

III B.TECH I SEMESTER

S.No	Category	Course Code	Title	L	T	P	Credits
1	PC	23A3351T	ADVANCED MACHINE LEARNING	3	0	0	3
2	PC	23A3352T	DATA WRANGLING & PREPROCESSING	3	0	0	3
3	PC	23A3353T	NATURAL LANGUAGE PROCESSING	3	0	0	3
4	PC	23A0554T	INTRODUCTION TO QUANTUM TECHNOLOGIES AND APPLICATIONS	3	0	0	3
5	PE-I	23A305AT 23A315BT 23A335CT 23A335BT	Professional Elective-I 1. DATA VISUALIZATION 2. ADAPTIVE COMPUTATIONAL METHODS 3. EXPLORATORY DATA ANALYSIS WITH PYTHON 4. INTRODUCTION TO REINFORCEMENT LEARNING	3	0	0	3
6	OE-I		Open Elective- I	3	0	0	3
7	PC	23A3354L	MACHINE LEARNING & NATURAL LANGUAGE PROCESSING LAB	0	0	3	1.5
8	PC	23A3352L	DATA WRANGLING LAB	0	0	3	1.5
9	SEC	23A0555L	FULL STACK DEVELOPMENT - II	0	1	2	2
10	EC	23A0556L	TINKERING LAB FOR COMPUTER ENGINEERS	0	0	2	1
11	INTERN	23A0557I	EVALUATION OF COMMUNITY SERVICE INTERNSHIP	0	0	0	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

S.No	Category	Course Code	Title	L	T	P	Credits
1	PC	23A3361T	INTRODUCTION TO DEEP LEARNING	3	0	0	3
2	PC	23A3362T	EXPLAINABLE AI & MODEL INTERPRETABILITY	3	0	0	3
3	PC	23A3363T	AI FOR EDGE COMPUTING	3	0	0	3
4	PE-II	23A336AT 23A336BT 23A306CT 23A336CT	Professional Elective-II 1. GRAPH NEURAL NETWORKS 2. RECOMMENDER SYSTEMS 3. PREDICTIVE ANALYTICS 4. BIG DATA	3	0	0	3
5	PE-III	23A306ET 23A306FT 23A306HT	Professional Elective-III 1. INTRODUCTION TO QUANTUM COMPUTING 2. COMPUTER VISION 3. SOCIAL NETWORK ANALYSIS	3	0	0	3
6	OE-II		Open Elective – II	3	0	0	3
7	PC	23A3364L	DEEP LEARNING & MACHINE LEARNING MODEL OPTIMIZATION LAB	0	0	3	1.5
8	PC	23A3363L	EDGE COMPUTING LAB	0	0	3	1.5
9	SEC	23AHS65L	Skill Enhancement course SOFT SKILLS	0	1	2	2
10	AC	23AHSM61T	Audit Course TECHNICAL PAPER WRITING & IPR	2	0	0	0
11	ES	23A0564L	WORKSHOP	0	0	0	0
Total				20	1	08	23
Mandatory Industry Intern ship of 6 to 8 weeks duration during summer vacation							

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

III B.TECH I SEMESTER

23A3351T

ADVANCED MACHINE LEARNING
(PROFESSIONAL CORE)
(Common to AI&ML)

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- Provide an in-depth understanding of advanced topics in machine learning beyond traditional models.
- Explore ensemble learning, kernel methods, structured prediction, and deep generative models.
- Equip students with the ability to evaluate and implement state-of-the-art machine learning algorithms for real-world problems.
- Introduce recent advancements in model generalization, regularization techniques, and probabilistic reasoning.
- Foster analytical thinking to solve complex AI problems through advanced modeling and optimization techniques.

COURSE OUTCOMES

- Demonstrate a clear understanding of advanced machine learning algorithms and their theoretical underpinnings.
- Apply ensemble methods, kernel tricks, and probabilistic models to diverse data science problems.
- Analyze and implement optimization techniques for large-scale machine learning problems.
- Design and evaluate structured models and generative approaches for complex datasets.
- Develop and test machine learning systems using modern frameworks and evaluate performance using robust metrics.

UNIT I – ENSEMBLE LEARNING AND MODEL GENERALIZATION (09)

Bias-Variance Trade-off Revisited, Bagging and Bootstrap Aggregating, Random Forests – Theory and Implementation, Boosting Techniques – AdaBoost, Gradient Boosting, XGBoost and LightGBM, Stacking and Blending of Models, Regularization Methods – L1, L2, Dropout, Early Stopping and Cross-Validation Strategies.

UNIT II – KERNEL METHODS AND SUPPORT VECTOR MACHINES (09)

Linear and Non-linear Classification, Kernel Trick – Polynomial, RBF, and Custom Kernels, Soft Margin SVMs, Dual Form and Optimization of SVM, Support Vector Regression, Kernel PCA for Non-linear Dimensionality Reduction, Practical Issues with Kernel Methods, Applications in Text and Image Classification.

UNIT III – PROBABILISTIC GRAPHICAL MODELS AND BAYESIAN LEARNING (09)

Introduction to Probabilistic Graphical Models, Bayesian Networks – Construction and Inference, Markov Random Fields (MRFs), Conditional Random Fields (CRFs), Expectation-Maximization (EM) Algorithm, Variational Inference, Bayesian Linear Regression, Gaussian Processes for Regression and Classification.

UNIT IV – STRUCTURED PREDICTION AND UNSUPERVISED LEARNING

(09)

Hidden Markov Models (HMMs) and Sequence Modeling, Structured SVMs and CRFs, Clustering Revisited – Hierarchical and Spectral Methods, Dimensionality Reduction – ICA, t-SNE, UMAP, Matrix Factorization and Collaborative Filtering, Autoencoders and Variational Autoencoders (VAEs), Clustering Evaluation Metrics, Advanced Use Cases in NLP and Computer Vision.

UNIT V – OPTIMIZATION AND DEEP GENERATIVE MODELS

(09)

Convex vs. Non-convex Optimization, Gradient Descent Variants – SGD, Adam, RMSProp, Deep Generative Models – VAEs and GANs, Conditional GANs and StyleGANs, Reinforcement Learning Introduction, Policy Gradient Methods, Generative Pre-trained Transformers (GPT) Overview, Advanced Topics – Meta Learning, Few-shot Learning.

TEXT BOOKS

1. Pattern Recognition and Machine Learning by Christopher M. Bishop
2. Machine Learning: A Probabilistic Perspective by Kevin P. Murphy
3. Deep Learning by Ian Goodfellow, Yoshua Bengio, and Aaron Courville

REFERENCE BOOKS

1. Understanding Machine Learning: From Theory to Algorithms by Shai Shalev-Shwartz and Shai Ben-David
2. The Elements of Statistical Learning by Trevor Hastie, Robert Tibshirani, and Jerome Friedman
3. Bayesian Reasoning and Machine Learning by David Barber
4. Recent IEEE Transactions and ACM journals on ML

ONLINE COURSES

1. [Advanced Machine Learning Specialization – Coursera \(HSE University\)](#)
2. [Probabilistic Graphical Models – Stanford \(Coursera\)](#)
3. [Advanced Deep Learning – DeepLearning.AI \(Coursera\)](#)
4. [Bayesian Methods for Machine Learning – Coursera](#)
5. Advanced Machine Learning – NPTEL

CO-PO MAPPING

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
23A3351T.1	3	2	1	2	1	-	-	-	-	2	-	2	3	2
23A3351T.2	3	3	3	2	2	-	-	-	-	2	-	2	3	3
23A3351T.3	3	3	3	3	2	-	-	-	-	1	-	2	3	3
23A3351T.4	3	3	3	3	2	-	-	-	1	2	1	2	3	3
23A3351T.5	3	3	3	3	3	-	-	-	2	3	2	3	3	3

III B.TECH I SEMESTER

23A3352T	DATA WRANGLING & PREPROCESSING (PROFESSIONAL CORE) (Common to AI&ML)	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To introduce students to data wrangling techniques using Python and other tools.
- To familiarize students with various data formats such as CSV, JSON, XML, and databases.
- To enable students to clean and preprocess data by handling missing values, duplicates, outliers, and normalization.
- To equip students with skills in data exploration, visualization, and transformation for analysis.
- To provide practical knowledge of web scraping techniques and data acquisition from various sources.

COURSE OUTCOMES

- Demonstrate proficiency in data wrangling techniques for structured and unstructured data.
- Apply data extraction and transformation techniques on various file formats (CSV, JSON, XML, Excel, PDF).
- Perform data cleaning operations, including handling missing values, outlier detection, duplicates, and normalization.
- Analyze datasets by performing exploratory data analysis (EDA) using visualization tools.
- Develop web scraping scripts using Python libraries such as Scrapy, BeautifulSoup, Selenium to gather real-time data.

UNIT I - INTRODUCTION TO DATA WRANGLING (09)

What Is Data Wrangling, Importance of Data Wrangling, Tasks of Data Wrangling, Data Wrangling Tools, Introduction to Python for Data Wrangling, Python Basics for Data Wrangling, Handling Structured Data: CSV, JSON, and XML Formats, Data Meant to Be Read by Machines

UNIT II - WORKING WITH EXCEL FILES, PDFS, AND DATABASES (09)

Installing Python Packages for Data Wrangling, Parsing Excel Files, Programmatic Approaches to PDF Parsing, Converting PDF to Text (pdfminer), Acquiring and Storing Data, Introduction to Databases for Data Wrangling, Relational Databases: MySQL and PostgreSQL, Non-Relational Databases: NoSQL and Alternative Data Storage

UNIT III - DATA CLEANING AND EXPLORATION (09)

Why Clean Data? Basics of Data Cleanup, Identifying and Formatting Data for Clean-Up, Finding Outliers and Bad Data, Removing Duplicates and Fuzzy Matching, Using Regular Expressions (RegEx) for Data Cleaning, Normalization and Standardization of Data, Saving Cleaned Data and Testing with New Data, Data Exploration: Table Functions and Joining Datasets

UNIT IV - DATA PREPROCESSING AND REDUCTION (09)

Data Quality: Why Preprocess Data? Major Tasks in Data Preprocessing, Handling Missing Values in Data, Identifying and Removing Noisy Data, Data Integration and Entity Identification Problem,

Redundancy and Correlation Analysis in Data, Detection and Resolution of Data Conflicts, Tuple Duplication and Its Impact

UNIT V - DATA TRANSFORMATION AND WEB SCRAPING

(09)

Overview of Data Transformation Strategies, Normalization and Standardization, Discretization by Binning and Histogram Analysis, Clustering, Sampling, and Data Cube Aggregation, Web Scraping: What to Scrape and How, Analyzing and Parsing Web Pages with LXML and XPath, Advanced Web Scraping Using Selenium and Scrapy.

TEXT BOOKS

1. Data Wrangling with Python: Tips and Tools to Make Your Life Easier – Dr. Jacqueline Kazil and Katharine Jarmul, O'Reilly Media.
2. Data Preprocessing for Machine Learning in Python" – M.G. Sumithra, CRC Press.

REFERENCE BOOKS

1. Web Scraping with Python: Collecting More Data from the Modern Web" – Ryan Mitchell, O'Reilly Media.
2. Data Cleaning and Exploration with Machine Learning" – Michael Walker, Packt Publishing.

CO-PO MAPPING

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
23A3352T.1	3	2	2	2	2	-	-	-	-	2	-	2	3	2
23A3352T.2	3	2	3	2	3	-	-	-	-	2	-	2	3	3
23A3352T.3	3	3	3	3	2	-	-	-	-	2	-	2	3	3
23A3352T.4	3	3	2	3	3	-	-	-	1	2	1	3	3	3
23A3352T.5	3	2	3	2	3	-	-	-	2	3	2	3	3	3

III B.TECH I SEMESTER

23A3353T

NATURAL LANGUAGE PROCESSING
(PROFESSIONAL CORE)
(Common to CSE(AI) and AI&ML)

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- Basics of NLP, Morphology, Tokenization, N-gram Models
- POS Tagging, Parsing, Treebanks, Ambiguity Handling
- Word Sense Disambiguation, Semantic Parsing, Sentiment Analysis
- Machine Translation, Transformers, BERT/GPT, Ethical NLP
- Speech Recognition, Feature Extraction, Discourse Analysis

COURSE OUTCOMES

- Understand morphological processing and the structure of words and documents.
- Analyze syntactic structures using various parsing algorithms.
- Apply semantic parsing techniques to interpret natural language text.
- Understand predicate-argument structures and meaning representation systems.
- Apply cross-lingual language models and speech recognition techniques in NLP applications

UNIT I - INTRODUCTION TO NLP

(09)

Introduction to NLP: Origins and Challenges, Language and Grammar in NLP, Regular Expressions and Finite-State Automata, Tokenization: Text Segmentation and Sentence Splitting, Morphological Parsing: Stemming and Lemmatization, Spelling Error Detection and Correction, Minimum Edit Distance and Applications, Statistical Language Models: Unigram, Bigram, and Trigram Models, Processing Indian Languages in NLP.

UNIT II - WORD-LEVEL AND SYNTACTIC ANALYSIS

(09)

Introduction, Part-of-Speech (POS) Tagging: Rule-Based, Stochastic and Transformation-Based Approaches, Hidden Markov Models (HMM) and Maximum Entropy Models for POS Tagging, Context-Free Grammar (CFG) and Constituency Parsing, Treebanks and Normal Forms for Grammar, Top-Down and Bottom-Up Parsing Strategies, CYK Parsing Algorithm, Probabilistic Context-Free Grammars (PCFGs), Feature Structures and Unification.

UNIT III - TEXT CLASSIFICATION AND INFORMATION RETRIEVAL

(09)

Naïve Bayes Classifier for Text Classification, Training and Optimization for Sentiment Analysis, Information Retrieval: Basic Concepts and Design Features, Information Retrieval Models: Classical, Non-Classical, and Alternative Models, Cluster Model, Fuzzy Model, and LSTM-Based Information Retrieval, Word Sense Disambiguation (WSD) Methods: Supervised and Dictionary-Based Approaches.

UNIT IV - MACHINE TRANSLATION AND SEMANTIC PROCESSING

(09)

Introduction to Machine Translation (MT), Language Divergence and Typology in MT Encoder-Decoder Model for Machine Translation, Translating in Low-Resource Scenarios, MT Evaluation Metrics and Techniques, Bias and Ethical Issues in NLP and Machine Translation, Semantic Analysis and First-Order Logic in NLP, Thematic Roles and Selectional Restrictions in Semantics, Word Senses and Relations Between Senses

UNIT V - SPEECH PROCESSING AND ADVANCED NLP MODELS

(09)

Speech Fundamentals: Phonetics and Acoustic Phonetics, Digital Signal Processing in Speech Analysis, Feature Extraction in Speech: Short-Time Fourier Transform (STFT), Mel-Frequency Cepstral Coefficients (MFCC) and Perceptual Linear Prediction (PLP), Hidden Markov Models (HMMs) in Speech Recognition.

TEXT BOOKS

1. Daniel Jurafsky & James H. Martin – Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition, Pearson Education, 2023.
2. Tanveer Siddiqui & U.S. Tiwary – Natural Language Processing and Information Retrieval, Oxford University Press.

REFERENCE BOOKS

1. T.V. Geetha – Understanding Natural Language Processing – Machine Learning and Deep Learning Perspectives, Pearson, 2024.
2. Akshay Kulkarni & Adarsha Shivananda – Natural Language Processing Recipes - Unlocking Text Data with Machine Learning and Deep Learning using Python, Apress, 2019.

WEB LINKS AND VIDEO LECTURES (E-RESOURCES)

1. <https://www.youtube.com/watch?v=M7SWr5xObkA>
2. https://onlinecourses.nptel.ac.in/noc23_cs45/preview
3. <https://archive.nptel.ac.in/courses/106/106/106106211/>

CO-PO MAPPING

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
23A3353T.1	3	2	1	2	2	-	-	-	-	2	-	2	3	2
23A3353T.2	3	3	2	3	2	-	-	-	-	2	-	2	3	3
23A3353T.3	3	3	3	3	2	-	-	-	-	2	-	2	3	3
23A3353T.4	3	3	3	3	2	-	-	-	1	2	1	3	3	3
23A3353T.5	3	3	3	3	3	-	-	-	2	3	2	3	3	3

III B.TECH I SEMESTER

23A0554T	INTRODUCTION TO QUANTUM TECHNOLOGIES AND APPLICATIONS (QUALITATIVE TREATMENT) (Common to all branches)	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- 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

- 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 (09)

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 (09)

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 (09)

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, Vision vs 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 (09)

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 (09)

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

TEXT BOOKS

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. Giuliano Benenti, Giulio Casati, Giuliano Strini, 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](#)

CO-PO MAPPING

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
23A0554T.1	3	2	1	2	1	-	-	-	-	2	-	3	3	2
23A0554T.2	3	3	2	2	2	-	-	-	-	2	-	3	3	3
23A0554T.3	2	3	2	3	2	-	-	-	-	2	-	3	3	3
23A0554T.4	2	3	3	3	3	-	-	-	-	3	-	3	3	3
23A0554T.5	1	2	2	2	3	2	2	2	2	3	2	3	2	3

III B.TECH I SEMESTER

23A305AT

DATA VISUALIZATION
(PROFESSIONAL ELECTIVE-I)
(Common to AI&DS, CSE(AI) and AI&ML)

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

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

UNIT I - INTRODUCTION TO DATA VISUALIZATION & PERCEPTION (09)

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 (09)

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 (09)

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 (09)

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**(09)**

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.

