**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**
**(Established by Govt. of A.P., ACT No.30 of 2008)**
**ANANTHAPURAMU – 515 002 (A.P) INDIA**
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B. Tech (Regular-Full time)

(Effective for the students admitted into I B.Tech from the Academic B.Tech 2023-24 onwards)

# CSE- ARTIFICIAL INTELLIGENCE

## COURSE STRUCTURE

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## SYLLABUS

## III B.Tech I Semester

| S.No | Course Code | Title | L | T | P | Credits |
|---|---|---|---|---|---|---|
| 1 | | Natural Language Processing | 3 | 0 | 0 | 3 |
| 2 | | Operating Systems C& System Programming | 3 | 0 | 0 | 3 |
| 3 | | Computer Vision & Image Processing | 3 | 0 | 0 | 3 |
| 4 | | Professional Elective-I<br>1. Data Visualization<br>2. Soft computing /<br>3. Exploratory Data Analysis with Python<br>4. Computational Intelligence | 3 | 0 | 0 | 3 |
| 5 | | **Open Elective- I** | 3 | 0 | 0 | 3 |
| 6 | | Computer Vision & NLP Lab | 0 | 0 | 3 | 1.5 |
| 7 | | AI & System Programming Lab | 0 | 0 | 3 | 1.5 |
| 8 | | **Skill Enhancement course**<br>Full Stack Development-II | 0 | 1 | 2 | 2 |
| 9 | | Tinkering Lab | 0 | 0 | 2 | 1 |
| 10 | | Evaluation of Community Service Internship | - | - | - | 2 |
| | | **Total** | **15** | **1** | **10** | **23** |

### Open Elective – I

| S.No. | Course Code | Course Name | Offered by the Dept. |
|---|---|---|---|
| 1 | | Green Buildings | CIVIL |
| 2 | | Construction Technology and Management | |
| 3 | | Electrical Safety Practices and Standards | EEE |
| 4 | | Sustainable Energy Technologies | ME |
| 5 | | Electronic Circuits | ECE |
| 6 | | Mathematics for Machine Learning and AI | Mathematics |
| 7 | | Materials Characterization Techniques | Physics |
| 8 | | Chemistry of Energy Systems | Chemistry |
| 9 | | English for Competitive Examinations | Humanities |
| 10 | | 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 | Course Code | Title | L | T | P | Credits |
|---|---|---|---|---|---|---|
| 1 | | Cloud Computing for AI | 3 | 0 | 0 | 3 |
| 2 | | Big Data Analytics & AI Applications | 3 | 0 | 0 | 3 |
| 3 | | Full Stack AI Development | 3 | 0 | 0 | 3 |
| 4 | | **Professional Elective-II**<br>1. Graph Neural Networks<br>2. Recommender Systems<br>3. Predictive Analytics/<br>4. Blockchain for AI | 3 | 0 | 0 | 3 |
| 5 | | **Professional Elective-III**<br>1. AI for Finance<br>2. Quantum Computing<br>3. Social Network Analysis<br>4. Cybersecurity & AI-driven Threat Detection | 3 | 0 | 0 | 3 |
| 6 | | **Open Elective – II** | 3 | 0 | 0 | 3 |
| 7 | | Big Data & Cloud Computing Lab | 0 | 0 | 3 | 1.5 |
| 8 | | Full Stack AI Lab | 0 | 0 | 3 | 1.5 |
| 9 | | **Skill Enhancement course**<br>Soft skills | 0 | 1 | 2 | 2 |
| 10 | | **Audit Course**<br>Technical Paper Writing & IPR | 2 | 0 | 0 | - |
| | | **Total** | **19** | **1** | **06** | **23** |
| Mandatory Industry Internship of 08 weeks duration during summer vacation | | | | | | |

### Open Elective – II

| S.No. | Course Code | Course Name | Offered by the Dept. |
|---|---|---|---|
| 1 | | Green Buildings | CIVIL |
| 2 | | Construction Technology and Management | |
| 3 | | Renewable Energy Sources | EEE |
| 4 | | Automation and Robotics | ME |
| 5 | | Digital Electronics | ECE |
| 6 | | Optimization Techniques | Mathematics |
| 7 | | Physics Of Electronic Materials And Devices | Physics |
| 8 | | Chemistry Of Polymers And Applications | Chemistry |
| 9 | | Academic Writing and Public Speaking | Humanities |

## IV B.Tech I Semester

| S.No | Course Code | Title | L | T | P | Credits |
|---|---|---|---|---|---|---|
| 1 | | Generative AI & Prompt Engineering | 3 | 0 | 0 | 3 |
| 2 | | **Management Course- II**<br>1.Business Ethics and Corporate Governance<br>2.E-Business<br>3.Management Science | 2 | 0 | 0 | 2 |
| 3 | | **Professional Elective-IV**<br>1. Explainable AI & Model Interpretability<br>2. AI for Robotics<br>3. AI in Cybersecurity<br>4. AI-driven Software Engineering & DevOps | 3 | 0 | 0 | 3 |
| 4 | | **Professional Elective-V**<br>1. AI for Smart Cities & IoT Systems<br>2. MLOps& AI Model Deployment<br>3. Data Wrangling<br>4. Healthcare AI | 3 | 0 | 0 | 3 |
| 5 | | **Open Elective-III** | 3 | 0 | 0 | 3 |
| 6 | | **Open Elective-IV** | 3 | 0 | 0 | 3 |
| 7 | | **Skill Enhancement Course**<br>Prompt Engineering | 0 | 1 | 2 | 2 |
| 8 | | **Audit Course**<br>Gender Sensitization | 2 | 0 | 0 | - |
| 9 | | Evaluation of Industry Internship | - | - | - | 2 |
| | | **Total** | **19** | **1** | **02** | **21** |

### Open Elective – III

| S.No | Course Code | Course Name | Offered by the Dept. |
|---|---|---|---|
| 1 | | Building Materials and Services | CIVIL |
| 2 | | Environmental Impact Assessment | |
| 3 | | Smart Grid Technologies | EEE |
| 4 | | 3D Printing Technologies | ME |
| 5 | | Microprocessors and Microcontrollers | ECE |
| 6 | | Wavelet transforms and its Applications | Mathematics |
| 7 | | Smart Materials And Devices | Physics |
| 8 | | Green Chemistry And Catalysis For Sustainable Environment | Chemistry |
| 9 | | Employability Skills | Humanities |

