competitive-exams-586.aspx**