TEXT BOOKS

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

CO-PO MAPPING

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
23A305AT.1	3	2	-	2	2	-	-	-	-	2	-	2	3	2
23A305AT.2	2	3	3	2	3	-	-	1	1	2	1	2	3	3
23A305AT.3	2	2	3	2	3	-	-	2	-	2	1	2	3	3
23A305AT.4	3	3	3	3	3	-	-	-	-	2	1	2	3	3
23A305AT.5	2	2	3	2	3	-	-	2	2	3	2	-	-	-

III B.TECH I SEMESTER

23A315BT

**ADAPTIVE COMPUTATIONAL METHODS
(PROFESSIONAL ELECTIVE-I)**
(Common to AI&DS, CSE(AI) and AI&ML)

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

- 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 (09)

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 (09)

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 (09)

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 (09)

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

(09)

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.

TEXT BOOKS

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)

CO-PO MAPPING

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
23A315BT.1	3	2	-	1	2	-	-	-	-	1	-	2	3	2
23A315BT.2	3	3	2	2	3	-	-	2	-	1	-	2	3	3
23A315BT.3	3	3	3	2	3	-	-	-	1	2	-	2	3	3
23A315BT.4	3	3	3	3	3	-	-	1	-	1	-	2	3	3
23A315BT.5	3	3	3	3	3	-	-	2	2	2	1	2	3	3

III B.TECH I SEMESTER

23A335CT	EXPLORATORY DATA ANALYSIS WITH PYTHON (PROFESSIONAL ELECTIVE-I) (Common to AI&DS, CSE(AI) and AI&ML)	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

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

UNIT I – INTRODUCTION TO EDA AND PYTHON ENVIRONMENT (09)

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 (09)

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 (09)

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 (09)

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 (09)

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.

TEXT BOOKS

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)

CO-PO MAPPING

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
23A335CT.1	3	3	2	2	3	-	-	-	-	1	-	2	3	2
23A335CT.2	3	2	2	2	3	-	-	-	-	2	-	2	3	3
23A335CT.3	3	3	3	2	3	-	-	-	-	1	-	2	3	3
23A335CT.4	2	2	3	3	3	-	-	-	-	2	-	2	3	3
23A335CT.5	2	3	3	3	3	-	-	-	-	2	-	2	3	3

III B.TECH I SEMESTER

23A335BT	INTRODUCTION TO REINFORCEMENT LEARNING (PROFESSIONAL ELECTIVE-I) (Common to AI&ML)	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

- 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 (09)

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 (09)

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 (09)

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 (09)

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 METHOD (09)

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

TEXT BOOKS

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/>
3. Coursera – Reinforcement Learning Specialization:
<https://www.coursera.org/specializations/reinforcement-learning>

CO-PO MAPPING

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
23A335BT.1	3	2	1	2	1	-	-	-	-	1	-	2	3	2
23A335BT.2	2	3	2	3	2	-	-	-	1	2	-	2	3	3
23A335BT.3	2	3	2	3	2	-	-	-	1	2	-	2	3	3
23A335BT.4	2	3	3	3	3	-	-	-	2	2	-	3	3	3
23A335BT.5	2	2	3	3	3	-	-	-	2	2	-	3	3	3

III B.TECH I SEMESTER

23A015DT

GREEN BUILDINGS
(OPEN ELECTIVE-I)
(Common to all branches)

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

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

COURSE OUTCOMES

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

UNIT I - INTRODUCTION TO GREEN BUILDING

(09)

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

(09)

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

(09)

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

(09)

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

(09)

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.

REFERENCE 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/>

CO-PO MAPPING

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
23A015DT.1	3	-	-	-	-	2	3	-	-	-	-	-	3	3
23A015DT.2	-	3	-	-	2	-	3	-	-	-	-	2	3	3
23A015DT.3	-	-	3	3	3	-	3	-	-	-	-	-	3	3
23A015DT.4	-	-	3	3	3	-	3	-	-	-	-	-	3	3
23A015DT.5	-	-	-	-	-	3	3	3	2	-	-	-	-	3

III B.TECH I SEMESTER

	CONSTRUCTION TECHNOLOGY AND MANAGEMENT	L	T	P	C
23A015ET	(OPEN ELECTIVE-I)	3	0	0	3
	<i>(Common to all branches)</i>				

COURSE OBJECTIVES

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

COURSE OUTCOMES

- Understand project management fundamentals, organizational structures, and leadership principles in construction.
- Analyze manpower planning, equipment management, and cost estimation in civil engineering projects.
- Apply planning, scheduling, and project management techniques such as CPM and PERT.
- Evaluate various contract types, contract formation, and legal aspects in construction management.
- Assess safety management practices, accident prevention strategies, and quality management systems in construction.

UNIT I – INTRODUCTION (09)

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 (09)

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 AND PROJECT MANAGEMENT (09)

Planning, Scheduling and Project Management: Planning Stages, Construction Schedules and Project Specification, Monitoring and Evaluation; Bar-Chart, CPM, PERT, Network- formulation and Time Computation.

UNIT IV – CONTRACTS

(09)

Types of Contracts, formation of Contract – Contract Conditions – Contract for Labour, 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

(09)

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.

REFERENCE BOOKS

1. Brien, J.O. and Plotnick, F.L., CPM in Construction Management, McGraw Hill, 2010.
2. Punmia, B.C., and Khandelwal, 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 and Organisational 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/>

CO-PO MAPPING

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
23A015ET.1	3	-	-	-	-	2	-	2	2	-	-	-	3	3
23A015ET.2	-	3	-	-	2	-	-	-	-	-	-	2	3	3
23A015ET.3	-	-	3	3	3	-	-	-	-	2	-	-	3	3
23A015ET.4	-	-	3	3	3	-	-	2	-	-	-	-	3	3
23A015ET.5	-	-	-	-	-	3	3	3	2	-	-	-	-	3

III B.TECH I SEMESTER

	ELECTRICAL SAFETY PRACTICES AND STANDARDS	L	T	P	C
23A025ET	(OPEN ELECTIVE-I)	3	0	0	3
	<i>(Common to all branches)</i>				

COURSE OBJECTIVES

- To introduce the fundamental concepts of electrical safety, including the physiological effects of electric shock, arc flash, and electrical blast hazards.
- To familiarize students with safety components, protective equipment, and preventive measures for electrical hazards, including insulation, grounding, and fire safety.
- To impart knowledge on grounding and bonding techniques as per electrical safety standards for both equipment and system grounding.
- To develop awareness of safety practices in various environments such as domestic, industrial, and public spaces, with emphasis on first aid and emergency response.
- To educate students on national and international electrical safety standards, including compliance with regulatory frameworks such as NFPA, OSHA, IEEE, and Indian Electricity Rules.

COURSE OUTCOMES

- Understanding the Fundamentals of Electrical Safety
- Identifying and Applying Safety Components
- Analyzing Grounding Practices and Electrical Bonding
- Applying Safety Practices in Electrical Installations and Environments
- Evaluating Electrical Safety Standards and Regulatory Compliance

UNIT I - INTRODUCTION TO ELECTRICAL SAFETY (08)

Fundamentals of Electrical Safety-Electric Shock- physiological effects of electric current - Safety requirements –Hazards of electricity- Arc - Blast- Causes for electrical failure.

UNIT II - SAFETY COMPONENTS (08)

Introduction to conductors and insulators- voltage classification -safety against over voltages- safety against static electricity-Electrical safety equipment's - Fire extinguishers for electrical safety.

UNIT III – GROUNDING (08)

General requirements for grounding and bonding- Definitions- System grounding- Equipment grounding - The Earth - Earthing practices- Determining safe approach distance-Determining arc hazard category.

UNIT IV - SAFETY PRACTICES (08)

General first aid- Safety in handling hand held electrical appliances tools- Electrical safety in train stations- swimming pools, external lighting installations, medical locations-Case studies.

UNIT V - STANDARDS FOR ELECTRICAL SAFETY (08)

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 electrical inspectorate.

TEXT BOOKS

1. Massimo A.G.Mitolo, —Electrical Safety of Low-Voltage Systems, McGraw Hill, USA, 2009.
2. Mohamed El-Sharkawi, —Electric Safety - Practice and Standards, CRC Press, USA, 2014.

REFERENCE BOOKS

1. Kenneth G.Mastrullo, Ray A. Jones, —The Electrical Safety Program Book, Jones and Bartlett Publishers, London, 2nd Edition, 2011.
2. Palmer Hickman, —Electrical Safety-Related Work Practices, Jones & Bartlett Publishers, London, 2009.
3. Fordham Cooper, W., —Electrical Safety Engineering, Butterworth and Company, London, 1986.
4. John Cadick, Mary Capelli-Schellpfeffer, Dennis K. Neitzel, —Electrical Safety Hand book, McGraw-Hill, New York, USA, 4th edition, 2012.

CO-PO MAPPING

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
23A025ET.1	3	2	-	-	-	2	2	-	-	-	-	2	2	-
23A025ET.2	3	2	2	-	2	2	2	-	-	-	-	2	2	-
23A025ET.3	3	3	2	2	-	2	2	-	-	-	-	2	3	-
23A025ET.4	2	3	2	2	2	3	3	-	-	-	-	2	3	-
23A025ET.5	3	3	2	2	2	3	3	-	-	-	-	3	3	-

III B.TECH I SEMESTER

	SUSTAINABLE ENERGY TECHNOLOGIES	L	T	P	C
23A035FT	(OPEN ELECTIVE-I)	3	0	0	3
	<i>(Common to all branches)</i>				

COURSE OBJECTIVES

- Demonstrate the importance the impact of solar radiation, solar pvmodules
- Understand the principles of storage in PV systems
- Discuss solar energy storage systems and their applications.
- Get knowledge in wind energy and bio-mass
- Gain insights in geothermal energy, ocean energy and fuel cells.

COURSE OUTCOMES

- Illustrate the importance of solar radiation and solar PV modules.
- Discuss the storage methods in PV systems.
- Explain the solar energy storage for different applications.
- Understand the principles of wind energy, and bio-mass energy.
- Attain knowledge in geothermal energy, ocean energy and fuel cells.

UNIT I - SOLAR RADIATION

(09)

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 II - STORAGE IN PV SYSTEMS

(09)

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 III - SOLAR ENERGY COLLECTION

(08)

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 IV - WIND ENERGY

(09)

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 V - GEOTHERMAL ENERGY

(09)

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 Kreith& 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

CO-PO MAPPING

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
23A035FT.1	3	2	-	-	-	2	3	-	-	-	-	2	2	-
23A035FT.2	3	2	2	-	-	2	2	-	-	-	-	2	2	-
23A035FT.3	3	2	2	-	-	2	3	-	-	-	-	2	2	-
23A035FT.4	2	2	2	-	-	3	3	-	-	-	-	2	2	-
23A035FT.5	2	2	2	-	-	3	3	-	-	-	-	3	2	-

III B.TECH I SEMESTER

23A045DT

ELECTRONIC CIRCUITS
(OPEN ELECTIVE-I)
(Common to all branches)

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

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

COURSE OUTCOMES

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

UNIT I - SEMICONDUCTOR DIODE AND APPLICATIONS

(09)

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)

(09)

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

(08)

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

(09)

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

(09)

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, LouisNashelsky 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.

CO-PO MAPPING

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
23A045DT.1	3	2	-	-	-	-	-	-	-	-	-	2	2	-
23A045DT.2	3	2	2	-	-	-	-	-	-	-	-	2	2	-
23A045DT.3	3	2	2	-	-	-	-	-	-	-	-	2	2	-
23A045DT.4	3	2	2	-	-	-	-	-	-	-	-	2	2	-
23A045DT.5	3	2	3	2	2	-	-	-	-	-	-	3	3	-

III B.TECH I SEMESTER

23A045ET

COMMUNICATION SYSTEMS
(OPEN ELECTIVE-I)
(Common to all branches)

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

1. To understand the fundamentals of communication systems and amplitude modulation techniques.
2. To learn about the angle modulation techniques and bandwidth considerations in communication systems.
3. To gain knowledge on pulse analog modulation and multiple access techniques used in digital communication systems.
4. To examine pulse modulation and digital modulation techniques used in modern communication systems.
5. To study wireless communication systems, cellular networks, and GSM technology

COURSE OUTCOMES

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

1. Comprehend the fundamentals of communication systems and amplitude modulation techniques.
2. Learn the angle modulation techniques and bandwidth considerations in communication systems.
3. Gain knowledge on pulse analog modulation and multiple access techniques used in digital communication systems.
4. Get familiar with pulse modulation and digital modulation techniques used in modern communication systems.

Unit I - ANALOG COMMUNICATION-I

(10)

Elements of communication systems, need for Modulation, Modulation Methods, Baseband and carrier communication Amplitude Modulation (AM), Generation of AM signals, Rectifier detector, Envelope detector, sideband and carrier power of AM,

UNIT II - ANALOG COMMUNICATION-II

(9)

Double side band suppressed carrier (DSB- SC) modulation & its demodulation, Switching modulators, Ring modulator, Balanced modulator, Single sideband (SSB) transmission, VSB Modulation.

Unit III - ANGLE MODULATION & DEMODULATION

(10)

Concept of instantaneous frequency Generalized concept of angle modulation, Bandwidth of angle modulated waves- Narrow band frequency modulation (NBFM); and Wide band FM (WBFM), Phase modulation, Pre-emphasis & De-emphasis.

Unit IV- DIGITAL COMMUNICATIONS-I (QUALITATIVE APPROACH ONLY)

(9)

Pulse analog modulation techniques, Generation and detection of Pulse amplitude modulation, Pulse width modulation, Pulse position modulation

Multiple Access Techniques: Introduction to multiple access techniques, FDMA, TDMA, CDMA, SDMA: Advantages and applications.

Unit V - DIGITAL COMMUNICATIONS-II (QUALITATIVE APPROACH ONLY)

(10)

CMOS Logic: Pulse Code Modulation, DPCM, Delta modulation, Adaptive delta modulation, Overview of ASK, PSK, QPSK, BPSK and M-PSK techniques.

PRESCRIBED TEXTBOOKS

1. H Taub, D. Schilling and Gautam Sahe, —Principles of Communication Systems, TMH, 2007, 3rd Edition.
2. George Kennedy and Bernard Davis, —Electronics & Communication System, 4th Edition, TMH 2009.
3. Wayne Tomasi, —Electronic Communication System: Fundamentals Through Advanced, 2nd edition, PHI,2001.

REFERENCE BOOKS

1. Simon Haykin, —Principles of Communication Systems, John Wiley, 2nd Edition.
2. Sham Shanmugam, —Digital and Analog communication Systems, Wiley-India edition,2006.
3. Theodore. S.Rappoport, —Wireless Communications, Pearson Education, 2nd Edition,2002

CO-PO MAPPING

COURSE OUTCOMES	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
23A045ET. 1	3	3	3	3	-	-	-	-	-	-	-	2	-	3
23A045ET. 2	3	3	3	3	-	-	-	-	-	-	-	2	-	3
23A045ET. 3	3	3	3	3	-	-	-	-	-	-	-	2	-	3
23A045ET. 4	3	3	3	3	-	-	-	-	-	-	-	2	-	3
23A045ET. 5	3	3	3	3	-	-	-	-	-	-	-	2	-	3

III B.TECH I SEMESTER

23A055GT	QUANTUM TECHNOLOGIES AND APPLICATIONS (OPEN ELECTIVE-I) (Common to all branches)	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.

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.

UNIT I - FUNDAMENTALS OF QUANTUM MECHANICS (07)

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 (07)

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

UNIT III - QUANTUM COMMUNICATION AND CRYPTOGRAPHY (07)

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

UNIT IV - QUANTUM SENSORS AND METROLOGY (07)

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

UNIT V - QUANTUM MATERIALS AND EMERGING TECHNOLOGIES (07)

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

TEXT BOOKS

1. "Quantum Computation and Quantum Information" by Michael A. Nielsen and Isaac L. Chuang (Cambridge University Press).
2. "Quantum Mechanics: The Theoretical Minimum" by Leonard Susskind and Art Friedman (Basic Books).