## Open Elective – IV

| S.No | Course Code | Course Name | Offered by the Dept. |
|---|---|---|---|
| 1 | | Geo-Spatial Technologies | CIVIL |
| 2 | | Solid Waste Management | |
| 3 | | Electric Vehicles | EEE |
| 4 | | Total Quality Management | ME |
| 5 | | Transducers and Sensors | ECE |
| 6 | | Financial Mathematics | Mathematics |
| 7 | | Sensors And Actuators For Engineering Applications | Physics |
| 8 | | Chemistry Of Nanomaterials and Applications | Chemistry |
| 9 | | Literary Vibes | Humanities |

## IV B.Tech II Semester (AI )

| S.No. | Course code | Title | Category | L | T | P | Credits |
|---|---|---|---|---|---|---|---|
| 1 | | Internship and Project | | - | - | 24 | 4+8=12 |
| | | | | | | | |

COURSES OFFERED FOR HONOURS DEGREE IN CSE- AI

| S. No | Course Name | Contact Hours Per Week | | | Credits |
|---|---|---|---|---|---|
| | | L | T | P | |
| 1 | Advanced Machine Learning & AI Systems | 3 | 0 | 0 | 3 |
| 2 | Deep Learning & Neural Networks | 3 | 0 | 0 | 3 |
| 3 | Reinforcement Learning & Decision Making | 3 | 0 | 0 | 3 |
| 4 | AI for Robotics & Automation | 3 | 0 | 0 | 3 |
| 5 | AI Ethics, Fairness & Explainability | 3 | 0 | 0 | 3 |
| 6 | AI & Machine Learning Lab | 0 | 0 | 3 | 1.5 |
| 7 | Robotics & Autonomous Systems Lab | 0 | 0 | 3 | 1.5 |

**Open Electives**

**Open Electives, offered to other department students:**

| S.No. | Category | Title | L | T | P | Credits |
|---|---|---|---|---|---|---|
| 1 | Open Elective I | Java Programming | 3 | 0 | 0 | 3 |
| | | Introduction to Artificial Intelligence | 3 | 0 | 0 | 3 |
| 2 | Open Elective II | Operating Systems | 3 | 0 | 0 | 3 |
| | | Machine Learning | 3 | 0 | 0 | 3 |
| 3 | Open Elective III | Data Base Management Systems | 3 | 0 | 0 | 3 |
| | | Cyber Security | 3 | 0 | 0 | 3 |
| 4 | Open Elective IV | Computer Networks | 3 | 0 | 0 | 3 |
| | | Internet of Things | 3 | 0 | 0 | 3 |

**III B.Tech I Semester**

| | **Natural Language processing (Professional Core)** | **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**

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**

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**

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**

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**

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.

**Textbooks (Core Learning Materials)**

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 (Supplementary Learning)**

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/

**III B.Tech I Semester**

| | **OPERATING SYSTEM & SYSTEM PROGRAMMING (Professional Core)** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|---|
| | | **3** | **0** | **0** | **3** |

**Course Objectives:**

1. To introduce the fundamentals of operating systems, process management, and synchronization techniques.
2. To explain memory, file, and storage management techniques including paging, segmentation, and file system structures.
3. To explore I/O systems, device management, system protection, and provide a practical overview of Unix/Linux systems.
4. To understand the architecture and components of system software including language processors, assemblers, macro processors, linkers, and loaders.
5. To analyze the concepts of system programming including scanning, parsing, compilation, and process-level system programming in Unix/Linux.

**Course Outcomes (COs):**

1. Describe the structure and functions of operating systems and apply scheduling and synchronization techniques to manage processes and resolve deadlocks.
2. Explain memory management and virtual memory concepts, and analyze file and storage system structures and algorithms.
3. Illustrate I/O system operations, protection mechanisms, and demonstrate basic Unix/Linux commands and shell scripting.
4. Identify and describe components of system software including language processors, assemblers, macro processors, linkers, and loaders.
5. Analyze the compilation process and implement basic system-level programming concepts like process creation, file I/O, and concurrency mechanisms.

**UNIT - I: Fundamentals of Operating Systems and Process Management**

**Introduction to Operating Systems:** Definition and Basics, Generations and Types of Operating Systems, OS Structure: Layered, Monolithic, Microkernel, OS Services, System Calls, System Boot, System Programs, Virtual Machines, **Process Management:** Process Concepts, Process States, Process Control Block, Context Switching, Threads and Multithreading, Process Scheduling: Scheduling Criteria and Scheduling Algorithms, Multiprocessor Scheduling: Types and Performance Evaluation, **Process Synchronization and Deadlocks:** Race Conditions, Critical Section, Mutual Exclusion, Peterson's Solution, Semaphores, Monitors Classic IP, C Problems: Reader-Writers, Dining Philosophers, Deadlocks: Definition, Characteristics, Prevention, Avoidance, Detection and Recovery

**UNIT - II: Memory, File, and Storage Management**

**Memory Management:** Logical vs. Physical Address Mapping, Contiguous Memory Allocation, Internal and External Fragmentation, Compaction, Paging and Page Tables, Segmentation, Virtual Memory: Demand Paging, Page Faults, Page Replacement Algorithms, Thrashing and Working Set Model, **File System Management:** File Concepts, Access Methods, File Types and Operations, Directory Structure, File System Structure, Allocation Methods, Free-Space Management, Directory Implementation. **Storage Management:** Mass Storage: Disk Structure, RAID Levels, Disk Scheduling Algorithms, Swap Space Management, Stable Storage, Tertiary Storage Structure.

**UNIT - III: I/O Systems, Security, and Unix/Linux Overview**

**I/O System Management:** I/O Hardware: Devices, Device Controllers, Direct Memory Access, I/O Software: Interrupt Handlers, Device Drivers, Device-Independent I/O Software, **System Protection and Security:** Security Environment, Security Design Principles, User Authentication, Protection Mechanisms, Protection Domain, Access Control List, **Unix/Linux Overview & Case Studies:** Development of Unix/Linux, Role of Kernel, System Calls, Elementary Linux Commands, Shell Programming, Directory Structure, System Administration.

**UNIT IV: System Software and Language Processing**

**Overview of System Software:** Software and Software Hierarchy, Systems Programming and Machine Structure, Interfaces, Address Space, and Computer Languages, System Software Development and Recent Trends, **Language Processors:** Programming Languages and Language Processing, Symbol Tables and Data Structures for Language Processing, Search and Allocation Data Structures, **Assemblers and Macro Processors:** Elements of Assembly Language Programming, Design and Types of Assemblers, Macro Definitions, Expansion, Nested Macros, and Advanced Macro Features, Design of Macro Assemblers and Macro Processors, **Linkers and Loaders:** Concept of Linking and Relocation, Linking in MS-DOS, Dynamic Linking, Loading Schemes: Sequential, Direct, Absolute, Relocating, and Linking Loaders, Comparison of Linkers and Loaders

**UNIT V: System Programming**

**Scanning and Parsing:** Programming Language Grammars and Classification, Ambiguity in Grammatic Specification, Scanning, Parsing, **Compilers and Interpreters:** Compilation Process, Semantic Gap, Binding, and Scope Rules, Memory Allocation, Compilation of Expressions & Control Structures, Code Optimization, Overview of Interpreters and Debuggers, **Operating System Command & Shell Basics:** C Development Tools, Machine-Level Representation of Data and Programs, **System-Level Programming and Concurrency:** File I/O, Process Creation & Control (fork, exec), Pipes, Signals, and Basic Threading.

**Textbooks:**


1. Operating System Concepts (9th or 10th Edition) by Abraham Silberschatz, Peter Baer Galvin, and Greg Gagne in publisher: Wiley
2. Operating Systems: A Concept-Based Approach (3rd Edition) by D. M. Dhamdhere publisher: McGraw Hill


**Reference Books:**


1. Real-Time Systems: Theory and Practice by Rajib Mall, Publisher: Pearson
2. System Software: An Introduction to Systems Programming (3rd Edition) by Leland L. Beck & D. Manjula, Publisher: Pearson.

**III B.Tech I Semester**

| | **Computer Vision and Image Processing (Professional Core)** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|---|
| | | **3** | **0** | **0** | **3** |

**Course Objectives:**

- Introduce fundamental concepts of image processing and computer vision.
- Develop proficiency in applying algorithms for image analysis and interpretation.
- Explore techniques for feature extraction, object recognition, and scene understanding.
- Understand the integration of machine learning methods in computer vision applications.

**Course Outcomes:**

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

1. Understand image formation, representation, and apply basic image processing and frequency domain techniques for image enhancement and restoration.
2. Apply edge detection, segmentation, morphological, and texture analysis techniques for extracting features from images.
3. Analyze 3D vision and motion using techniques like stereo vision, optical flow, and camera calibration for scene understanding and depth estimation.
4. Evaluate object recognition approaches and machine learning models including traditional and deep learning techniques used in computer vision.
5. Implement advanced computer vision applications such as image compression, face recognition, and medical image analysis using case studies.

**UNIT I: Introduction to Computer Vision and Image Processing**

Overview of Computer Vision and Image Processing:Definitions and scope, Historical development and applications, Image Formation and Representation: Image acquisition methods, Sampling and quantization, Color spaces and models, Fundamentals of Image Processing:Point operations (brightness and contrast adjustments), Histogram processing, Spatial filtering techniques Fourier Transform and Frequency Domain Processing:Discrete Fourier Transform (DFT), Filtering in the frequency domain, Image restoration concept.

**UNIT II: Image Analysis Techniques**

Edge Detection and Feature Extraction:Gradient operators (Sobel, Prewitt), Canny edge detector, Corner and interest point detection, Image Segmentation:Thresholding methods, Region-based segmentation, Clustering techniques (K-means, Mean-Shift), Morphological Image Processing: Erosion and dilation, Opening and closing operations, Applications in shape analysis, Texture Analysis, Statistical methods (co-occurrence matrices), Transform-based methods (Gabor filters), Applications in pattern recognition

**UNIT III: 3D Vision and Motion Analysis**

Stereo Vision:Epipolar geometry,Disparity mapping, Depth estimation techniques, Structure from Motion (SfM):Feature tracking across frames, 3D reconstruction from motion, Applications in scene understanding, Optical Flow and Motion Analysis:Lucas-Kanade method, Horn-Schunck method, Motion segmentation, Camera Calibration and 3D Reconstruction:Intrinsic and extrinsic parameters, Calibration techniques, 3D point cloud generation

**UNIT IV: Object Recognition and Machine Learning in Vision**

Feature Descriptors and Matching:Scale-Invariant Feature Transform (SIFT), Speeded-Up Robust Features (SURF), Feature matching algorithms, Object Detection and Recognition:Template matching , Deformable part models, Convolutional Neural Networks (CNNs), Introduction to Machine Learning for Vision:Supervised and unsupervised learning, Support Vector Machines (SVMs), Decision trees and random forests, Deep Learning Architectures:Autoencoders, Recurrent Neural Networks (RNNs), Generative Adversarial Networks (GANs)

**UNIT V: Applications and Advanced Topics**

Image Compression:Lossy and lossless compression techniques, Standards (e.g., JPEG, PNG), Morphological Image Processing:Dilation, erosion, opening, and closing operations.,Applications in shape analysis, Case Studies:Face recognition systems., Automated visual inspection, Medical image analysis.

**Reference Books**

1. Forsyth, D. A., & Ponce, J. (2002). Computer Vision: A Modern Approach. Prentice Hall.
2. Shapiro, L. G., & Stockman, G. C. (2001). Computer Vision. Prentice Hall.

**Textbooks:**

1. Gonzalez, R. C., & Woods, R. E. (2008). Digital Image Processing (3rd ed.). Pearson Prentice Hall.Stony Brook University
2. Szeliski, R. (2010). Computer Vision: Algorithms and Applications. Springer.

**Online Learning Resources:**

1. Coursera: Introduction to Computer Vision and Image Processing. LinkCoursera
2. Stanford University: CS231n: Deep Learning for Computer Vision. Linkcs231n.stanford.edu
3. MIT OpenCourseWare: Introduction to Computer Vision. Link

**III B.Tech I Semester**

| | DATA VISUALIZATION (Professional Elective-I) | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**Course Objectives:**

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

**Course Outcomes:**

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

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

**UNIT I: Introduction to Data Visualization & Perception**

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

**UNIT II: Visualization Techniques for Categorical & Quantitative Data**

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

**UNIT III: Multidimensional, Temporal and Hierarchical Data Visualization**

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

**UNIT IV: Data Visualization Using Python and Dashboards**

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

**UNIT V: Storytelling with Data and Ethical Visualization**

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

**Textbooks:**

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

**Reference Books:**

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

**Online Learning Resources:**

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

**III B.Tech I Semester**

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

**Course Objectives:**

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

**Course Outcomes:**

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

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

**UNIT I: Introduction to Soft Computing and Fuzzy Logic**

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

**UNIT II: Artificial Neural Networks – I**

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

**UNIT III: Artificial Neural Networks – II**

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

**UNIT IV: Genetic Algorithms and Optimization**

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

**UNIT V: Hybrid Systems and Advanced Topics**

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

**Textbooks:**

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

**Reference Books:**

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

**Online Learning Resources:**

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

**III B.Tech I Semester**

| | **Exploratory Data Analysis with Python (Professional Elective-I)** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|---|
| | | **3** | **0** | **0** | **3** |