REFERENCE BOOKS

1. "Quantum Computing for Everyone" by Chris Bernhardt (MIT Press).
2. "Quantum Physics: A Beginner's Guide" by Alastair I.M. Rae.
3. "An Introduction to Quantum Computing" by Phillip Kaye, Raymond Laflamme, and Michele Mosca.
4. IBM Quantum Experience and Qiskit Documentation (<https://qiskit.org/>).

CO-PO MAPPING

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
23A055GT.1	3	2	-	-	-	-	-	-	-	-	-	2	2	-
23A055GT.2	3	2	2	-	-	-	-	-	-	-	-	2	2	-
23A055GT.3	3	2	2	-	-	-	-	-	-	-	-	2	2	-
23A055GT.4	3	2	2	-	-	-	-	-	-	-	-	2	2	-
23A055GT.5	3	2	3	2	2	-	-	-	-	-	-	3	3	-

III B.TECH I SEMESTER

23AHS51T	MATHEMATICS FOR MACHINE LEARNING AND AI (OPEN ELECTIVE-I) (Common to all branches)	L	T	P	C
		3	0	0	3

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

- Apply linear algebra concepts to ML techniques like PCA and regression.
- Analyze probabilistic models and statistical methods for AI applications.
- Implement optimization techniques for machine learning algorithms.
- Utilize vector calculus and transformations in AI-based models.
- Develop graph-based AI models using mathematical representations.

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).

TEXT BOOKS

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

CO-PO MAPPING

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
23AHS51T.1	3	3	2	2	1	-	-	-	-	-	-	1	-	-
23AHS51T.2	3	3	2	3	2	-	-	-	-	-	-	2	-	-
23AHS51T.3	3	3	3	3	2	1	-	-	-	-	-	2	-	-
23AHS51T.4	3	3	2	2	1	-	-	-	-	-	-	1	-	-
23AHS51T.5	3	3	3	3	2	-	-	-	-	-	-	2	-	-

III B.TECH I SEMESTER

23AHS52T	MATERIALS CHARACTERIZATION TECHNIQUES (OPEN ELECTIVE-I) <i>(Common to all branches)</i>	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

COURSE OUTCOMES

- Analyze the crystal structure and crystallite size by various methods.
- Analyze the morphology of the sample by using a Scanning Electron Microscope.
- Analyze the morphology and crystal structure of the sample by using Transmission Electron Microscope.
- Explain the principle and experimental arrangement of various spectroscopic techniques.
- Identify the construction and working principle of various Electrical & Magnetic Characterization Technique.

UNIT I - STRUCTURE ANALYSIS BY POWDER X-RAY DIFFRACTION (09)

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) (09)

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) (09)

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

(09)

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

(09)

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.

TEXT BOOKS

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

NPTEL COURSES LINK

- <https://nptel.ac.in/courses/115/103/115103030/>
- https://nptel.ac.in/content/syllabus_pdf/113106034.pdf
- <https://nptel.ac.in/noc/courses/noc19/SEM1/noc19-mm08/>

CO-PO MAPPING

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
23AHS52T.1	3	3	2	2	1	-	-	-	-	-	-	-	-	-
23AHS52T.2	3	3	2	1	1	-	-	-	-	-	-	-	-	-
23AHS52T.3	3	3	2	1	1	-	-	-	-	-	-	-	-	-
23AHS52T.4	3	2	1	1	-	-	-	-	-	-	-	-	-	-
23AHS52T.5	3	3	1	1	-	-	-	-	-	-	-	-	-	-

III B.TECH I SEM

23AHS53T

CHEMISTRY OF ENERGY SYSTEMS
(OPEN ELECTIVE-I)
(Common to all branches)

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

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

COURSE OUTCOMES

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

- Understand electrochemical concepts and battery technologies with their practical applications.
- Apply the principles of fuel cell technology to explain their design, working, classification, efficiency, and applications, including PEM and SOFC types.
- Apply the concepts of photochemical cells to understand their working, specificity, advantages in photo electrocatalytic conversions, and practical applications.
- Analyze the principles of solar energy conversion to differentiate between photovoltaic and concentrated solar power technologies and evaluate the performance and applications of solar cells.
- Analyze hydrogen storage and delivery methods by comparing their mechanisms, advantages, and limitations.

UNIT 1 - ELECTROCHEMICAL SYSTEMS (09)

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 (09)

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 (09)

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

(09)

Introduction and prospects, photovoltaic (PV) technology, concentrated solar power (CSP), Solar cells and applications.

UNIT 5 - HYDROGEN STORAGE

(09)

Introduction-Hydrogen fuel, 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. Ira N. Levine Physical Chemistry, 6th edition, McGraw-Hill Education, 2011
2. Bahl, A., Bahl, B. S., & Tuli, G. D. Essentials of physical chemistry. New Delhi: S. Chand. 2010.

REFERENCE BOOKS

1. Fuel Cell Hand Book, 7th Edition, by US Department of Energy (EG&G technical services and corporation)
2. Arvind, & Shyam. (2018). Handbook of Solar Energy: Theory, Analysis and Applications. Springer.
3. Solar energy fundamental, technology and systems by Klaus Jagar et.al. (2014) Delft University of Technology, Delft.

CO-PO MAPPING

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
23AHS53T.1	3	2	2	1	-	-	2	-	-	-	-	1	-	-
23AHS53T.2	3	2	2	1	-	-	2	-	-	-	-	1	-	-
23AHS53T.3	3	2	2	1	-	-	2	-	-	-	-	1	-	-
23AHS53T.4	3	2	2	1	-	-	2	-	-	-	-	1	-	-
23AHS53T.5	3	2	2	1	-	-	2	-	-	-	-	1	-	-

III B.TECH I SEM

23AHS54T	ENGLISH FOR COMPETITIVE EXAMINATIONS (OPEN ELECTIVE-I) (Common to all branches)	L 3	T 0	P 0	C 3
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COURSE OBJECTIVES

- To raise awareness of the importance of English for competitive exams
- To understand the grammatical aspects and identify the errors
- To enhance verbal ability and identify the errors
- To enrich vocabulary to face competitive exams and for effective expression
- To equip learners with the skills and confidence needed to succeed in competitive exams

COURSE OUTCOMES

- Identify the basics of English grammar and its importance.
- Explain the use of grammatical structures in sentences.
- Demonstrate the ability to use various concepts in grammar and vocabulary and their applications In everyday use and in competitive exams.
- Analyze an unknown passage and reach conclusions about it.
- Use correct verb forms and improve speed reading and comprehension to excel in competitive exams.

UNIT I - GRAMMAR-1 (09)

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

UNIT II - GRAMMAR-2 (09)

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 (09)

Sentence completion-Verbal analogies-Word groups-Instructions-Critical reasoning-Verbal deduction-Select appropriate pair-Reading Comprehension-Paragraph-Jumbles.

UNIT IV - READING COMPREHENSION AND VOCUBULARY (09)

Reading Comprehension Skills-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.

UNIT V - WRITING FOR COMPETITIVE EXAMINATIONS (09)

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.

TEXT BOOKS

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.

REFERENCES

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>

CO-PO MAPPING

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
23AHS54T.1	-	-	-	-	-	-	-	-	-	3	-	3	-	-
23AHS54T.2	-	-	-	-	-	-	-	-	-	3	-	3	-	-
23AHS54T.3	-	-	-	-	-	-	-	-	-	3	-	3	-	-
23AHS54T.4	-	-	-	-	-	-	-	-	-	3	-	3	-	-
23AHS54T.5	-	-	-	-	-	-	-	-	-	3	-	3	-	-
23AHS54T.6	-	-	-	-	-	-	-	-	-	3	-	3	-	-

III B.TECH I SEM

23AHS56T	ENTREPRENEURSHIP AND NEW VENTURE CREATION	L	T	P	C
	(OPEN ELECTIVE-I)	3	0	0	3
	(Common to all branches)				

COURSE OBJECTIVES

- To foster an entrepreneurial mind-set for venture creation and intrapreneurial leadership.
- To encourage creativity and innovation.
- To enable them to learn pitching and presentation skills.
- To make the students understand MVP development and validation techniques to determine Product-Market fit and Initiate Solution design, Prototype for Proof of Concept.
- To enhance the ability of analyzing Customer and Market segmentation, estimate.
- Market size, develop and validate Customer Persona.

COURSE OUTCOMES

- Develop an entrepreneurial mindset and appreciate the concept of entrepreneurship
- Comprehend the process of problem-opportunity identification through design thinking, identify market potential and customers while developing a compelling value proposition solution
- Analyze and refine business models to ensure sustainability and profitability Build Prototype for Proof of Concept and validate MVP of their practice venture Idea
- Create business plan, conduct financial analysis and feasibility analysis to assess the financial viability of a venture
- Prepare and deliver an investible pitch deck of their practice venture to attract stakeholders

UNIT I - ENTREPRENEURSHIP FUNDAMENTALS AND CONTEXT (09)

Meaning and concept, attributes and mindset of entrepreneurial and intrapreneurial leadership, role models in each and their role in economic development. An understanding of how to build entrepreneurial mindset, skill sets, attributes and networks while on campus.

Core Teaching Tool: Simulation, Game, Industry Case Studies (Personalized for students – 16 industries to choose from), Venture Activity.

UNIT II - PROBLEM & CUSTOMER IDENTIFICATION (09)

Understanding and analysing the macro-Problem and Industry perspective - technological, socioeconomic and urbanization trends and their implication on new opportunities - Identifying passion - identifying and defining problem using Design thinking principles - Analysing problem and validating with the potential customer - Understanding customer segmentation, creating and validating customer personas.

Core Teaching Tool: Several types of activities including Class, game, Gen AI, ‘Get out of the Building’ and Venture Activity.

UNIT III - SOLUTION DESIGN, PROTOTYPING & OPPORTUNITY ASSESSMENT AND SIZING (09)

Understanding Customer Jobs-to-be-done and crafting innovative solution design to map to customer's needs and create a strong value proposition - Understanding prototyping and Minimum Viable product (MVP) - Developing a feasibility prototype with differentiating value, features and benefits - Assess relative market position via competition analysis - Sizing the market and assess scope and potential scale of the opportunity.

Core Teaching Tool: Venture Activity, no-code Innovation tools, Class activity.

UNIT IV - BUSINESS & FINANCIAL MODEL, GO-TO-MARKET PLAN (09)

Introduction to Business model and types, Lean approach, 9 block lean canvas model, riskiest assumptions to Business models. Importance of Build - Measure – Lean approach.

Business planning: components of Business plan- Sales plan, People plan and financial plan. Financial Planning: Types of

costs, preparing a financial plan for profitability using financial template, understanding basics of Unit economics and analysing financial performance.

Introduction to Marketing and Sales, Selecting the Right Channel, creating digital presence, building customer acquisition strategy.

Choosing a form of business organization specific to your venture, identifying sources of funds: Debt & Equity, Map the Start-up Life-cycle to Funding Options.

Core Teaching Tool: Founder Case Studies – Sama and Securely Share; Class activity and discussions; Venture Activities.

UNIT V - SCALE OUTLOOK AND VENTURE PITCH READINESS

(09)

Understand and identify potential and aspiration for scale vis-a-vis your venture idea. Persuasive Storytelling and its key components. Build an Investor ready pitch deck.

Core Teaching Tool: Expert talks; Cases; Class activity and discussions; Venture Activities.

TEXT BOOKS

1. Robert D. Hisrich, Michael P. Peters, Dean A. Shepherd, Sabyasachi Sinha . Entrepreneurship, cGrawHill, 11th Edition.(2020).
2. Ries, E. The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses. Crown Business,(2011).
3. Osterwalder, A., & Pigneur, Y. Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers. John Wiley & Sons. (2010).

REFERENCES

1. Simon Sinek, Start with Why, Penguin Books limited. (2011)
2. Brown Tim, Change by Design Revised & Updated: How Design Thinking Transforms Organizations and Inspires Innovation, Harper Business.(2019)
3. Namita Thapar (2022) The Dolphin and the Shark: Stories on Entrepreneurship, Penguin Books Limited
4. Saras D. Sarasvathy, (2008) Effectuation: Elements of Entrepreneurial Expertise, Elgar Publishing Ltd.

E-RESOURCES

- Learning resource- Ignite 5.0 Course Wadhvani platform (Includes 200+ components of custom created modular content + 500+ components of the most relevant curated content)

CO-PO MAPPING

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
23AHS56T.1	2	-	-	-	2	2	-	-	2	2	-	3	2	-
23AHS56T.2	2	2	2	2	3	2	-	-	2	3	-	3	2	-
23AHS56T.3	2	2	3	3	3	2	-	-	2	3	-	3	3	-
23AHS56T.4	2	2	3	3	3	2	-	-	2	3	-	3	3	-
23AHS56T.5	2	3	3	2	3	2	-	-	2	3	-	3	3	-
23AHS56T.6	2	-	-	-	2	-	-	-	3	3	-	2	2	-

III B.TECH I SEMESTER

23A3354L	MACHINE LEARNING & NATURAL LANGUAGE PROCESSING LAB (PROFESSIONAL CORE) (Common to AI&ML)	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVES

- To provide hands-on experience with fundamental Machine Learning and NLP algorithms.
- To enable students to preprocess, train, and evaluate models on structured and unstructured data.
- To develop NLP applications like classification, summarization, and conversational agents.
- To equip students with the skills to use ML libraries and frameworks for solving real-world language problems.

COURSE OUTCOMES

- Apply supervised and unsupervised ML algorithms on various datasets.
- Preprocess and analyze textual data for NLP applications.
- Implement machine learning pipelines using tools like scikit-learn and NLP libraries.
- Develop and deploy basic NLP applications such as chatbots, sentiment analyzers, and translators.
- Evaluate models using appropriate metrics and improve them using tuning techniques.

LIST OF EXPERIMENTS

1. Preprocess textual data: Tokenization, Lemmatization, Stopword removal
2. Build a Naïve Bayes classifier for SMS/email spam detection
3. Implement a sentiment analysis model using logistic regression
4. Apply TF-IDF and Bag of Words on a corpus and analyze vector results
5. Train a Named Entity Recognition (NER) model using spaCy
6. Build a text summarizer using frequency or transformer-based models
7. Create a text classification pipeline using SVM and scikit-learn
8. Implement Word2Vec/GloVe embeddings for text similarity tasks
9. Develop a basic chatbot using NLTK / Transformers (e.g., BERT)
10. Train a Bi-LSTM for sequence labeling tasks (e.g., POS tagging)
11. Perform topic modeling using LDA (Latent Dirichlet Allocation)
12. Mini Project: Build and deploy a full-stack NLP application

SOFTWARE/TOOLS REQUIRED

- Python (3.7+), Jupyter Notebook/Google Colab
- Libraries: scikit-learn, pandas, NumPy, NLTK, spaCy, gensim, TensorFlow/Keras, Hugging Face Transformers
- IDE: VS Code or Jupyter Lab
- Online platforms (optional): Hugging Face Spaces, Colab, Kaggle

TEXT BOOKS & REFERENCE BOOKS

1. Jurafsky & Martin, Speech and Language Processing, 3rd Edition Draft, Pearson.
2. Steven Bird, Ewan Klein, and Edward Loper, Natural Language Processing with Python, O'Reilly.
3. Aurélien Géron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, O'Reilly, 2022.
4. Sebastian Raschka, Python Machine Learning, Packt Publishing.
5. Delip Rao and Brian McMahan, Natural Language Processing with PyTorch, O'Reilly.

CO-PO MAPPING

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
23A3354L.1	3	2	1	2	1	-	-	-	-	1	-	2	3	2
23A3354L.2	2	3	2	3	2	-	-	-	1	2	-	2	3	3
23A3354L.3	2	3	2	3	2	-	-	-	1	2	-	2	3	3
23A3354L.4	2	3	3	3	3	-	-	-	2	2	-	3	3	3
23A3354L.5	2	2	3	3	3	-	-	-	2	2	-	3	3	3

III B.TECH I SEMESTER

23A3352L

DATA WRANGLING LAB
(PROFESSIONAL CORE)
(Common to AI&ML)

L	T	P	C
0	0	3	1.5

COURSE OBJECTIVES

- To provide hands-on experience in collecting, cleaning, transforming, and preparing data for analysis.
- To enable students to handle missing, inconsistent, and unstructured data using Python tools.
- To familiarize students with data integration from multiple sources including APIs, databases, and web scraping.
- To enhance skills in preparing datasets for Machine Learning and Data Analytics tasks.