**Course Objectives:**

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

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

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

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

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

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

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

**UNIT V – EDA Case Studies and Real-Time Datasets**
Step-by-step EDA on Sample Datasets (Titanic, Iris, Sales, etc.), Outlier Detection Techniques, Feature Engineering Techniques in EDA, EDA Report Generation using Python Notebooks, Preparing Data for Machine Learning Models

**Textbooks:**

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

**Reference Books:**

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

**Online Learning Resources:**

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

**III B.Tech I Semester**

| | **COMPUTATIONAL INTELLIGENCE (Professional Elective-I)** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|---|
| | | **3** | **0** | **0** | **3** |

**Course Objectives:**

- Understand the concepts and foundations of computational intelligence.
- Study neural networks, fuzzy logic systems, and evolutionary algorithms.
- Explore hybrid systems and their applications.
- Apply computational intelligence techniques to real-world problem-solving.
- Analyze the effectiveness of various computational intelligence approaches.

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

- Describe and differentiate neural networks, fuzzy logic, and evolutionary computation. (Understand)
- Apply neural and fuzzy systems for real-time decision-making. (Apply)
- Analyze complex problems using soft computing tools. (Analyze)
- Develop hybrid intelligent systems. (Create)
- Evaluate and compare the performance of CI-based systems. (Evaluate)

**UNIT I: Introduction to Computational Intelligence and Artificial Neural Networks**

Definition and Scope of Computational Intelligence (CI), Components of CI: Neural Networks, Fuzzy Logic, Evolutionary Computation, Biological Neuron vs. Artificial Neuron, McCulloch-Pitts Model, Perceptron, Adaline and Madaline, Multilayer Feedforward Networks, Backpropagation Algorithm, Applications of ANN in Pattern Recognition and Classification.

**UNIT II: Fuzzy Logic and Fuzzy Systems**

Introduction to Fuzzy Logic and Fuzzy Sets, Membership Functions, Fuzzy Set Operations, Fuzzy Rules and Inference Systems, Fuzzification and Defuzzification, Fuzzy Control Systems, Fuzzy Reasoning and Approximate Reasoning

**UNIT III: Evolutionary Computation Techniques**

Basics of Evolutionary Algorithms (EA), Genetic Algorithms (GA): Operators, Encoding, Fitness Function, Selection, Crossover and Mutation, Convergence Criteria, Genetic Programming (GP), Differential Evolution (DE), Applications of GA and GP

**UNIT IV: Swarm Intelligence and Hybrid Systems**

Swarm Intelligence: Ant Colony Optimization (ACO), Particle Swarm Optimization (PSO), Behavior of Swarms and Collective Intelligence, Comparison of Evolutionary Algorithms and Swarm Techniques, Hybrid Systems: Neuro-Fuzzy, Fuzzy-GA, ANN-GA Systems, Case Studies in Hybrid Systems

**UNIT V: Applications of Computational Intelligence**

CI in Image and Signal Processing, CI for Optimization Problems and Robotics, CI in Biomedical Engineering and Finance, Intelligent Agents and Decision-Making Systems, Real-time Applications and Emerging Trends in CI.

**Textbooks:**

1. S. Rajasekaran and G. A. Vijayalakshmi Pai, Neural Networks, Fuzzy Logic, and Genetic Algorithms: Synthesis and Applications, PHI Learning.
2. Timothy J. Ross, Fuzzy Logic with Engineering Applications, Wiley India.

**Reference Books:**

1. S.N. Sivanandam, S. N. Deepa, Principles of Soft Computing, Wiley India.
2. Simon Haykin, Neural Networks and Learning Machines, Pearson.
3. James Kennedy and Russell C. Eberhart, Swarm Intelligence, Morgan Kaufmann.
4. Andries P. Engelbrecht, Computational Intelligence: An Introduction, Wiley.

**Online Learning Resources:**

1. NPTEL - Computational Intelligence
2. Coursera – Computational Intelligence
3. YouTube: IIT Lectures on Soft Computing and CI

**III B.Tech I Semester**

| 23A05505a | JAVA PROGRAMMING (Open Elective-1) | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**Course Objectives:** The main objective of the course is to

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

**Course Outcomes**: After completion of the course, students will be able to
**CO1:** Analyze problems, design solutions using OOP principles, and implement them efficiently in Java. (L4)
**CO2:** Design and implement classes to model real-world entities, with a focus on attributes, behaviors, and relationships between objects (L4)
**CO3:** Demonstrate an understanding of inheritance hierarchies and polymorphic behaviour, including method overriding and dynamic method dispatch. (L3)
**CO4:** Apply Competence in handling exceptions and errors to write robust and fault-tolerant code. (L3)
**CO5:** Perform file input/output operations, including reading from and writing to files using Java I/O classes, graphical user interface (GUI) programming using JavaFX. (L3)
**CO6:** Choose appropriate data structure of Java to solve a problem (L6)

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

**Unit -II**
**Classes and Objects:** Introduction, Class Declaration and Modifiers, Class Members, Declaration of Class Objects, Assigning One Object to Another, Access Control for Class Members, Accessing Private Members of Class, Constructor Methods for Class, Overloaded Constructor Methods, Nested Classes, Final Class and Methods, Passing Arguments by Value and by Reference, Keyword this.
**Methods:** Introduction, Defining Methods, Overloaded Methods, Overloaded Constructor Methods, Class Objects as Parameters in Methods, Access Control, Recursive Methods, Nesting of Methods, Overriding Methods, Attributes Final and Static.

**Unit III**

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

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

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

**Learning Resources:**
**Textbooks:**

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

**Reference Books:**

1. The complete Reference Java, 11thedition, Herbert Schildt,TMH
2. Introduction to Java programming, 7th Edition, Y Daniel Liang, Pearson

Online Learning Resources:

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

**III B.Tech I Semester**

| 23A05505a | INTRODUCTION TO ARTIFICIAL INTELLIGENCE | L | T | P | C |
|---|---|---|---|---|---|

| | | | | | |
|---|---|---|---|---|---|
| | **(Open Elective-1)** | **3** | **0** | **0** | **3** |

**Course Objectives:**

- To learn the distinction between optimal reasoning Vs. human like reasoning.
- To understand the concepts of state space representation, exhaustive search, heuristic
- search together with the time and space complexities.
- To learn different knowledge representation techniques.
- To understand the applications of AI, namely game playing, theorem proving, and machine learning.