COURSE OUTCOMES

- Perform data cleaning operations using Python and related libraries.
- Handle missing, duplicate, and inconsistent data in real-world datasets.
- Integrate and transform data from heterogeneous sources.
- Conduct exploratory analysis and reshape datasets as per analytical needs.
- Apply preprocessing techniques to make data suitable for machine learning models.

List of Experiments (with Cognitive Levels):

1. Load and explore datasets using Pandas: Shape, info, describe, data types
2. Handle missing data using techniques: fillna, dropna, interpolation
3. Detect and remove duplicate and inconsistent records in real datasets
4. Data type conversions and formatting (e.g., datetime parsing, string manipulation)
5. Merge, join, and concatenate multiple datasets
6. Normalize and standardize numerical features using sklearn
7. Apply label encoding and one-hot encoding to categorical variables
8. Perform data binning, transformation, and discretization
9. Web scraping using BeautifulSoup or Selenium to extract tabular data
10. Read and write data using CSV, Excel, JSON, and SQLite/SQLAlchemy
11. Visualize data quality and outliers using seaborn/matplotlib
12. Mini Project: Real-world data wrangling and cleaning pipeline for an open dataset

SOFTWARE/TOOLS REQUIRED

- Python (3.7+), Jupyter Notebook / Google Colab
- pandas, NumPy, seaborn, matplotlib
- scikit-learn (for preprocessing utilities)
- BeautifulSoup, requests, Selenium (for web scraping)
- SQLAlchemy / SQLite (for basic data import/export)

TEXT BOOKS & REFERENCE BOOKS

- Wes McKinney, Python for Data Analysis, 3rd Edition, O'Reilly, 2022
- Hadley Wickham, R for Data Science (for concepts, applicable to Python too)
- Jake VanderPlas, Python Data Science Handbook, O'Reilly
- Aurélien Géron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, O'Reilly
- Joel Grus, Data Science from Scratch, O'Reilly

CO-PO MAPPING

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
23A3352L.1	2	2	1	2	3	-	-	-	1	2	-	2	3	2
23A3352L.2	2	3	1	2	3	-	-	-	1	2	-	2	3	3
23A3352L.3	2	2	2	3	3	-	-	-	2	2	-	2	3	3
23A3352L.4	2	2	2	3	2	-	-	-	2	2	-	2	3	3
23A3352L.5	2	2	3	3	3	-	-	-	2	2	-	3	3	3

III B.TECH I SEMESTER

23A0555L

FULL STACK DEVELOPMENT - II
(SKILL ENHANCEMENT COURSE)
(Common to all branches)

L	T	P	C
0	1	2	2

COURSE OBJECTIVES

- To become knowledgeable about the most recent web development technologies.
- Idea for creating two tier and three tier architectural web applications.
- Design and Analyse real time web applications.
- Constructing suitable client and server-side applications.
- To learn core concept of both front end and back-end programming.

COURSE OUTCOMES

- Develop a fully functioning website and deploy on a web server.
- Gain Knowledge about the front end and back-end Tools.
- Find and use code packages based on their documentation to produce working results in a project.
- Create web pages that function using external data.
- Implementation of web application employing efficient database access.

UNIT I - WEB DEVELOPMENT BASICS (09)

Web development Basics - HTML & Web servers Shell - UNIX CLI Version control - Git & Github HTML, CSS.

UNIT II - FRONTEND DEVELOPMENT (09)

Javascript basics OOPS Aspects of JavaScript Memory usage and Functions in JS AJAX for data exchange with server jQuery Framework jQuery events, UI components etc. JSON data format.

UNIT III - REACT JS (09)

Introduction to React React Router and Single Page Applications React Forms, Flow Architecture and Introduction to Redux More Redux and Client-Server Communication.

UNIT IV - JAVA WEB DEVELOPMENT (09)

JAVA PROGRAMMING BASICS, Model View Controller (MVC) Pattern MVC Architecture using Spring RESTful API using Spring Framework Building an application using Maven.

UNIT V - DATABASES & DEPLOYMENT (09)

Relational schemas and normalization Structured Query Language (SQL) Data persistence using Spring JDBC Agile development principles and deploying application in Cloud.

TEXT BOOKS

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. Learning PHP, MySQL, JavaScript, CSS & HTML5: A Step-by-Step Guide to Creating Dynamic Websites by Robin Nixon
3. Full Stack JavaScript: Learn Backbone.js, Node.js and MongoDB. Copyright © 2015 BY AZAT MARDAN

REFERENCE BOOKS

1. Full-Stack JavaScript Development by Eric Bush
2. Mastering Full Stack React Web Development Paperback – April 28, 2017 by Tomasz Dyl, Kamil Przeorski, Maciej Czarnecki

CO-PO MAPPING

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
23A0555L.1	2	2	3	3	3	-	-	-	2	2	-	3	3	3
23A0555L.2	2	3	3	3	3	-	-	-	2	1	-	2	3	3
23A0555L.3	2	2	2	2	3	-	-	-	2	2	-	2	3	3
23A0555L.4	2	2	3	3	3	-	-	-	2	2	-	2	3	3
23A0555L.5	2	2	3	3	3	-	-	-	2	2	-	3	3	3

III B.TECH I SEMESTER

23A0556L

TINKERING LAB FOR COMPUTER ENGINEERS
(Common to all branches)

L	T	P	C
0	0	2	1

COURSE OBJECTIVES

- Encourage Innovation and Creativity
- Provide Hands-on Learning and Impart Skill Development
- Foster Collaboration and Teamwork
- Enable Interdisciplinary Learning, Prepare for Industry and Entrepreneurship
- Impart Problem-Solving mind-set

COURSE OUTCOMES

- 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) Demonstrate a traffic light circuit using breadboard.
- 3) Build and demonstrate automatic Street Light using LDR.
- 4) Simulate the Arduino LED blinking activity in Tinkercad.
- 5) Build and demonstrate an Arduino LED blinking activity using Arduino IDE.
- 6) Interfacing IR Sensor and Servo Motor with Arduino.
- 7) Blink LED using ESP32.
- 8) LDR Interfacing with ESP32.
- 9) Control an LED using Mobile App.
- 10) Design and 3D print a Walking Robot
- 11) Design and 3D Print a Rocket.
- 12) Build a live soil moisture monitoring project, and monitor soil moisture levels of a remote plan in your computer dashboard.
- 13) Demonstrate all the steps in design thinking to redesign a motor bike.

STUDENTS NEED TO REFER TO THE FOLLOWING LINKS

1. <https://aim.gov.in/pdf/equipment-manual-pdf.pdf>
2. <https://atl.aim.gov.in/ATL-Equipment-Manual/>
3. <https://aim.gov.in/pdf/Level-1.pdf>
4. <https://aim.gov.in/pdf/Level-2.pdf>
5. <https://aim.gov.in/pdf/Level-3.pdf>

CO-PO MAPPING

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
23A0556L.1	2	2	3	3	3	-	-	-	2	2	-	3	3	3
23A0556L.2	2	3	3	3	3	-	-	-	2	1	-	2	3	3
23A0556L.3	2	2	2	2	3	-	-	-	2	2	-	2	3	3
23A0556L.4	2	2	3	3	3	-	-	-	2	2	-	2	3	3
23A0556L.5	2	2	3	3	3	-	-	-	2	2	-	3	3	3

III B.TECH II SEMESTER

23A3361T

INTRODUCTION TO DEEP LEARNING
(PROFESSIONAL ELECTIVE-III)
(Common to AI&ML)

L	T	P	C
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

- 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 - LINEAR ALGEBRA

(08)

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, Bayes' Rule, Information Theory. Numerical Computation: Overflow and Underflow, Gradient-Based Optimization, Constrained Optimization, Linear Least Squares.

UNIT II - MACHINE LEARNING

(09)

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 - REGULARIZATION FOR DEEP LEARNING

(08)

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 - CONVOLUTION NETWORKS

(09)

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 - SEQUENCE MODELLING

(08)

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.

TEXT BOOKS

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>

CO-PO MAPPING

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
23A3361T.1	3	3	2	2	2	-	-	-	-	2	-	2	3	2
23A3361T.2	3	2	2	2	2	-	-	-	-	2	-	2	3	2
23A3361T.3	3	2	3	2	3	-	-	-	-	2	-	2	3	3
23A3361T.4	3	2	3	3	3	-	-	-	-	2	-	2	3	3
23A3361T.5	3	2	3	3	3	-	-	-	-	2	-	2	3	3

III B.TECH II SEMESTER

23A3362T

EXPLAINABLE AI & MODEL INTERPRETABILITY
(PROFESSIONAL CORE)
(Common to AI&ML)

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- To introduce the principles of interpretability and explainability in AI/ML models.
- To analyze the trade-offs between model accuracy and interpretability.
- To explore popular post-hoc and intrinsic explainability techniques.
- To examine fairness, accountability, and transparency in AI systems.
- To develop hands-on skills with interpretability tools and libraries.

COURSE OUTCOMES

- Understand the need for explainability in modern AI systems.
- Differentiate between black-box and white-box models.
- Apply interpretability techniques such as SHAP, LIME, and PDPs.
- Evaluate the fairness and transparency of AI systems.
- Use explainability tools for model auditing and deployment in high-stakes domains.

UNIT I - FOUNDATIONS OF EXPLAINABLE AI

(09)

Introduction to Explainability and Interpretability, Importance of XAI in Healthcare, Finance, and Law , White-box vs Black-box Models, Desiderata: Fairness, Accountability, Transparency, Human-Centered AI and Trust ,Taxonomy of XAI Techniques (Global vs Local, Post-hoc vs Intrinsic), Regulatory and Ethical Implications (GDPR, AI Bill of Rights), Model Simplicity vs Predictive Power.

UNIT II - MODEL-SPECIFIC EXPLAINABILITY TECHNIQUES

(09)

Decision Trees and Rule-based Models, Linear Models and Feature Importance, Generalized Additive Models (GAMs), Visualization of Weights and Coefficients, Logistic Regression Coefficient Interpretation, Case Study: Credit Scoring using Transparent Models, Comparison of Interpretable ML Models, Use Cases and Trade-offs.

UNIT III - MODEL-AGNOSTIC EXPLAINABILITY TECHNIQUES

(09)

Local Interpretable Model-agnostic Explanations (LIME), SHAP Values (SHapley Additive exPlanations), Partial Dependence Plots (PDPs), Individual Conditional Expectation (ICE) Plots, Anchors and Counterfactual Explanations, Feature Interaction and Permutation Importance, Comparative Analysis of SHAP, LIME, PDP, Model Debugging with XAI.

UNIT IV - DEEP LEARNING EXPLAINABILITY

(09)

Visualizing CNNs: Filters, Feature Maps, Saliency Maps and Grad-CAM, Integrated Gradients, Explaining RNNs and LSTM Outputs, Concept Activation Vectors (TCAV), Attention-based Interpretability in Transformers, Explaining Language Models (BERT, GPT) Evaluation of Deep Model Explanations.

UNIT V - FAIRNESS, BIAS & TOOLS FOR XAI**(09)**

Fairness Metrics: Demographic Parity, Equal Opportunity, Sources of Bias in Data and Models, Discrimination Detection and Mitigation Strategies, Introduction to AIF360, What-If Tool, Fairlearn, Case Study: Bias in Hiring Algorithms, Explainability in ML Pipelines (MLFlow, Skater), XAI in Federated and Privacy-Preserving AI, Designing Interpretable AI Systems from Scratch.

TEXT BOOKS

1. Christoph Molnar, —Interpretable Machine Learning, Leanpub.
2. Sameer Singh et al., —Explainable AI: Interpreting, Explaining and Visualizing Deep Learning, Springer.
3. Dan Roth, Zachary Lipton, and Been Kim, —Explainable AI: Foundations, Developments, Prospects, MIT Press (Online forthcoming).

REFERENCE BOOKS

1. Marco Tulio Ribeiro et al., —Why Should I Trust You? (LIME) – Research Paper
2. Scott Lundberg et al., —A Unified Approach to Interpreting Model Predictions (SHAP) – NIPS
3. A. Barredo Arrieta et al., —Explainable Artificial Intelligence (XAI): Concepts, Taxonomies, Opportunities and Challenges, Information Fusion Journal.
4. Zachary C. Lipton, —The Mythos of Model Interpretability – Communications of the ACM

ONLINE LEARNING RESOURCES

- Coursera – Explainable AI with Google Cloud
- Udacity – AI for Everyone by Andrew Ng
- HarvardX – Data Science: Machine Learning Interpretability

CO-PO MAPPING

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
23A3362T.1	3	2	-	-	2	2	-	2	-	1	-	2	2	-
23A3362T.2	3	2	-	-	2	-	-	1	-	-	-	2	2	-
23A3362T.3	3	3	2	2	3	-	-	-	-	-	-	2	3	3
23A3362T.4	2	3	2	2	2	3	-	3	1	-	-	3	2	3
23A3362T.5	2	3	3	3	3	2	-	2	2	1	2	3	3	3

III B.TECH II SEMESTER

23A3363T

AI FOR EDGE COMPUTING
(PROFESSIONAL CORE)
(Common to AI&ML)

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- Introduce students to the fundamentals and applications of Edge Computing and how AI is integrated at the edge.
- Enable learners to understand the design and deployment of AI models on edge devices.
- Familiarize students with energy-efficient, latency-aware, and privacy-preserving AI systems in edge environments.
- Equip students with hands-on skills in frameworks, tools, and platforms that support edge-based AI deployments.
- Address challenges like model compression, edge-cloud collaboration, and inference acceleration at the edge.

COURSE OUTCOMES

- Describe the fundamentals of Edge Computing and its relationship with Artificial Intelligence.
- Analyze edge-centric architectures and frameworks suitable for AI workloads.
- Design and deploy optimized AI models on edge devices considering resource constraints.
- Apply real-time data analytics and AI inference on edge nodes with minimal latency.
- Explore future directions and open research areas in edge-based AI systems and applications.

UNIT I – INTRODUCTION TO EDGE COMPUTING AND AI (09)

Evolution of Computing Paradigms: Cloud, Fog, and Edge, Introduction to Edge AI – Concepts and Motivation, Architecture of Edge Computing Systems, Differences between Edge AI and Cloud AI, Use Cases of Edge AI – Smart Cities, Healthcare, IoT, and Industry 4.0, Hardware for Edge AI – Edge GPUs, TPUs, FPGAs, Types of Edge Devices – Raspberry Pi, Jetson Nano, Coral, Challenges in Deploying AI on Edge

UNIT II – AI MODELS AND EDGE INFERENCE (09)

Types of AI Models Suitable for Edge Deployment, Model Optimization Techniques: Quantization, Pruning, Distillation, Transfer Learning for Edge AI, Inference Acceleration using Edge Hardware, Lightweight Models: MobileNet, SqueezeNet, TinyML, Frameworks for Edge Deployment: TensorFlow Lite, ONNX, OpenVINO, Compilation Tools: TVM, Glow, Energy and Latency-aware Inference.

UNIT III – EDGE-CENTRIC ARCHITECTURES AND DATA MANAGEMENT (09)

Distributed AI Architectures: Edge, Fog, and Cloud, Collaborative Intelligence – Edge-Cloud Offloading Strategies, Data Lifecycle in Edge AI Systems, Real-time Stream Processing at the Edge, Data Compression and Fusion Techniques, Caching and Scheduling Mechanisms, Privacy-Preserving Edge AI (Federated Learning, Differential Privacy), Case Study: Real-time Video Analytics using Edge Devices,

UNIT IV – SECURITY, PRIVACY, AND ETHICAL ASPECTS OF AI AT THE EDGE (09)

Security Threats in Edge Environments, Privacy Concerns with AI Inference on Personal Devices, Federated Learning: Concepts and Frameworks (e.g., Flower, TensorFlow Federated), Data Anonymization and Encryption Techniques, Blockchain for Secure Edge AI, Explainable AI for Edge Decisions, Regulations and Ethical Challenges in Edge AI, Case Studies on Privacy-Aware AI Systems.

UNIT V – APPLICATIONS AND FUTURE TRENDS IN EDGE AI (09)

Edge AI in Autonomous Vehicles, Industrial Automation and Predictive Maintenance, AI-Driven Surveillance and Smart Homes, Edge AI in Healthcare Monitoring Systems, 5G and Edge AI Integration, Emerging Trends: TinyML, Neuromorphic Computing, Benchmarking Tools for Edge AI Performance, Future Research Directions and Innovation Opportunities.

TEXT BOOKS

1. "Artificial Intelligence at the Edge" by Daniel Situnayake & Pete Warden
2. "Edge Computing: A Primer" by Jie Cao, Weisong Shi, and Qun Li
3. "TinyML: Machine Learning with TensorFlow Lite on Arduino and Ultra-Low-Power Microcontrollers" by Pete Warden and Daniel Situnayake

REFERENCE BOOKS

1. "Designing Distributed Systems" by Brendan Burns (O'Reilly)
2. "Hands-On Edge Analytics with Azure IoT" by Abhishek Kumar
3. Recent IEEE and ACM journal publications on Edge AI and Federated Learning

ONLINE COURSES

1. TinyML Specialization – Harvard & Google (edX)
2. AI for Edge Computing – NPTEL
3. Federated Learning – Coursera (Intel & University of Illinois)

CO-PO MAPPING

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
23A3363T.1	3	2	-	-	2	2	-	-	-	1	-	2	3	2
23A3363T.2	3	3	2	2	3	-	-	-	1	-	-	2	3	3
23A3363T.3	3	3	3	2	3	-	2	-	2	1	2	3	3	3
23A3363T.4	3	3	3	3	3	2	2	1	2	1	2	3	3	3
23A3363T.5	2	3	2	2	3	2	2	2	-	1	-	3	3	3

III B.TECH II SEMESTER

23A336AT	GRAPH NEURAL NETWORKS (PROFESSIONAL ELECTIVE-II) <i>(Common to CSE(AI) and AI&ML)</i>	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To introduce the fundamentals of graph theory and graph-structured data.
- To explore the concepts of neural networks extended to non-Euclidean domains.
- To understand architectures and algorithms behind various types of GNNs.
- To apply GNN models in real-world applications such as recommendation, social networks, and bioinformatics.
- To enable students to build and evaluate GNN models using frameworks like PyTorch Geometric and DGL.

COURSE OUTCOMES

- Understand the basics of graph structures and their significance in machine learning.
- Learn and implement different types of GNN architectures.
- Apply GNNs to real-world structured data problems.
- Use modern libraries and tools to train and evaluate GNNs.
- Analyze the effectiveness and limitations of GNNs in different domains.

UNIT I - FUNDAMENTALS OF GRAPH THEORY AND MACHINE LEARNING ON GRAPHS (09)

Introduction to Graphs: Nodes, Edges, Adjacency Matrix, Types of Graphs: Directed, Undirected, Weighted, Bipartite, Graph Traversal Algorithms (BFS, DFS), Graph Representations for ML (Adjacency List, Matrix, Laplacian), Node, Edge, and Graph-level Prediction Problems, Motivation and Challenges for Learning on Graphs.

UNIT II - SPECTRAL AND SPATIAL METHODS FOR GRAPH LEARNING (09)

Spectral Graph Theory Basics, Graph Convolution via Spectral Methods, Chebyshev and First-order Approximations, Spatial Graph Convolutions, Comparison of Spectral vs Spatial GNNs, Graph Laplacian and Eigenvalue Properties.

UNIT III - GRAPH NEURAL NETWORK ARCHITECTURES (09)

Graph Convolutional Networks (GCNs), Graph Attention Networks (GATs), GraphSAGE: Sampling and Aggregation, Graph Isomorphism Networks (GIN), Message Passing Neural Networks (MPNNs), Inductive vs Transductive GNN Learning.

UNIT IV - APPLICATIONS OF GNNs (09)

Node Classification (e.g., Cora, Citeseer), Link Prediction (e.g., Recommender Systems), Graph Classification (e.g., Molecule Property Prediction), Traffic Forecasting and Social Network Modeling, GNNs in Healthcare and Bioinformatics, Explainability and Interpretability in GNNs.

UNIT V - IMPLEMENTATION, OPTIMIZATION, AND RECENT ADVANCES (09)

Overview of PyTorch Geometric and DGL, Data Loading and Preprocessing for Graph Datasets, Model Training, Loss Functions, and Evaluation Metrics, Hyperparameter Tuning in GNNs, Recent Research Trends and Architectures (e.g., Heterogeneous GNNs, Graph Transformers), Challenges and Future Directions in GNNs.

TEXT BOOKS

1. Zonghan Wu, Shirui Pan, Fengwen Chen, Guodong Long, Chengqi Zhang, Philip S. Yu, *A Comprehensive Survey on Graph Neural Networks*, IEEE Transactions on Neural Networks and Learning Systems, 2021.
2. Yao Ma, Jiliang Tang, *Deep Learning on Graphs*, Cambridge University Press, 2021.

REFERENCE BOOKS

1. William L. Hamilton, *Graph Representation Learning*, Morgan & Claypool Publishers, 2020.
2. Barrett, Jure Leskovec, *Mining of Massive Datasets*, Cambridge University Press.
3. Thomas Kipf, *GCN and related papers and tutorials* (arXiv).
4. Petar Veličković, *Graph Attention Networks* (original paper and slides).
5. Michael Bronstein et al., *Geometric Deep Learning: Grids, Groups, Graphs, Geodesics, and Gauges* (arXiv preprint).

ONLINE LEARNING RESOURCES

1. <https://pytorch-geometric.readthedocs.io/> – PyTorch Geometric Docs
2. <https://cs.stanford.edu/people/jure/> – Stanford GNN Projects
3. <https://www.coursera.org/learn/graph-neural-networks> – Coursera GNN Course by Stanford

CO-PO MAPPING

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
23A336AT.1	3	3	-	-	2	-	-	-	-	-	-	2	2	2
23A336AT.2	3	3	3	2	3	-	-	-	-	-	-	2	3	3
23A336AT.3	3	2	3	2	3	-	-	-	-	-	-	2	3	3
23A336AT.4	3	2	3	2	3	-	-	-	2	2	-	2	3	3
23A336AT.5	3	3	2	2	3	2	2	-	-	-	2	3	3	3

III B. TECH II SEMESTER

23A336BT

RECOMMENDER SYSTEMS
(PROFESSIONAL ELECTIVE-II)
(Common to CSE(AI) and AI&ML)

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- To understand the theoretical foundations and practical techniques behind recommender systems.
- To explore collaborative, content-based, and hybrid recommendation methods.
- To apply matrix factorization and deep learning for building intelligent recommenders.
- To analyze system performance using standard evaluation metrics.
- To design and implement recommender systems for real-world applications.

COURSE OUTCOMES

- Explain the core concepts and types of recommender systems.
- Implement basic collaborative and content-based filtering techniques.
- Apply matrix factorization and deep learning models to recommendation problems.
- Evaluate and optimize recommender systems using appropriate metrics.
- Design scalable and context-aware recommender systems for diverse applications.

UNIT I - INTRODUCTION TO RECOMMENDER SYSTEMS (09)

Introduction to Information Filtering Systems, Types of Recommender Systems: Content-based, Collaborative, Hybrid, Data Sources: Explicit vs Implicit Feedback, Applications and Challenges in Recommendation, User and Item Profiling, Popularity, Personalization, and Serendipity Trade-offs.

UNIT II - COLLABORATIVE FILTERING TECHNIQUES (09)

User-based Collaborative Filtering, Item-based Collaborative Filtering, Similarity Measures: Cosine, Pearson, Jaccard, Neighborhood Selection and k-NN, Cold-start and Data Sparsity Issues, Memory-based vs Model-based Collaborative Filtering.

UNIT III - CONTENT-BASED AND HYBRID SYSTEMS (09)

Item Feature Extraction and Vector Representation, TF-IDF and Cosine Similarity in Recommendations, User Profile Learning, Limitations of Content-based Filtering, Hybrid Recommender Architectures, Case Study: Netflix, Amazon Hybrid Systems.

UNIT IV - MATRIX FACTORIZATION AND DEEP LEARNING APPROACHES (09)

Latent Factor Models and SVD, ALS and SGD for Matrix Factorization, Non-negative Matrix Factorization (NMF), Neural Collaborative Filtering (NCF), Deep Learning Models: Autoencoders, CNNs, RNNs for Recommendations, Graph-based and Knowledge Graph Recommenders.

UNIT V - EVALUATION, ETHICS, AND INDUSTRIAL APPLICATIONS (09)

Evaluation Metrics: Precision, Recall, F1, NDCG, MAP, A/B Testing in Recommender Systems, Explainability in Recommendations, Fairness, Bias, and Privacy in Recommenders, Scalability and Real-time Recommendations, Deploying Recommender Systems at Scale (e.g., Spotify, YouTube).

TEXT BOOKS

1. Charu C. Aggarwal, *Recommender Systems: The Textbook*, Springer, 2016.
2. Francesco Ricci, Lior Rokach, and Bracha Shapira, *Recommender Systems Handbook*, Springer, 2nd Ed., 2015.

REFERENCE BOOKS

1. Jannach, Dietmar et al., *Recommender Systems: An Introduction*, Cambridge University Press, 2010.
2. Michael Ekstrand, Joseph A. Konstan, *Collaborative Filtering Recommender Systems*, Now Publishers, 2011.
3. Research papers from *ACM RecSys* Conference proceedings.

ONLINE LEARNING RESOURCES

- <https://www.coursera.org/learn/recommender-systems> – Coursera: University of Minnesota
- <https://www.kaggle.com/learn/recommendation-systems> – Kaggle Course
- <https://developers.google.com/machine-learning/recommendation> – Google Developers

CO-PO MAPPING

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
23A336BT.1	3	2	-	-	2	-	-	-	-	-	-	2	2	2
23A336BT.2	3	3	3	2	3	-	-	-	-	-	-	2	3	3
23A336BT.3	3	3	3	2	3	-	-	-	-	-	-	2	3	3
23A336BT.4	3	2	2	3	3	-	-	-	2	2	-	2	3	3
23A336BT.5	3	3	3	2	3	2	2	-	2	2	2	3	3	3

III B.TECH II SEMESTER

23A306CT

PREDICTIVE ANALYTICS
(PROFESSIONAL ELECTIVE-II)
(Common to CSE(AI) and AI&ML)

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

- 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 (09)

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 (09)

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 (09)

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 (09)

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 (09)

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.

TEXT BOOKS

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

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

CO-PO MAPPING

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
23A306CT.1	3	2	-	-	2	-	-	-	-	-	-	2	2	1
23A306CT.2	3	3	3	2	3	-	-	-	-	-	-	2	3	3
23A306CT.3	3	3	2	3	3	-	-	-	-	-	-	2	3	3
23A306CT.4	3	3	2	3	3	-	-	-	-	-	-	2	3	3
23A306CT.5	3	3	3	3	3	2	1	1	2	2	2	3	3	3

III B.TECH II SEMESTER

23A336CT

BIG DATA
(PROFESSIONAL ELECTIVE-II)
(Common to AI&ML)

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

- 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 (09)

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 (09)

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 (09)

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 (09)

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

(09)

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.

TEXT BOOKS

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

CO-PO MAPPING

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
23A336CT.1	3	2	-	-	2	2	-	1	-	1	-	2	3	2
23A336CT.2	3	3	2	2	3	-	-	-	-	-	1	2	3	3
23A336CT.3	3	3	3	2	3	-	-	-	2	-	2	3	3	3
23A336CT.4	3	3	3	3	3	2	2	2	2	1	2	3	3	3
23A336CT.5	3	3	3	3	3	2	-	2	2	2	3	3	3	3

III B.TECH II SEMESTER

23A306ET

INTRODUCTION TO QUANTUM COMPUTING
(PROFESSIONAL ELECTIVE-III)
(Common to AI&ML)

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

- 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 (08)

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 (09)

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 (09)

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 (09)

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 (09)

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.

TEXT BOOKS

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

CO-PO MAPPING

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
23A306ET.1	3	2	-	-	2	2	-	1	-	1	-	2	3	2
23A306ET.2	3	3	2	2	3	-	-	-	1	-	-	2	3	3
23A306ET.3	3	3	3	3	3	1	-	-	1	-	-	3	3	3
23A306ET.4	3	3	3	2	3	-	-	-	2	1	1	3	3	3
23A306ET.5	3	3	2	3	3	2	1	2	2	1	2	3	3	3

III B.TECH II SEMESTER

23A306FT

COMPUTER VISION
(PROFESSIONAL ELECTIVE-III)
(Common to AI&ML)

L	T	P	C
3	0	0	3

COURSE 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

- 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 (08)

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 (09)

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 (09)

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 (08)

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 (08)

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

CO-PO MAPPING

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
23A306FT.1	3	2	-	-	2	-	-	-	-	-	-	2	2	-
23A306FT.2	2	2	-	-	-	-	-	-	-	-	-	2	1	-
23A306FT.3	3	3	3	2	3	-	-	-	-	-	-	2	3	2
23A306FT.4	3	3	3	2	3	-	-	-	2	2	2	3	3	3

III B.TECH II SEMESTER

23A306HT

**SOCIAL NETWORK ANALYSIS
(PROFESSIONAL ELECTIVE-III)
(Common to CSE(AI) and AI&ML)**

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

- 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 (09)

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 (09)

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 (09)

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 (09)

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 (09)

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.

TEXT BOOKS

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.

REFERENCE BOOKS

1. Newman, M., *Networks: An Introduction*, Oxford University Press, 2010.
2. Borgatti, S. P., Everett, M. G., & Johnson, J. C., *Analyzing Social Networks*, SAGE Publications, 2018.
3. Barabási, A.-L., *Linked: How Everything Is Connected to Everything Else*, Basic Books, 2014.
4. 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

CO-PO MAPPING

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
23A306HT.1	3	2	-	-	-	-	-	-	-	-	-	2	3	1
23A306HT.2	3	3	2	2	-	-	-	-	-	-	-	2	3	2
23A306HT.3	3	3	3	3	2	-	-	-	-	-	-	3	3	2
23A306HT.4	3	3	3	3	3	2	-	-	-	2	2	3	3	2
23A306HT.5	3	2	3	3	3	-	-	2	2	2	2	3	3	3

III B.TECH II SEMESTER

23A016GT

DISASTER MANAGEMENT
(OPEN ELECTIVE-I)
(Common to all branches)

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- To understand the fundamental concepts of natural disasters, their occurrence, and disaster risk reduction strategies.
- To analyze the impact of cyclones on structures and explore retrofitting techniques for adaptive reconstruction.
- To apply wind engineering principles and computational techniques in designing wind-resistant structures.
- To evaluate earthquake effects on buildings and develop strategies for seismic retrofitting.
- To assess seismic safety planning, design considerations, and innovative construction materials for disaster-resistant structures.

COURSE OUTCOMES

- Understand the fundamental concepts of natural disasters, their occurrence, and disaster risk reduction strategies.
- Analyze the impact of cyclones on structures and explore retrofitting techniques for adaptive reconstruction.
- Apply wind engineering principles and computational techniques in designing wind-resistant structures.
- Evaluate earthquake effects on buildings and develop strategies for seismic retrofitting.
- Assess seismic safety planning, design considerations, and innovative construction materials for disaster-resistant structures.

UNIT I - INTRODUCTION TO NATURAL DISASTERS

(09)

Introduction to Natural Disasters– Brief Introduction to Different Types of Natural Disasters, Occurrence of Disasters in Different Climatic and Geographical Regions, Hazard Maps (Earthquake and Cyclone) of The World and India, Regulations for Disaster Risk Reduction, Post-Disaster Recovery and Rehabilitation (Socioeconomic Consequences).

UNIT II - CYCLONES AND THEIR IMPACT

(09)

Cyclones and Their Impact– Climate Change and Its Impact On Tropical Cyclones, Nature of Cyclonic Wind, Velocities and Pressure, Cyclone Effects, Storm Surges, Floods, and Landslides. Behavior of Structures in Past Cyclones and Windstorms, Case Studies. Cyclonic Retrofitting, Strengthening of Structures, and Adaptive Sustainable Reconstruction. Life-Line Structures Such as Temporary Cyclone Shelters.

UNIT III - WIND ENGINEERING AND STRUCTURAL RESPONSE (09)

Wind Engineering and Structural Response– Basic Wind Engineering, Aerodynamics of Bluff Bodies, Vortex Shedding, and Associated Unsteadiness Along and Across Wind forces. Lab: Wind Tunnel Testing and Its Salient Features. Introduction to Computational Fluid Dynamics (CFD). General Planning and Design Considerations Under Windstorms and Cyclones. Wind Effects On Buildings, towers, Glass Panels, Etc., and Wind-Resistant Features in Design. Codal Provisions, Design Wind Speed, Pressure Coefficients. Coastal Zoning Regulations for Construction and Reconstruction in Coastal Areas. Innovative Construction Materials and Techniques, Traditional Construction Techniques in Coastal Areas.