**Course Outcomes:**

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

**UNIT - I**

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

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

**UNIT-II**

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

**UNIT-III**

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

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

**UNIT-IV**

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

**UNIT-V**

**Probabilistic Reasoning:**

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

**TEXT BOOK:**

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

**REFERENCE BOOKS:**

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

**III B.Tech I Semester**

| | **Computer Vision and NLP Lab (Professional Core)** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|---|
| | | **0** | **0** | **3** | **1.5** |

**Course Objectives:**

- To provide hands-on experience in implementing image processing and computer vision algorithms.
- To familiarize students with natural language processing techniques using Python libraries.
- To enable the integration of CV and NLP for building intelligent applications.

**Course Outcomes:**

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

- Apply image processing techniques for feature extraction and classification.
- Implement NLP techniques such as tokenization, POS tagging, and sentiment analysis.
- Analyze visual and textual data using open-source tools.
- Develop applications that combine Computer Vision and NLP for real-world tasks.

**List of Experiments:**

**1.** Load and display an image using OpenCV and perform basic operations like resizing, cropping, and rotation.

**2.** Apply edge detection (Sobel, Canny) and thresholding techniques on grayscale and color images.

**3.** Implement image filtering operations: Gaussian, Median, and Bilateral filters.

**4.** Perform object detection using contour detection and bounding boxes.

**5.** Detect faces using Haar Cascade or DNN-based pre-trained models in OpenCV.

**6.** Implement color-based object tracking using HSV space and CamShift algorithm.

**7.** Preprocess text data (tokenization, stopword removal, stemming, lemmatization) using NLTK/spaCy.

**8.** Implement Part-of-Speech (POS) tagging and Named Entity Recognition (NER) using spaCy.

**9.** Build a simple sentiment analysis classifier using bag-of-words or TF-IDF and Naïve Bayes.

**10.** Perform topic modeling using Latent Dirichlet Allocation (LDA).

**11.** Extract text from an image using Optical Character Recognition (OCR) with Tesseract and perform text summarization.

**12.** Final Mini Project: Integrate CV and NLP (e.g., Read text from signboards or documents and translate/summarize it).

**Lab Software Requirements:**

- **Languages/Tools:** Python, OpenCV, NLTK, spaCy, Tesseract OCR, scikit-learn, NumPy, Pandas, Matplotlib
- **Platforms:** Jupyter Notebook / Google Colab / PyCharm / VS Code

**III B.Tech I Semester**

| | **AI & SYSTEM PROGRAMMING LAB (Professional Core)** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|---|
| | | **0** | **0** | **3** | **1.5** |

**Course Objectives:**

- To provide practical exposure to foundational AI algorithms and system programming.
- To develop skills to write intelligent systems and low-level programs.
- To integrate concepts of AI and system programming for automation and optimization.

**Course Outcomes:**

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

- Implement search algorithms and logic programming using AI tools.
- Construct assemblers, macro processors, and shell scripts.
- Develop system utilities using C and integrate them with AI tools.
- Demonstrate real-time intelligent system automation using scripting and AI logic.

**1.** Write simple programs in Prolog for facts, rules, and queries.

**2.** Develop a Prolog-based expert system for medical diagnosis or animal identification.

**3.** Implement Depth-First Search (DFS) and Breadth-First Search (BFS) in Python.

**4.** Implement A* Search Algorithm using heuristics in Python.

**5.** Implement the Minimax algorithm for a simple game (e.g., Tic Tac Toe).

**6.** Design and implement a two-pass assembler in C.

**7.** Implement a Macro Processor using C for assembly language programs.

**8.** Develop a simple Linux Shell (command interpreter) using C.

**9.** Write shell scripts for file operations, process creation, and monitoring.

**10.** Demonstrate inter-process communication using pipes and signals in Linux.

**11.** Integrate AI logic (search/expert system) into a shell script or system utility for task automation.

**12.Final Mini Project**: Develop an AI-powered system utility (e.g., Intelligent File Manager, AI Bot for CLI commands).

**Lab Software Requirements:**

- **Languages:** Python, Prolog, C
- **Tools:** GCC, SWI-Prolog, Linux (Ubuntu/WSL), Shell, Lex/Yacc (optional)
- **IDEs:** Code::Blocks / VS Code / Geany / Terminal-based compilation

**III B.Tech I Semester**

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

**COURSE OUTCOMES:**

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

**COURSE OBJECTIVES:**

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

**UNIT-I**

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

**UNIT-II**

Frontend Development: 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: 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: 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: 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

**III B.Tech – I semester**

| L | T | P | C |
|---|---|---|---|
| 2 | 0 | 0 | 1 |

## TINKERING LAB

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

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

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

**List of experiments:**

1) Make your own parallel and series circuits using breadboard for any application of your choice.
2) 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:

**Course Outcomes:** The students will be able to experiment, innovate, and solve real-world challenges.

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

**III B.Tech II Semester**

| | **Cloud Computing for AI (Professional Core)** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|---|
| | | **3** | **0** | **0** | **3** |

**Course Objectives**:

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

**Course Outcomes**:

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

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

**UNIT I: Introduction to Cloud Computing and AI Integration**

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

**UNIT II: Storage, Computing, and Data Processing in the Cloud**

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

**UNIT III: Cloud-based Machine Learning and Deep Learning**

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

**UNIT IV: Advanced Cloud Concepts for AI Applications**

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

**UNIT V: Security, Ethics, and Case Studies in Cloud AI**

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

**Textbooks**:

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

**III B.Tech II Semester**

| | **Big Data Analytics & AI Applications (Professional Core)** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|---|
| | | **3** | **0** | **0** | **3** |

**Course Objectives**:

1. To introduce the fundamentals of big data and its role in AI-driven applications.
2. To explore big data tools and technologies such as Hadoop, Spark, and NoSQL databases.
3. To enable students to build scalable AI pipelines for data analytics.
4. To apply AI/ML algorithms for real-time and batch processing environments.
5. To demonstrate use cases of big data in domains like healthcare, finance, and IoT using AI.

**Course Outcomes**:

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

1. Understand the architecture and ecosystem of big data processing.
2. Analyze and manage large-scale datasets using Hadoop and Spark.
3. Apply AI/ML techniques to extract insights from big data.
4. Design and implement scalable data pipelines using distributed frameworks.
5. Solve real-world domain problems with AI-powered big data solutions.