UNIT IV - SEISMOLOGY AND EARTHQUAKE EFFECTS (09)

Seismology and Earthquake Effects– Causes of Earthquakes, Plate Tectonics, Faults, Seismic Waves; Magnitude, Intensity, Epicenter, Energy Release, and Ground Motions. Earthquake Effects– On Ground, Soil Rupture, Liquefaction, Landslides. Performance of Ground and Buildings in Past Earthquakes– Behavior of Various Types of Buildings and Structures, Collapse Patterns; Behavior of Non-Structural Elements Such as Services, Fixtures, and Mountings – Case Studies. Seismic Retrofitting– Weakness in Existing Buildings, Aging, Concepts in Repair, Restoration, and Seismic Strengthening.

UNIT V - PLANNING AND DESIGN CONSIDERATIONS FOR SEISMIC SAFETY (09)

Planning and Design Considerations for Seismic Safety– General Planning and Design Considerations; Building forms, Horizontal and Vertical Eccentricities, Mass and Stiffness Distribution, Soft Storey Effects, Etc.; Seismic Effects Related to Building Configuration. Plan and Vertical Irregularities, Redundancy, and Setbacks. Construction Details– Various Types of Foundations, Soil Stabilization, Retaining Walls, Plinth Fill, Flooring, Walls, Openings, Roofs, Terraces, Parapets, Boundary Walls, Underground and Overhead Tanks, Staircases, and Isolation of Structures. Innovative Construction Materials and Techniques. Local Practices– Traditional Regional Responses. Computational Investigation Techniques.

TEXT BOOKS

1. David Alexander, Natural Disasters, 1st Edition, CRC Press, 2017.
2. Edward A. Keller and Duane E. DeVecchio, Natural Hazards: Earth's Processes as Hazards, Disasters, and Catastrophes, 5th Edition, Routledge, 2019.

REFERENCE BOOKS

1. Ben Wisner, J.C. Gaillard, and Ilan Kelman (Editors), Handbook of Hazards and Disaster Risk Reduction and Management, 2nd Edition, Routledge, 2012.
2. Damon P. Coppola, Introduction to International Disaster Management, 4th Edition, Butterworth-Heinemann, 2020.
3. Bimal Kanti Paul, Environmental Hazards and Disasters: Contexts, Perspectives and Management, 2nd Edition, Wiley-Blackwell, 2020.

ONLINE LEARNING RESOURCES

- <https://nptel.ac.in/courses/124107010>
- https://onlinecourses.swayam2.ac.in/cec19_hs20/preview

CO-PO MAPPING

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
23A016GT.1	3	-	-	-	-	2	-	2	2	-	-	-	3	3
23A016GT.2	-	3	-	-	2	-	-	-	-	-	-	2	3	-
23A016GT.3	3	-	-	3	-	-	3	-	-	2	-	-	-	3
23A016GT.4	-	-	3	-	3	-	-	2	-	-	-	-	3	-
23A016GT.5	-	-	-	3	-	3	3	3	2	-	-	-	-	3

III B.TECH II SEMESTER

	SUSTAINABILITY IN ENGINEERING PRACTICES	L	T	P	C
23A016HT	(OPEN ELECTIVE-II)	3	0	0	3
	<i>(Common to all branches)</i>				

COURSE OBJECTIVES

- To understand the fundamentals of sustainability, the carbon cycle, and the environmental impact of construction materials.
- To analyze sustainable construction materials, their durability, and life cycle assessment.
- To apply energy calculations in construction materials and assess their embodied energy.
- To evaluate green building standards, energy codes, and performance ratings.
- To assess the environmental effects of energy use, climate change, and global warming.

COURSE OUTCOMES

- Understand the fundamentals of sustainability, the carbon cycle, and the environmental impact of construction materials.
- Analyze sustainable construction materials, their durability, and life cycle assessment.
- Apply energy calculations in construction materials and assess their embodied energy.
- Evaluate green building standards, energy codes, and performance ratings.
- Assess the environmental effects of energy use, climate change, and global warming.

UNIT I – INTRODUCTION (09)

Introduction and Definition of Sustainability - Carbon Cycle - Role of Construction Material: Concrete and Steel, Etc. - CO₂ Contribution From Cement and Other Construction Materials

UNIT II - MATERIALS USED in SUSTAINABLE CONSTRUCTION (09)

Construction Materials and Indoor Air Quality - No/Low Cement Concrete - Recycled and Manufactured Aggregate - Role of QC and Durability - Life Cycle and Sustainability.

UNIT III - ENERGY CALCULATIONS (09)

Components of Embodied Energy - Calculation of Embodied Energy for Construction Materials - Energy Concept and Primary Energy - Embodied Energy Via-A-Vis Operational Energy in Conditioned Building - Life Cycle Energy Use.

UNIT IV - GREEN BUILDINGS (09)

Control of Energy Use in Building - ECBC Code, Codes in Neighboring Tropical Countries - OTTV Concepts and Calculations – Features of LEED and TERI – GRIHA Ratings - Role of Insulation and Thermal Properties of Construction Materials - Influence of Moisture Content and Modeling - Performance Ratings of Green Buildings - Zero Energy Building.

UNIT V - ENVIRONMENTAL EFFECTS (09)

Non-Renewable Sources of Energy and Environmental Impact– Energy Norm, Coal, Oil, Natural Gas - Nuclear Energy - Global Temperature, Green House Effects, Global Warming - Acid Rain: Causes, Effects and Control Methods - Regional Impacts of Temperature Change.

TEXT BOOKS

1. Charles J Kibert, Sustainable Construction: Green Building Design & Delivery, 4th Edition , Wiley Publishers 2016.
2. Steve Goodhew, Sustainable Construction Process, Wiley Blackwell,UK, 2016.

REFERENCE BOOKS

1. Craig A. Langston & Grace K.C. Ding, Sustainable Practices in the Built Environment, Butterworth Heinemann Publishers, 2011.
2. William P Spence, Construction Materials, Methods & Techniques (3e), Yesdee Publication Pvt. Ltd, 2012.

ONLINE LEARNING RESOURCES

- <https://archive.nptel.ac.in/courses/105/105/105105157/>

CO-PO MAPPING

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
23A016HT.1	3	-	-	-	-	2	3	2	-	-	-	-	3	3
23A016HT.2	-	3	-	-	2	-	3	-	-	-	-	2	3	3
23A016HT.3	-	-	3	3	3	-	2	-	-	2	-	-	3	3
23A016HT.4	-	-	3	3	3	-	3	2	-	-	-	-	3	3
23A016HT.5	-	-	-	-	-	3	3	3	-	-	-	-	-	3

III B.TECH II SEMESTER

23A026IT

RENEWABLE ENERGY SOURCES
(OPEN ELECTIVE-II)
(Common to all branches)

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- To introduce the fundamental principles and working mechanisms of various renewable energy sources such as solar, wind, geothermal, ocean, biomass, and fuel cells.
- To develop an understanding of the energy conversion processes and technologies involved in harvesting renewable energy.
- To enable students to analyze and evaluate the performance, efficiency, and site selection criteria of renewable energy systems.
- To familiarize students with the design and application aspects of solar PV modules, wind turbines, and biomass energy systems.
- To promote awareness of the environmental, economic, and sustainability aspects of using renewable energy for power generation.

COURSE OUTCOMES

- Understand principal operation of various renewable energy sources.
- Identify site selection of various renewable energy sources.
- Analyze various factors affecting on solar energy measurements, wind energy conversion techniques, Geothermal, Biomass, Tidal Wave and Fuel cell energies
- Design of Solar PV modules and considerations of horizontal and vertical axis Wind energy systems.
- Apply the concepts of Geo Thermal Energy, Ocean Energy, Bio mass and Fuel Cells for generation of power.

UNIT I - SOLAR ENERGY

(09)

Solar radiation - beam and diffuse radiation, solar constant, Sun at Zenith, attenuation and measurement of solar radiation, local solar time, derived solar angles, sunrise, sunset and day length. flat plate collectors, concentrating collectors, storage of solar energy-thermal storage.

UNIT II - PV ENERGY SYSTEMS

(09)

Introduction, The PV effect in crystalline silicon basic principles, the film PV, Other PV technologies, Solar PV modules from solar cells, mismatch in series and parallel connections design and structure of PV modules, Electrical characteristics of silicon PV cells and modules, Stand-alone PV system configuration, Grid connected PV systems.

UNIT III - WIND ENERGY

(09)

Principle of wind energy conversion; Basic components of wind energy conversion systems; wind mill components, various types and their constructional features; design considerations of horizontal and vertical axis wind machines: analysis of aerodynamic forces acting on wind mill blades; wind data and energy estimation and site selection considerations.

UNIT IV - GEOTHERMAL ENERGY

(09)

Estimation and nature of geothermal energy, geothermal sources and resources like hydrothermal, geopressured hot dry rock, magma. Advantages, disadvantages and application of geothermal energy, prospects of geothermal energy in India.

UNIT – V - MISCELLANEOUS ENERGY TECHNOLOGIES

(09)

Ocean Energy: Tidal Energy-Principle of working, Operation methods, advantages and limitations. Wave Energy-Principle of working, energy and power from waves, wave energy conversion devices, advantages and limitations.

Bio mass Energy: Biomass conversion technologies, Biogas generation plants, Classification, advantages and disadvantages, constructional details, site selection, digester design consideration
 Fuel cell: Principle of working of various types of fuel cells and their working, performance and limitations.

TEXT BOOKS

1. G. D. Rai, —Non-Conventional Energy Sources, 4th Edition, Khanna Publishers, 2000.
2. Chetan Singh Solanki —Solar Photovoltaics fundamentals, technologies and applications, 2nd Edition PHI Learning Private Limited. 2012.

REFERENCE BOOKS

1. Stephen Peake, —Renewable Energy Power for a Sustainable Future, Oxford International Edition, 2018.
2. S. P. Sukhatme, —Solar Energy, 3rd Edition, Tata Mc Graw Hill Education Pvt. Ltd, 2008.
3. B H Khan — Non-Conventional Energy Resources, 2nd Edition, Tata Mc Graw Hill Education Pvt Ltd, 2011.
4. S. Hasan Saeed and D.K.Sharma,—Non-Conventional Energy Resources, 3rd Edition, S.K.Kataria & Sons, 2012.
5. G. N. Tiwari and M.K.Ghosal, —Renewable Energy Resource: Basic Principles and Applications, Narosa Publishing House, 2004.

ONLINE LEARNING RESOURCES

- <https://nptel.ac.in/courses/103103206>
- <https://nptel.ac.in/courses/108108078>

CO-PO MAPPING

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
23A026IT.1	3	2	-	-	-	2	-	-	-	-	-	-	2	-
23A026IT.2	3	2	2	-	2	2	-	-	-	-	-	-	2	1
23A026IT.3	3	3	3	-	2	-	-	-	-	-	-	2	3	2
23A026IT.4	3	3	3	2	3	-	-	-	-	-	-	2	3	3
23A026IT.5	3	3	2	2	2	2	2	-	-	-	-	2	3	2

III B.TECH II SEMESTER

23A036KT

AUTOMATION AND ROBOTICS
(OPEN ELECTIVE-II)
(Common to all branches)

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- Fundamentals of industrial automation, production types, automation strategies, and hardware elements used in modern manufacturing processes.
- Understanding of automated manufacturing systems, and strategies for improving productivity And flexibility in industrial automation.
- Knowledge of industrial automation and robotics, sensors, and end-effector design for modern manufacturing environments.
- Explain industrial automation and robotics, and trajectory planning for intelligent and efficient manufacturing applications.
- Familiarity of industrial automation and robotics, and practical applications in manufacturing processes.

COURSE OUTCOMES

- Understand and analyze the structure and functions of automated manufacturing systems, and evaluate hardware components for efficient production.
- Analyze and design automated flow lines with or without buffer storage, perform quantitative evaluations, apply assembly line balancing techniques.
- Classify robot configurations, select suitable actuators and sensors, analyze and apply automation and robotics principles to optimize production efficiency and flexibility.
- Simply kinematic and dynamic modeling using D-H notation and select appropriate hardware and control strategies for real-world industrial scenario to analyze and design automated and robotic systems.
- Design, program, and implement robotic systems, understand and apply robotics technology to manufacturing tasks.

UNIT I - INTRODUCTION TO AUTOMATION (09)

Introduction to Automation, Need, Types, Basic elements of an automated system, Manufacturing Industries, Types of production, Functions in manufacturing, Organization and information processing in manufacturing, Automation strategies and levels of automation, Hardware components for automation and process control, mechanical feeders, hoppers, orienters, high speed automatic insertion devices.

UNIT II - AUTOMATED FLOW LINES (09)

Automated flow lines, Part transfer methods and mechanisms, types of Flow lines, flow line with/without buffer storage, Quantitative analysis of flow lines. Assembly line balancing: Assembly process and systems assembly line, line balancing methods, ways of improving line balance, flexible assembly lines.

UNIT III - INTRODUCTION TO INDUSTRIAL ROBOTICS (09)

Introduction to Industrial Robotics, Classification of Robot Configurations, functional line diagram, degrees of freedom. Components common types of arms, joints grippers, factors to be considered in the design of grippers.

Robot actuators and Feedback components: Actuators, Pneumatic, Hydraulic actuators, Electric & Stepper motors, comparison. Position sensors - potentiometers, resolvers, encoders - velocity sensors, Tactile sensors, Proximity sensors.

UNIT IV - MANIPULATOR KINEMATICS

(09)

Manipulator Kinematics, Homogenous transformations as applicable to rotation and translation - D-H notation, Forward inverse kinematics.

Manipulator Dynamics: Differential transformations, Jacobians, Lagrange - Euler and Newton – Euler formations. Trajectory Planning: Trajectory Planning and avoidance of obstacles path planning, skew motion, joint integrated motion - straight line motion.

UNIT V - ROBOT PROGRAMMING

(09)

Robot Programming, Methods of programming - requirements and features of programming languages, software packages. Problems with programming languages.

Robot Application in Manufacturing: Material Transfer - Material handling, loading and unloading - Process - spot and continuous arc welding & spray painting - Assembly and Inspection.

TEXT BOOKS

1. Automation, Production systems and CIM, M.P. Groover /Pearson Edu.
2. Industrial Robotics - M.P. Groover, TMH.

REFERENCES

1. Robotics, Fu K S, McGraw Hill, 4th edition, 2010.
2. An Introduction to Robot Technology, P. Coiffet and M. Chaironze, Kogam Page Ltd. 1983 London.
3. Robotic Engineering, Richard D. Klafter, Prentice Hall
4. Robotics, Fundamental Concepts and analysis – Ashitave Ghosal, Oxford Press, 1/e, 2006
5. Robotics and Control, Mittal R K & Nagrath I J, TMH.

ONLINE LEARNING RESOURCES

- <https://www.youtube.com/watch?v=yxZm9WQJUA0&list=PLRLB5WCqU54UJG45UnazSYmmnhl-gt76o>
- <https://www.youtube.com/watch?v=6f3bvIhSWyM&list=PLRLB5WCqU54X5Vy4DwjfSODT3 ZJgwEjyE>

CO-PO MAPPING

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
23A036KT.1	3	2	2	2	3	-	-	-	-	-	-	2	3	2
23A036KT.2	2	3	3	3	3	-	-	-	-	-	-	2	3	2
23A036KT.3	3	3	3	2	3	-	-	-	-	-	-	2	3	3
23A036KT.4	3	3	3	3	3	-	-	-	-	-	-	3	3	3
23A036KT.5	2	3	3	2	3	-	-	-	-	-	-	3	3	3

III B.TECH II SEMESTER

23A046GT

DIGITAL ELECTRONICS
(OPEN ELECTIVE-II)
(Common to all branches)

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- To Learn Boolean algebra, logic simplification techniques, and combinational circuit design.
- To analyze combinational circuits like adders, subtractors, and code converters.
- To explore combinational logic circuits and their applications in digital design.
- To understand sequential logic circuits, including latches, flip-flops, counters, and shift registers.
- To gain knowledge about programmable logic devices and digital IC's.

COURSE OUTCOMES

- Learn Boolean algebra, logic simplification techniques, and combinational circuit design.
- Analyze combinational circuits like adders, subtractors, and code converters.
- Explore combinational logic circuits and their applications in digital design.
- Understand sequential logic circuits, including latches, flip-flops, counters, and shift registers.
- Gain knowledge about programmable logic devices and digital IC's.

UNIT I - LOGIC SIMPLIFICATION AND COMBINATIONAL LOGIC DESIGN (09)

Review of Boolean Algebra and De Morgan's Theorem, SOP & POS forms, Canonical forms, Introduction to Logic Gates, Ex-OR, Ex- NOR operations, Minimization of Switching Functions: Karnaugh map method, Logic function realization: AND-OR, OR-AND and NAND/NOR realizations.