**UNIT I: Introduction to Big Data and Analytics Ecosystem**
Definition and Characteristics of Big Data – Volume, Velocity, Variety, Veracity, Value, Types of Analytics: Descriptive, Diagnostic, Predictive, Prescriptive, Big Data Challenges and Opportunities, Hadoop Ecosystem Overview: HDFS, MapReduce, YARN, NoSQL Databases: Key-Value, Columnar, Document, Graph Models, Data Lake vs. Data Warehouse.

**UNIT II: Big Data Tools and Frameworks**
Apache Spark Architecture and RDDs, Spark SQL, DataFrames, and Datasets, Spark Streaming for Real-Time Analytics, Kafka for Data Ingestion and Message Queues, Hive, Pig, and Impala for Big Data Querying, Comparative Analysis of Hadoop vs. Spark.

**UNIT III: Machine Learning on Big Data**
Introduction to MLlib and Scikit-learn, Data Preprocessing for Big Data ML Pipelines, Supervised Learning: Classification and Regression on Large Datasets, Unsupervised Learning: Clustering and Dimensionality Reduction, Model Evaluation and Validation Techniques, Distributed Training and Optimization Techniques.

**UNIT IV: AI Applications on Big Data**
Predictive Maintenance using Big Data & AI, Fraud Detection in Banking with Machine Learning, AI in Healthcare: Diagnosis, Genomics, Patient Monitoring, Retail and E-commerce Analytics, AI for Smart Cities and IoT Sensor Data Analysis, Evaluation of Real-Time AI Applications on Streaming Data.

**UNIT V: Advanced Topics and Case Studies**
Deep Learning on Big Data using TensorFlow on Spark, Explainable AI (XAI) in Big Data Environments, Ethical Issues and Data Governance in Big Data AI, Edge Computing and AI for Low Latency Applications, Case Study 1: AI-Powered Big Data in Healthcare, Case Study 2: Big Data AI Solution in Smart Manufacturing.

**Textbooks**:

1. Big Data: Principles and Paradigms by Rajkumar Buyya, Rodrigo N. Calheiros, Amir Vahid Dastjerdi – Wiley
2. Learning Spark: Lightning-Fast Big Data Analysis by Jules S. Damji et al. – O'Reilly
3. Data Science and Big Data Analytics by EMC Education Services – Wiley

**Reference Books**:

1. Designing Data-Intensive Applications by Martin Kleppmann – O'Reilly
2. Machine Learning with Spark by Rajdeep Dua, Tathagata Das – Packt Publishing
3. Streaming Systems by Tyler Akidau – O'Reilly Media
4. Artificial Intelligence for Big Data by Anand Deshpande – Packt

**Online Learning Resources**:

- https://www.coursera.org/specializations/big-data – Coursera Big Data Specialization
- https://spark.apache.org/docs/latest/ – Apache Spark Documentation

## III B.Tech II Semester

| | Full stack AI Development (Professional Core) | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**Course Objectives**:

- To introduce the concepts of full stack development with integration of AI capabilities.
- To provide practical exposure to frontend and backend frameworks suitable for AI applications.
- To build intelligent web applications using ML/DL models.
- To explore RESTful APIs, microservices, and deployment strategies for AI solutions.
- To develop skills for scalable, end-to-end AI-powered application development.

**Course Outcomes**:

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

- Understand the architecture and components of full stack AI systems.
- Develop web interfaces and backend logic integrated with AI models.
- Use Python, JavaScript, and frameworks like Flask, Node.js, React for AI web solutions.
- Deploy machine learning models using RESTful APIs and containers.
- Build, test, and scale full-stack intelligent applications.

**UNIT I: Introduction to Full Stack AI Development**
Overview of Full Stack Development in AI Context, Components: Frontend, Backend, Database, AI Models, MVC, MVVM Architectures for AI Applications, Introduction to Web Technologies (HTML, CSS, JS, Bootstrap), Role of JavaScript Frameworks in AI Dashboards, Full Stack AI Development Life Cycle.

**UNIT II: Frontend Technologies for AI Applications**
React.js for Dynamic AI Interfaces, State Management in React (Hooks, Redux), Data Binding and Visualization with Chart.js, D3.js, Integration with AI Results (JSON APIs to UI), UI/UX Design for Intelligent Apps, Responsive Design and Accessibility.

**UNIT III: Backend and AI Model Integration**
Node.js and Express.js for Backend Services, Flask API Development for ML Models, REST API Creation and Consumption, Handling File Uploads, JSON Input, Streaming Output, Integration of Pre-trained Models (Sklearn, TensorFlow, PyTorch), Middleware, Error Handling, and Model Response Evaluation.

**UNIT IV: Databases, Authentication, and AI Workflows**
MongoDB and PostgreSQL for Storing AI Inputs/Outputs, User Authentication and Session Management (JWT, OAuth), CRUD Operations with AI Insights, Building AI Feedback Loops with Data Storage, Secure AI Application Workflows, Creating Intelligent Dashboards with Real-Time Data.

**UNIT V: Deployment, Scaling & Case Studies**
Containerization using Docker for AI Microservices, Deployment to Cloud (AWS, GCP, Azure), CI/CD Pipelines for AI Model Updates, Monitoring and Logging in AI Apps, Performance and Load Testing of AI APIs, Case Study: End-to-End Full Stack AI Project (Deployment + Demo).

**Textbooks**:

1. Full Stack Development with Flask and React by O. Olatunde – Packt Publishing
2. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow by Aurélien Géron – O'Reilly
3. Flask Web Development by Miguel Grinberg – O'Reilly Media

**Reference Books**:

1. Node.js Design Patterns by Mario Casciaro – Packt
2. Building Machine Learning Powered Applications by Emmanuel Ameisen – O'Reilly
3. Mastering React by Adam Horton – Packt
4. MongoDB: The Definitive Guide by Kristina Chodorow – O'Reilly

**Online Learning Resources**:

- https://fullstackopen.com/en/ – Full Stack Open
- https://www.coursera.org/specializations/full-stack – Coursera Full Stack Development

**III B.Tech II Semester**

| | **Graph Neural Networks (Professional Elective-II)** | **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**:

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

- 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**
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**
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**
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**
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**
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.

**Textbooks**:

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.
3. William L. Hamilto**n**, Graph Representation Learning, Morgan & Claypool Publishers, 2020.