UNIT II - INTRODUCTION TO COMBINATIONAL DESIGN 1 (09)

Binary Adders, Subtractors and BCD adder, Code converters - Binary to Gray, Gray to Binary, BCD to excess3, BCD to Seven Segment display.

UNIT III – COMBINATIONAL LOGIC DESIGN 2 (09)

Decoders, Encoders, Priority Encoder, Multiplexers, Demultiplexers, Comparators, Implementations of Logic Functions using Decoders and Multiplexers.

UNIT IV - SEQUENTIAL LOGIC DESIGN (09)

Latches, Flip-flops, S-R, D, T, JK and Master-Slave JK FF, Edge triggered FF, set up and hold times, Ripple counters, Shift registers.

UNIT V - PROGRAMMABLE LOGIC DEVICES (09)

ROM, Programmable Logic Devices (PLA and PAL).

Digital IC's:Decoder (74x138), Priority Encoder (74x148), multiplexer (74x151) and de-multiplexer (74x155), comparator (74x85).

TEXT BOOKS

1. Digital Design, M.Morris Mano & Michel D. Ciletti, 5th Edition, Pearson Education, 1999.
2. Switching theory and Finite Automata Theory, ZviKohavi and NirahK.Jha, 2nd Edition, Tata McGraw Hill, 2005.

REFERENCE BOOKS

1. Fundamentals of Logic Design, Charles H Roth,Jr., 5th Edition, Brooks/cole Cengage Learning, 2004.

CO-PO MAPPING

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
23A046GT.1	3	2	2	-	2	-	-	-	-	-	-	2	3	2
23A046GT.2	3	3	3	2	2	-	-	-	-	-	-	-	3	2
23A046GT.3	3	3	3	2	3	-	-	-	-	-	-	2	3	3
23A046GT.4	3	3	3	3	3	-	-	-	-	-	-	2	3	3
23A046GT.5	3	2	3	2	3	-	-	-	-	-	-	2	3	3

III B.TECH II SEMESTER

23AHS61T

OPTIMIZATION TECHNIQUES FOR ENGINEERS
(OPEN ELECTIVE-II)
(Common to all branches)

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- To formulate and solve optimization problems using various techniques.
- To apply optimization algorithms to real-world problems.
- To analyze and interpret the results of optimization models.
- To use optimization software tools to solve problems.

COURSE OUTCOMES

- Understand the meaning, purpose, tools of Operations Research and linear programming in solving practical problems in industry.
- Interpret the transportation models' solutions and infer solutions to the real-world problems.
- Develop mathematical skills to analyze and solve nonlinear programming models arising from a wide range of applications.
- Apply the concept of non-linear programming for solving the problems involving non-linear constraints and objectives.
- Apply the concept of unconstrained geometric programming for solving the problems involving non-linear constraints and objectives.

UNIT I - LINEAR PROGRAMMING I

(08)

Introduction, Applications of Linear Programming, Standard form of a Linear Programming Problem, Geometry of Linear Programming Problems, Basic Definitions in Linear Programming. Simplex Method, Simplex Algorithm and Two-phase Simplex Method, Big-M method.

UNIT II - LINEAR PROGRAMMING II: DUALITY IN LINEAR PROGRAMMING

(08)

Symmetric Primal-Dual Relations, General Primal-Dual Relations, Duality Theorem, Dual Simplex Method, Transportation Problem and assignment problem, Complementary slackness Theorem.

UNIT III - NON-LINEAR PROGRAMMING: UNCONSTRAINED OPTIMIZATION TECHNIQUES

(08)

Introduction: Classification of Unconstrained minimization methods.

Direct Search Methods: Random Search Methods: Descent Method and Fletcher Powell Method, Grid Search Method.

UNIT IV - NON-LINEAR PROGRAMMING: CONSTRAINED OPTIMIZATION TECHNIQUES

(08)

Introduction, Characteristics of a constrained problem, Random Search Methods, complex method, Sequential linear programming, Basic approach in methods of Feasible directions, Zoutendijk's method of feasible directions: direction finding problem, determination of step length, Termination criteria.

UNIT V - GEOMETRIC PROGRAMMING

(08)

Unconstrained Minimization Problems: solution of unconstrained geometric programming using differential calculus and arithmetic-geometric inequality.

Constrained minimization Problems: Solution of a constrained geometric programming problem, primal-dual programming in case of less-than inequalities, geometric programming with mixed inequality constraints.

TEXT BOOK

1. Singiresu S Rao., Engineering Optimization: Theory and Practices, New Age Int. (P) Ltd. Publishers, New Delhi.
2. J. C. Panth, Introduction to Optimization Techniques, (7-e) Jain Brothers, New Delhi.

REFERENCES

1. Harvey M. Wagner, Principles of Operation Research, Printice-Hall of India Pvt. Ltd. New Delhi.
2. Peressimi A.L., Sullivan F.E., Vhl, J. J. Mathematics of Non-linear Programming, Springer – Verlag.

WEB REFERENCE

- https://onlinecourses.nptel.ac.in/noc24_ee122/preview
- <https://archive.nptel.ac.in/courses/111/105/111105039/>
- https://onlinecourses.nptel.ac.in/noc21_ce60/preview

CO-PO MAPPING

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
23AHS61T.1	3	3	2	2	-	-	-	-	-	-	-	1	-	-
23AHS61T.2	3	2	2	2	-	-	-	-	-	-	-	1	-	-
23AHS61T.3	3	2	2	1	-	-	-	-	-	-	-	1	-	-
23AHS61T.4	2	2	2	1	-	-	-	-	-	-	-	1	-	-
23AHS61T.5	3	3	2	1	-	-	-	-	-	-	-	1	-	-

23AHS66T	MATHEMATICAL FOUNDATION OF QUANTUM TECHNOLOGIES (OPEN ELECTIVE – II) (Common to all branches)	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To provide students with essential linear algebra foundations including vector spaces, inner products, and operators for quantum mechanical applications.
- To develop understanding of the transition from finite-dimensional systems to infinite-dimensional function spaces and Hilbert space concepts.
- To establish quantum mechanical formalism including measurement theory, uncertainty relations, and time evolution principles.
- To enable students to apply quantum mechanical principles to solve problems in simple quantum systems and understand statistical interpretation.
- To introduce advanced concepts in composite systems, measurement processes, and modern perspectives in quantum mechanics.

COURSE OUTCOMES

- Understand vector spaces, inner products, and linear operators with applications to quantum systems.
- Apply linear algebra concepts to function spaces and analyze the transition from finite to infinite dimensional systems.
- Analyze quantum mechanical formalism including measurement theory, uncertainty relations, and time evolution.
- Apply quantum mechanical principles to solve problems in simple quantum systems and evaluate statistical interpretations.
- Evaluate advanced concepts in composite systems and synthesize understanding of measurement processes and modern quantum theory.

UNIT I - LINEAR ALGEBRA FOUNDATION FOR QUANTUM MECHANICS (10)

Vector spaces definition and examples ($\mathbb{R}^2$, $\mathbb{R}^3$, function spaces), Inner products (dot product, orthogonality, normalization), Linear operators (matrices, eigenvalues, eigenvectors), Finite-dimensional examples (2×2 matrices, spin-1/2 systems), Dirac notation introduction ($|\psi\rangle$, $\langle\phi|$, $\langle\phi|\psi\rangle$), Change of basis (transformations, unitary matrices).

UNIT II - FROM FINITE TO INFINITE DIMENSIONS (08)

Function spaces (L^2 space, square-integrable functions), Inner products for functions ($\int \psi^* \phi dx$), Orthogonal function sets (Fourier series, basis functions), Introduction to Hilbert space concept (complete inner product spaces), Position and momentum representations (wave functions), Operators on functions (d/dx , multiplication by x).

UNIT III - QUANTUM MECHANICAL FORMALISM (08)

Mathematical formulation (states as vectors, observables as operators), Measurement theory (Born rule, expectation values, probabilities), Uncertainty relations (mathematical derivation from commutators), Time evolution (Schrödinger equation, unitary evolution).

UNIT IV - APPLICATIONS AND STATISTICAL INTERPRETATION (06)

Simple applications (infinite square well, harmonic oscillator), Statistical interpretation (ensembles, pure vs mixed states), Measurement process (von Neumann measurement scheme).

UNIT V - ADVANCED TOPICS

(08)

Composite systems (tensor products basic introduction), Reversibility and irreversibility (unitary evolution vs measurement), Thermodynamic connections (equilibrium states, entropy), Modern perspectives (decoherence, measurement problem conceptual).

TEXT BOOKS

1. David J. Griffiths, Darrell F. Schroeter, —Introduction to Quantum Mechanics, 3rd Edition, Cambridge University Press (2018).
2. R. Shankar, Principles of Quantum Mechanics, 2nd Edition, Kluwer Academy/Plenum Publishers (1994).

REFERENCE BOOKS

1. George. F. Simmons, —Introduction to Topology and Modern Analysis, MedTech Science Press.
2. Gilbert Strang, Linear Algebra and Its Applications, 4th Edition, Cengage Learning (2006).
3. John von Neumann and Robert T Beyer, Mathematical Foundations of Quantum Mechanics, Princeton Univ. Press (1996).

WEB RESOURCES

1. <https://eclass.uoa.gr/modules/document/file.php/CHEM248/Griffiths%20-%20Introduction%20to%20Quantum%20Mechanics%203rd%20ed%202018.pdf>
2. <https://fisica.net/mecanica-quantica/Shankar%20-%20Principles%20of%20quantum%20mechanics.pdf>

CO-PO MAPPING

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
23AHS66T.1	3	3	2	2	1	-	-	-	-	-	-	2	-	-
23AHS66T.2	3	3	2	3	2	-	-	-	-	-	-	2	-	-
23AHS66T.3	3	3	3	3	2	-	-	-	-	-	-	2	-	-
23AHS66T.4	3	3	3	3	2	-	-	-	-	-	-	2	-	-
23AHS66T.5	3	3	3	3	2	1	-	-	-	-	-	3	-	-

III B.TECH II SEMESTER

23AHS62T	PHYSICS OF ELECTRONIC MATERIALS AND DEVICES (OPEN ELECTIVE-II) (Common to all branches)	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

COURSE OUTCOMES

- Analyze the crystal structure and crystallite size by various methods.
- Analyze the morphology of the sample by using a Scanning Electron Microscope.
- Analyze the morphology and crystal structure of the sample by using Transmission Electron Microscope.
- Explain the principle and experimental arrangement of various spectroscopic techniques.
- Identify the construction and working principle of various Electrical & Magnetic Characterization technique.

UNIT I - FUNDAMENTALS OF MATERIALS SCIENCE (09)

Introduction, Phase rule, Phase Diagram, Elementary idea of Nucleation and Growth, Methods of crystal growth. The basic idea of point, line, and planar defects. Concept of thin films, preparation of thin films, Deposition of thin film using sputtering methods (RF and glow discharge).

UNIT II - SEMICONDUCTORS (09)

Introduction, charge carriers in semiconductors, effective mass, Diffusion and drift, Diffusion and recombination, Diffusion length. The Fermi level & Fermi-Dirac distribution, Electron and Hole in quantum well, Change of electron-hole concentration- Qualitative analysis, Temperature dependency of carrier concentration, Conductivity and mobility, Effects of temperature and doping on mobility, High field effects.

UNIT III - PHYSICS OF SEMICONDUCTOR DEVICES (09)

Introduction, Band structure, PN junctions and their typical characteristics under equilibrium and under bias, Heterojunctions, Transistors, MOSFETs.

UNIT IV - EXCITONS AND LUMINESCENCE (09)

Luminescence: Different types of luminescence, basic definitions, Light emission in solids, Inter- band luminescence, Direct and indirect gap materials. Photoluminescence: General Principles of photoluminescence, Excitation and relaxation, OLED, Quantum-dot. Electro-luminescence: General Principles of electroluminescence, light emitting diode, diode laser.

UNIT V - DISPLAY DEVICES (09)

LCD, three-dimensional display: Holographic display, light-field displays: Head-mounted display, MOEMS (Micro-Opto-Electro-Mechanical Systems) and MEMS displays.

TEXT BOOKS

1. Principles of Electronic Materials and Devices-S.O. Kasap, McGraw-Hill Education (India) Pvt. Ltd., 4th edition, 2021.
2. Semiconductor physics & devices: basic principles, 4th Edition, McGraw-Hill, 2012.

REFERENCE BOOKS

1. Solid State Electronic Devices -B.G. Streetman and S. Banerjee, PHI Learning, 6th edition
2. Electronic Materials Science- Eugene A. Irene, Wiley, 2005
3. Electronic Components and Materials, Grover and Jamwal, Dhanpat Rai and Co., New Delhi., 2012.
4. An Introduction to Electronic Materials for Engineers-Wei Gao, Zhengwei Li, Nigel Sammes, World Scientific Publishing Co. Pvt. Ltd. 2nd Edition, 2011

NPTEL COURSE LINKS

- <https://nptel.ac.in/courses/113/106/113106062/>
- https://onlinecourses.nptel.ac.in/noc20_ph24/preview

CO-PO MAPPING

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
23AHS62T.1	3	3	2	2	1	-	-	-	-	-	-	-	-	-
23AHS62T.2	3	3	2	1	1	-	-	-	-	-	-	-	-	-
23AHS62T.3	3	3	2	1	1	-	-	-	-	-	-	-	-	-
23AHS62T.4	3	2	1	1	-	-	-	-	-	-	-	-	-	-
23AHS62T.5	3	3	1	1	-	-	-	-	-	-	-	-	-	-

III B.TECH II SEMESTER

23AHS63T

CHEMISTRY OF POLYMERS AND APPLICATIONS
(OPEN ELECTIVE-II)
(Common to all branches)

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- To understand the basic principles of polymers
- To understand natural polymers and their applications.
- To impart knowledge to the students about synthetic polymers, their preparation and importance.
- To enumerate the applications of hydrogel polymers.
- To enumerate applications of conducting and degradable polymers in engineering.

COURSE OUTCOMES

- Explain polymerization mechanism and measurement of molecular weight of polymer.
- Describe the physical, chemical properties and applications of natural polymers and modified Cellulosics.
- Explain types of polymerizations, types of polymers and applications.
- Understand polymer networks, hydrogels, and their applications.
- Explain classification and mechanism of conducting and degradable polymers.

UNIT I - POLYMERS-BASICS AND CHARACTERIZATION (09)

Basic concepts: monomers, repeating units, degree of polymerization, linear, branched and network polymers, classification of polymers, Polymerization: addition, condensation, copolymerization and coordination polymerization. Average molecular weight concepts: number, weight and viscosity average molecular weights, polydispersity and molecular weight distribution. Measurement of molecular weight: End group, viscosity, light scattering, osmotic and ultracentrifugation methods, analysis and testing of polymers.

UNIT II - NATURAL POLYMERS & MODIFIED CELLULOSICS (09)

Natural Polymers: Chemical & Physical structure, properties, source, important chemical modifications, applications of polymers such as cellulose, lignin, starch, rosin, shellac, latexes, vegetable oils and gums, proteins.

Modified cellulosics: Cellulose esters and ethers such as Ethyl cellulose, CMC, HPMC, cellulose acetals, Liquid crystalline polymers; specialty plastics- PES, PAES, PEEK, PEA.

UNIT III - SYNTHETIC POLYMERS (09)

Addition and condensation polymerization processes– Bulk, Solution, Suspension and Emulsion polymerization. Preparation and significance, classification of polymers based on physical properties. Thermoplastics, Thermosetting plastics, Fibers and elastomers, General Applications. Preparation of Polymers based on different types of monomers, Olefin polymers(PE,PVC), Butadiene polymers(BUNA-S,BUNA-N), nylons, Urea-formaldehyde, phenol – formaldehyde, Melamine Epoxy and Ion exchange resins.

UNIT IV- HYDROGELS OF POLYMER NETWORKS (09)

Definitions of Hydrogel, polymer networks, Types of polymer networks, Methods involved in hydrogel preparation, Classification, Properties of hydrogels, Applications of hydrogels in drug delivery.

UNIT V- CONDUCTING AND DEGRADABLE POLYMERS (09)

Conducting polymers: Introduction, Classification, Mechanism of conduction in Poly Acetylene, Poly

Aniline, Poly Thiophene, Doping, Applications.

Degradable polymers: Introduction, Classifications, Examples, Mechanism of degradation, poly lactic acid, Nylon-6, Polyesters, applications.