**Reference Books**:

1. Barrett, Jure Leskovec, Mining of Massive Datasets, Cambridge University Press.
2. Thomas Kipf, GCN and related papers and tutorials (arXiv).
3. Petar Veličković, Graph Attention Networks (original paper and slides).
4. 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

**III B.Tech II Semester**

| | RECOMMENDER SYSTEMS (Professional Elective-II) | 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**:

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

- 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**

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**

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**

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**

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**

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).

**Textbooks**:

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

**III B.Tech II Semester**

| | **PREDICTIVE ANALYTICS (Professional Elective-II)** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|---|
| | | **3** | **0** | **0** | **3** |

**Course Objectives**:

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

**Course Outcomes**:

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

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

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

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

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

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

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

**Textbooks**:

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

**Reference Books**:

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

**Online Learning Resources**:

- 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

**III B.Tech II Semester**

| | **BLOCKCHAIN FOR AI (Professional Elective-II)** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|---|
| | | **3** | **0** | **0** | **3** |

**Course Objectives**:

- To understand the foundational concepts of blockchain technology and its architecture.
- To explore smart contracts, consensus algorithms, and distributed ledger technology.
- To investigate the integration of AI with blockchain for secure, decentralized applications.
- To develop blockchain-enabled AI solutions for real-world use cases.
- To understand the ethical, security, and scalability challenges in Blockchain-AI ecosystems.

**Course Outcomes**:

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

- Explain the fundamentals of blockchain and its components.
- Analyze the role of consensus mechanisms in maintaining trust and decentralization.
- Apply blockchain for secure data sharing in AI systems.
- Develop and deploy smart contracts using Ethereum/Solidity.
- Evaluate blockchain-based AI applications in healthcare, finance, and supply chains.

**UNIT I: Blockchain Fundamentals and Architecture**

Introduction to Blockchain Technology, Components: Blocks, Hashing, Merkle Trees, Types of Blockchains: Public, Private, Consortium, Distributed Ledger Technology (DLT) and P2P Networks, Blockchain Structure and Mining, Use Cases and Evolution of Blockchain.

**UNIT II: Smart Contracts and Consensus Mechanisms**

Smart Contracts: Definition, Features, Use Cases, Ethereum and Solidity Basics, Consensus Algorithms: PoW, PoS, DPoS, PBFT, Gas, Transactions, and Events in Ethereum, Hyperledger Fabric: Architecture and Chaincode, Deployment and Testing of Smart Contracts.

**UNIT III: Integration of Blockchain and AI**

Motivation for Integrating Blockchain with AI, Decentralized AI Models and Federated Learning, Secure Model Sharing and Provenance, Blockchain for Data Integrity in AI Systems, AI for Blockchain (e.g., optimizing consensus), Case Study: Decentralized AI Marketplace.

**UNIT IV: Applications of Blockchain in AI Systems**

Blockchain for Explainable and Trusted AI, Applications in Healthcare and Genomics, Blockchain for Autonomous Vehicles and IoT, Financial AI Systems with Smart Contracts, Supply Chain and Logistics Intelligence, NFT-based AI Applications (Digital Identity, IP).

**UNIT V: Security, Privacy and Challenges in Blockchain-AI**

Security Challenges: Sybil Attacks, 51% Attacks, Privacy Preservation and Zero Knowledge Proofs, Scalability and Energy Concerns in Blockchain-AI, Ethical and Legal Concerns in AI with Blockchain, Interoperability of Blockchain Platforms, Future Trends: Quantum-Resistant Blockchain-AI.

**Textbooks**:

1. Imran Bashir, Mastering Blockchain: Unlocking the Power of Cryptocurrencies, Smart Contracts, and Decentralized Applications, Packt, 2020.
2. Melanie Swan, Blockchain: Blueprint for a New Economy, O'Reilly Media, 2015.
3. Joseph Holbrook, Architecting AI Solutions on Blockchain, Packt Publishing, 2020.

**Reference Books**:

1. Arshdeep Bahga, Vijay Madisetti, Blockchain Applications: A Hands-On Approach, VPT, 2017.
2. Karamjit Singh, Blockchain for AI: Use Cases and Implementation, Springer, 2023.
3. Roger Wattenhofer, The Science of the Blockchain, 2016.

**Online Learning Resources**:

- Coursera: Blockchain Specialization – University at Buffalo
- edX: Blockchain Fundamentals – UC Berkeley
- Coursera: AI and Blockchain – IBM

**III B.Tech II Semester**

| | AI FOR FINANCE<br>(Professional Elective-III) | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**Course Objectives**:

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

**Course Outcomes**:

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

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

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

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

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

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

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

**Textbooks**:

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

**Reference Books**:

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

**Online Learning Resources**:

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

**III B.Tech II Semester**

| | QUANTUM COMPUTING (Professional Elective-III) | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**Course Objectives**:

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

**Course Outcomes**:

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

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

**UNIT I: Fundamentals of Quantum Mechanics and Linear Algebra**

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

**UNIT II: Quantum Gates and Circuits**

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

**UNIT III: Quantum Algorithms and Complexity**

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

**UNIT IV: Quantum Programming and Simulation Platforms**

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

**UNIT V: Applications and Future of Quantum Computing**

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

**Textbooks**:

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

**Reference Books**:

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

**Online Learning Resources**:

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

**III B.Tech II Semester**

| | SOCIAL NETWORK ANALYSIS (Professional Elective-III) | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**Course Objectives**:

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

**Course Outcomes**:

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

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

**UNIT I: Introduction to Social Networks and Graph Theory**

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

**UNIT II: Structural Properties of Networks**

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

**UNIT III: Community Detection and Subgroup Analysis**

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

**UNIT IV: Information Diffusion and Influence in Networks**

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

**UNIT V: Tools, Applications, and Ethics in SNA**

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

**Textbooks**:

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

**Reference Books**:

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

**Online Learning Resources**:

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

**III B.Tech II Semester**

| | **CYBERSECURITY & AI-DRIVEN THREAT DETECTION (Professional Elective-III)** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|---|
| | | **3** | **0** | **0** | **3** |

**Course Objectives**:

- To provide a foundational understanding of cybersecurity principles and threat landscapes.
- To explore the application of AI and machine learning techniques in detecting cyber threats.
- To analyze malware behavior, intrusion patterns, and anomaly detection using intelligent systems.
- To evaluate and build automated systems for real-time security analytics.
- To understand the ethical, legal, and societal implications of AI-driven security systems.

**Course Outcomes**:

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

- Understand cybersecurity frameworks, threat types, and vulnerabilities.
- Apply AI/ML techniques for cyber threat identification and classification.
- Analyze patterns in malware, network traffic, and security logs.
- Design and evaluate intelligent intrusion detection and prevention systems.
- Explore ethical hacking practices and policy aspects in AI-based security.