TEXT BOOKS

1. Fred W. Billmeyer, Jr. is: Billmeyer F. W. A Textbook of Polymer Science, Textbook of Polymer Science (3rd ed.). Wiley-Interscience, 1984.
2. Introduction to polymer chemistry, G.S. Mishra, Wiley Eastern Ltd., New Delhi. Newage publishers

REFERENCES BOOKS

1. Polymer science- V.R Gowrikar, N V Viswanathan, Jayaadev Sreedhar-New age International Publishers. 1986
2. Organic polymer Chemistry, K.J. Saunders, Chapman and Hall
3. Advanced Organic Chemistry, B. Miller, Prentice Hall
4. Polymer Science and Technology by Premamoy Ghosh, 3rd edition, McGraw-Hill, 2010

CO-PO MAPPING

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
23AHS63T.1	3	3	2	2	-	-	2	-	-	-	-	1	-	-
23AHS63T.2	2	2	1	1	-	-	2	-	-	-	-	1	-	-
23AHS63T.3	2	2	1	1	-	-	2	-	-	-	-	1	-	-
23AHS63T.4	2	2	1	1	-	-	2	-	-	-	-	1	-	-
23AHS63T.5	2	2	1	1	-	-	2	-	-	-	-	1	-	-

III B.TECH II SEMESTER

23AHS64T

ACADEMIC WRITING AND PUBLIC SPEAKING
(OPEN ELECTIVE-II)
(Common to all branches)

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- To encourage all-round development of the students by focusing on writing skills
- To make the students aware of non-verbal skills
- To enhance analytical skills in academic writing for deeper knowledge enhancement
- To cultivate proficiency in delivering clear and engaging public speeches

COURSE OUTCOMES

- Understand various elements of Academic Writing
- Identify sources and avoid plagiarism
- Demonstrate the knowledge in writing a Research paper
- Analyze different types of essays
- Assess the strengths of other speakers and build confidence in delivering impactful presentations to an audience.

UNIT I - INTRODUCTION TO ACADEMIC WRITING (09)

Introduction to Academic Writing – Essential Features of Academic Writing – Courtesy – Clarity – Conciseness – Correctness – Coherence – Completeness – Types – Descriptive, Analytical, Persuasive, Critical writing.

UNIT II - ACADEMIC JOURNAL ARTICLE (09)

Art of condensation- summarizing and paraphrasing - Abstract Writing, writing Project Proposal, writing application for internship, Technical/Research/Journal Paper Writing – Conference Paper writing - Editing, Proof Reading – Plagiarism.

UNIT III - ESSAY & WRITING REVIEWS (09)

Compare and Contrast – Argumentative Essay – Exploratory Essay – Features and Analysis of Sample Essays – Writing Book Report, Summarizing, Book/film Review- SoP

UNIT IV - PUBLIC SPEAKING (09)

Introduction, Nature, characteristics, significance of Public Speaking – Presentation – 4 Ps of Presentation – Stage Dynamics – Answering Strategies – Analysis of Impactful Speeches- Speeches for Academic events.

UNIT V - PUBLIC SPEAKING AND NON-VERBAL DELIVERY (09)

Body Language – Facial Expressions-Kinesics – Oculistics – Proxemics – Haptics – Chronemics – Paralanguage – Signs.

TEXT BOOKS

1. Critical Thinking, Academic Writing and Presentation Skills: MG University Edition Paperback – 1 January 2010 Pearson Education; First edition (1 January 2010).
2. Pease, Allan & Barbara. The Definitive Book of Body Language RHUS Publishers, 2016.

REFERENCES BOOKS

1. Alice Savage, Masoud Shafiei Effective Academic Writing, 2nd Ed., 2014. ssrP ytisrevinU drofxO
2. Shalini Verma, Body Language, S Chand Publications 2011.
3. Sanjay Kumar and Pushpalata, Communication Skills 2E 2015, Oxford.
4. Sharon Gerson, Steven Gerson, Technical Communication Process and Product, Pearson, New Delhi, 2014.
5. Elbow, Peter. Writing with Power. OUP USA, 1998.

ONLINE LEARNING RESOURCES

1. <https://youtu.be/NNhTIT81nH8>
2. <https://www.youtube.com/watch?v=478ccrWKY-A>
3. <https://www.youtube.com/watch?v=nzGo5ZC1gMw>
4. <https://www.youtube.com/watch?v=Qve0ZBmJMh4>
5. <https://courses.lumenlearning.com/publicspeakingprinciples/chapter/chapter-12-nonverbal-aspects-of-delivery/>
6. https://onlinecourses.nptel.ac.in/noc21_hs76/preview
7. <https://archive.nptel.ac.in/courses/109/107/109107172/#>
8. <https://archive.nptel.ac.in/courses/109/104/109104107/>

CO-PO MAPPING

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
23AHS64T.1	-	-	-	-	-	-	-	-	-	3	-	3	-	-
23AHS64T.2	-	-	-	-	-	-	-	-	-	3	-	3	-	-
23AHS64T.3	-	-	-	-	-	-	-	-	-	3	-	3	-	-
23AHS64T.4	-	-	-	-	-	-	-	-	-	3	-	3	-	-
23AHS64T.5	-	-	-	-	-	-	-	-	-	3	-	3	-	-

III B.TECH II SEMESTER

23A3364L	DEEP LEARNING & MACHINE LEARNING MODEL OPTIMIZATION LAB (PROFESSIONAL CORE) (Common to AI&ML)	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVES

- To provide practical exposure to model optimization techniques for improving performance and efficiency of machine learning models.
- To explore various hyperparameter tuning methods and optimization algorithms.
- To apply regularization techniques to control overfitting and improve generalization.
- To evaluate model performance through various metrics and validation strategies.
- To learn pruning, quantization, and deployment strategies for optimized models in real-world applications.

COURSE OUTCOMES

- Students will gain hands-on experience in optimizing machine learning models using advanced techniques like hyperparameter tuning, regularization, pruning, and quantization.
- Student will be able to assess model performance critically using evaluation metrics and implement strategies for reducing computational complexity.
- Students with the skills necessary to build efficient, scalable, and high-performing ML systems suitable for deployment in constrained environments such as edge devices and mobile platforms.

LIST OF LAB EXPERIMENTS

1. Implementing Grid Search and Random Search
 - Hyperparameter tuning using Scikit-learn's GridSearchCV and RandomizedSearchCV
(Cognitive Level: Apply & Analyze)
2. Bayesian Optimization using Hyperopt / Optuna
 - Optimize model hyperparameters using probabilistic approaches
(Cognitive Level: Analyze & Evaluate)
3. Early Stopping in Training Deep Learning Models
 - Implement early stopping to avoid overfitting with TensorFlow/Keras
(Cognitive Level: Apply & Evaluate)
4. Regularization Techniques (L1, L2, Dropout)
 - Apply different regularization methods to improve model generalization
(Cognitive Level: Analyze)
5. Cross-Validation Techniques
 - K-Fold, Stratified K-Fold, and Leave-One-Out Cross-Validation
(Cognitive Level: Apply & Evaluate)
6. Model Performance Evaluation
 - Use confusion matrix, precision, recall, F1-score, AUC-ROC for performance
(Cognitive Level: Evaluate)
7. Model Pruning
 - Prune unimportant weights in a trained neural network using PyTorch/TensorFlow
(Cognitive Level: Create & Evaluate)
8. Quantization Aware Training (QAT)
 - Train a quantized model to reduce memory usage without losing accuracy
(Cognitive Level: Apply & Create)

9. Knowledge Distillation
 - Transfer knowledge from a large model to a small one (student-teacher model)
(Cognitive Level: Analyze & Create)
10. Optimizing Model Inference Time
 - Use ONNX, TensorRT, or OpenVINO for faster model inference
(Cognitive Level: Apply & Evaluate)
11. Automated Machine Learning (AutoML)
 - Use Auto-Sklearn, Google AutoML, or TPOT for full pipeline optimization
(Cognitive Level: Evaluate & Create)
12. Model Deployment Optimization
 - Optimize model for deployment using TFLite/ONNX in edge devices
(Cognitive Level: Create & Evaluate)

TEXT BOOKS

1. Aurélien Géron, Hands-On Machine Learning with Scikit-Learn, Keras & TensorFlow, O'Reilly.
2. Sebastian Raschka, Python Machine Learning, Packt Publishing.
3. Francois Chollet, Deep Learning with Python, Manning.

REFERENCE BOOKS

1. Ian Goodfellow, Yoshua Bengio, Aaron Courville, Deep Learning, MIT Press.
2. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning.
3. Vijay Madisetti, Machine Learning and Optimization Models for Real-Time Applications, Springer.

ONLINE COURSES

1. Model Optimization Techniques – Coursera (DeepLearning.AI)
2. Hyperparameter Tuning in Python – Udacity

CO-PO MAPPING

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
23A3364L.1	3	3	2	2	3	-	-	-	2	-	-	2	3	3
23A3364L.2	3	3	3	3	3	-	-	-	-	2	-	2	3	2
23A3364L.3	3	3	3	2	3	-	-	-	2	2	2	3	3	3
23A3364L.4	3	3	3	2	3	-	-	-	2	2	2	3	3	3

III B.TECH II SEMESTER

23A3363L	EDGE COMPUTING LAB (PROFESSIONAL CORE) (Common to AI&ML)	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVES

- To impart practical knowledge of edge computing architecture and frameworks.
- To provide hands-on experience in deploying AI and IoT applications on edge devices.
- To explore edge-native computing environments like Raspberry Pi, Jetson Nano, etc.
- To introduce performance analysis, optimization, and energy efficiency in edge computing.
- To understand data preprocessing, model deployment, and real-time inferencing on the edge.

COURSE OUTCOMES

- Students will be able to practically implement edge computing applications using real-world platforms and tools.
- Students gain experience in deploying lightweight ML models on edge devices, manage data flow between edge and cloud, and ensure system performance under limited computing and networking resources.
- Students will understand how to optimize latency, power consumption, and reliability of edge solutions for smart environments.

LIST OF LAB EXPERIMENTS

1. Setup and Configuration of Edge Devices
 - Raspberry Pi/Jetson Nano installation, SSH, GPIO control
 2. Data Acquisition from Sensors
 - Reading data from temperature, motion, and environmental sensors
 3. Deploying a Lightweight ML Model on Edge
 - Using TensorFlow Lite or PyTorch Mobile for deployment
 4. Real-Time Image Classification at the Edge
 - Using camera module with edge device for inference
 5. MQTT-Based Edge Communication
 - Setup publisher/subscriber model for edge-to-cloud communication
 6. Integrating Edge Devices with Cloud Platforms
 - AWS IoT, Azure IoT Hub, or Google Cloud IoT integration
 7. Edge Device Power and Latency Monitoring
 - Measuring latency and energy consumption during model inference
 8. Edge AI Application – Smart Surveillance System
 - Face or object detection on live video stream using OpenCV
 9. Streaming Data Analytics on Edge
 - Local aggregation and event processing with Kafka or lightweight alternatives
 10. Model Optimization for Edge Deployment
 11. Quantization, pruning, and compression for reducing model size
TinyML for Microcontroller-Based Inference
 12. Deploy a model on Arduino/Nano BLE using TensorFlow Lite Micro
Edge-Orchestrated Federated Learning Prototype
- Basic FL setup using two edge devices sharing a model

TEXT BOOKS

1. Perry Lea, Edge Computing: From Hype to Reality, Manning Publications.
2. Satyanarayana G. et al., Edge Analytics with Raspberry Pi, Springer.
3. Arun Kumar Sangaiah et al., Edge Computing and Computational Intelligence Paradigms for the IoT, Elsevier.

REFERENCE BOOKS

1. Flavio Bonomi, Fog and Edge Computing: Principles and Paradigms, Wiley.
2. Preetha Evangeline, IoT and Edge Computing for Architects, Packt Publishing.
3. Rajkumar Buyya, Internet of Things and Edge Computing for Smart Environments, Springer.

ONLINE COURSES

1. Edge AI and Computer Vision – Udacity (NVIDIA)
2. AI on the Edge with Raspberry Pi – Coursera

CO-PO MAPPING

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
23A3363L.1	3	3	3	2	3	-	-	-	2	2	-	2	3	3
23A3363L.2	3	3	3	3	3	-	-	-	2	2	2	3	3	3
23A3363L.3	3	3	3	3	3	-	2	-	2	2	2	3	3	3
23A3363L.4	3	3	3	2	3	-	-	-	2	2	2	3	3	3

III B.TECH II SEMESTER

23AHS65L

SOFT SKILLS
(SKILL ENHANCEMENT COURSE)
(Common to all branches)

L	T	P	C
0	1	2	2

COURSE OBJECTIVES

- To encourage all round development of the students by focusing on soft skills.
- To develop Inter and Intrapersonal skills of the students to enhance leadership qualities.
- To make the students aware of critical thinking and problem-solving skills.
- To enhance healthy relationships and understanding within and outside an organization.
- To function effectively with heterogeneous teams.

COURSE OUTCOMES

- List out various elements of soft skills.
- Describe methods for building professional image.
- Apply critical thinking skills through listening skills in problem solving.
- Analyze the needs of an individual and team for well-being.
- Make informed decisions and foster a positive workplace using social and work-life skills for personal and emotional well-being.

UNIT I - SOFT SKILLS & COMMUNICATION SKILLS

(12)

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

Activities:

(Interpersonal Skills& Intra-personal skills- Group Discussion - Group leader presenting views (non-controversial and secular) on contemporary issues or on a given topic.)

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

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

UNIT II - CRITICAL THINKING

(09)

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

(09)

Meaning & features of Problem Solving – Managing Conflict – Conflict resolution – Team building - Effective decision making in teams – Methods & Styles- Group Discussions.

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.

UNIT IV - EMOTIONAL INTELLIGENCE & STRESS MANAGEMENT

(12)

Managing Emotions – Thinking before Reacting – Empathy for Others – Self-awareness – Self-Regulation – Stress factors – Controlling Stress – Tips (oral presentation, Organizing Debates).

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

(06)

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.

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, I K International Publishing House, 2018

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

ONLINE LEARNING RESOURCES

1. https://youtu.be/DUlsNJtg2L8?list=PLLy_2iUCG87CQhELCYtvXh0E_y-bOO1_q
2. https://youtu.be/xBaLgJZ0t6A?list=PLzf4HHlsQFwJZel_j2PUy0pwjVUgj7_KIJ
3. <https://youtu.be/-Y-R9hDI7IU>
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
10. https://youtu.be/DUlsNJtg2L8?list=PLLy_2iUCG87CQhELCYtvXh0E_y-bOO1_q
11. https://youtu.be/xBaLgJZ0t6A?list=PLzf4HHlsQFwJZel_j2PUy0pwjVUgj7_KIJ

12. <https://youtu.be/-Y-R9hDI7IU>

CO-PO MAPPING

Course Outcomes	Engineering Knowledge	Problem Analysis	Design/Development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	PSO1	PSO2
23AHS65L.1	-	-	-	-	-	-	-	-	-	3	-	3	-	-
23AHS65L.2	-	-	-	-	-	-	-	-	-	3	-	3	-	-
23AHS65L.3	-	-	-	-	-	-	-	-	-	3	-	3	-	-
23AHS65L.4	-	-	-	-	-	-	-	-	-	3	-	3	-	-
23AHS65L.5	-	-	-	-	-	-	-	-	-	3	-	3	-	-

III B.TECH II SEMESTER

23AHSM61T

TECHNICAL PAPER WRITING & IPR

L	T	P	C
2	0	0	0

(Common to all branches)

COURSE OBJECTIVES

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

COURSE OUTCOMES

- Identify key secondary literature related to their proposed technical paper writing.
- Explain various principles and styles in technical writing.
- Use the acquired knowledge in writing a research/technical paper.
- Analyse rights and responsibilities of holder of Patent, Copyright, Trademark, International Trademark etc.
- Evaluate different forms of IPR available at national & international level.
- Develop skill of making search of various forms of IPR by using modern tools and techniques.

UNIT I - PRINCIPLES OF TECHNICAL WRITING (09)

styles in technical writing; clarity, precision, coherence and logical 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 (09)

Abstract- Objectives-Limitations-Review of Literature- Problems and Framing Research Questions-Synopsis.

UNIT III - PROCESS OF RESEARCH (09)

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 (09)

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 (09)

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.

TEXT BOOKS

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.ht ml>
3. <https://www.ewh.ieee.org/soc/emcs/acstrial/newsletters/summer10/TechPaperWriting.ht ml>
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>

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23AHSM61T.1	3	2	2	3	2	-	-	-	-	-	-	1	3	2
23AHSM61T.2	3	3	3	3	2	-	-	-	-	-	-	2	2	3
23AHSM61T.3	2	3	3	3	3	-	-	-	-	-	-	2	3	3
23AHSM61T.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23AHSM61T.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-