**UNIT I: Fundamentals of Cybersecurity**

Introduction to Cybersecurity: CIA Triad, Threats & Vulnerabilities, Types of Attacks: Malware, Phishing, DDoS, Insider Threats, Security Policies and Access Controls, Risk Assessment and Vulnerability Management, Cryptography Basics: Symmetric, Asymmetric, Hash Functions, Cybersecurity Frameworks: NIST, ISO 27001, OWASP.

**UNIT II: Machine Learning for Cyber Threat Detection**

Supervised and Unsupervised Learning in Security Contexts, Feature Engineering for Security Data, Classification Models for Intrusion Detection (SVM, RF, KNN), Clustering Techniques for Anomaly Detection, Evaluation Metrics: Accuracy, Precision, ROC, F1 Score, Case Study: AI for Email Phishing Detection.

**UNIT III: Deep Learning in Threat Intelligence**

Deep Neural Networks for Cybersecurity, RNNs and LSTMs for Log and Sequence Data, Autoencoders for Anomaly Detection, CNNs for Malware Classification using Binary Analysis, Adversarial Attacks on AI-based Security Systems, Case Study: Threat Detection using Deep Learning.

**UNIT IV: Real-Time Threat Detection and SIEM Systems**

Security Information and Event Management (SIEM), Log Analysis and Real-Time Alerting, Threat Intelligence Platforms (TIPs), Integration of AI in SIEM Tools (Splunk, ELK Stack), Network Traffic and Packet Inspection using ML, SOC Operations and Automation using AI

**UNIT V: Ethical Hacking, Privacy, and Legal Aspects**

Penetration Testing & Ethical Hacking with AI Tools, Red Team vs. Blue Team Simulation, Data Privacy Regulations: GDPR, HIPAA, Cyber Laws, AI Bias and Fairness in Security Decision-Making, Case Study: Ethical Dilemmas in AI Security Systems, Future Trends: Zero Trust, AI SOC, Federated Threat Detection.

**Textbooks**:

1. Stallings, W., Network Security Essentials: Applications and Standards, Pearson Education.
2. Shon Harris & Fernando Maymi, CISSP All-in-One Exam Guide, McGraw Hill.
3. Emmanuel Tsukerman, Machine Learning for Cybersecurity Cookbook, Packt Publishing.
4. Clarence Chio & David Freeman, Machine Learning and Security, O'Reilly Media.

**Reference Books**:

1. John Paul Mueller, Luca Massaron, Machine Learning for Dummies, Wiley.
2. Mark Stamp, Information Security: Principles and Practice, Wiley.
3. Bruce Schneier, Secrets and Lies: Digital Security in a Networked World, Wiley.
4. Shai Shalev-Shwartz and Shai Ben-David, Understanding Machine Learning, Cambridge University Press.

**Online Learning Resources**:

- Coursera – AI for Cybersecurity (IBM)
- edX – Cybersecurity Fundamentals by Rochester Institute of Technology
- MIT OpenCourseWare – Computer and Network Security
- [YouTube – Cybersecurity & AI Tutorials by Simplilearn, Great Learning]
- Udemy – Machine Learning for Cybersecurity
- Splunk Documentation – AI & Threat Detection

**III B.Tech II Semester**

| | **OPERATING SYSTEMS (Open Elective-II)** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|---|
| | | **3** | **0** | **0** | **3** |

**Course Objectives:** The main objectives of the course is to make student

- Understand the basic concepts and principles of operating systems, including process management, memory management, file systems, and Protection
- Make use of process scheduling algorithms and synchronization techniques to achieve better performance of a computer system.
- Illustrate different conditions for deadlock and their possible solutions.

**Course Out comes:** After completion of the course, students will be able to

**CO1:** Describe the basics of the operating systems, mechanisms of OS to handle processes, threads, and their communication. (L1)

**CO2:** Under stand the basic concepts and principles of operating systems, including process management, memory management, file systems, and Protection. (L2)

**CO3:** Make use of process scheduling algorithms and synchronization techniques to achieve better performance of a computer system. (L3)

**CO4:** Illustrate different conditions for deadlock and their possible solutions. (L2) Analyze the memory management and its allocation policies. (L4)

CO5: Able to design and implement file systems, focusing on file access methods, directory structure, free space management, and also explore various protection mechanisms,

**UNIT - I**

**Operating Systems Overview:** Introduction, Operating system functions, Operating systems operations, Computing environments, Free and Open-Source Operating Systems **System Structures:** Operating System Services, User and Operating-System Interface, system calls, Types of System Calls, system programs, Operating system Design and Implementation, Operating system structure, Building and Booting an Operating System, Operating system debugging

**UNIT - II**

**Processes:** Process Concept, Process scheduling, Operations on processes, Inter-process communication. **Threads and Concurrency:** Multithreading models, Thread libraries, Threading issues. **CPU Scheduling:** Basic concepts, Scheduling criteria, Scheduling algorithms, Multiple processor scheduling.

**UNIT – III**

**Synchronization Tools:** The Critical Section Problem, Peterson's Solution, Mutex Locks, Semaphores, Monitors, Classic problems of Synchronization. **Deadlocks:** system Model, Deadlock characterization, Methods for handling Deadlocks, Deadlock prevention, Deadlock avoidance, Deadlock detection, Recovery from Deadlock.

**UNIT - IV**

**Memory- Management Strategies:** Introduction, Contiguous memory allocation, Paging, Structure of the Page Table, Swapping. **Virtual Memory Management:** Introduction, Demand paging, Copy-on-write, Page replacement, Allocation of frames, Thrashing. **Storage Management:** Overview of Mass Storage Structure, HDD Scheduling.

**UNIT - V**

**File System:** File System Interface: File concept, Access methods, Directory Structure; File system Implementation: File-system structure, File-system Operations, Directory implementation, Allocation method, Free space management; File-System Internals: File System Mounting, Partitions and Mounting, File Sharing. **Protection:** Goals of protection, Principles of protection, Protection Rings, Domain of protection, Access matrix.

**Textbooks:**

1. Operating System Concepts, Silber schatz A, Galvin P B, Gagne G, 10th Edition, Wiley, 2018.
2. Modern Operating Systems, Tanenbaum A S, 4th Edition, Pearson , 2016

**Reference Books:**

1. Operating Systems -Internals and Design Principles, Stallings W, 9th edition, Pearson, 2018
2. Operating Systems: A Concept Based Approach, D.M Dhamdhere, 3rd Edition, McGraw- Hill, 2013

**Online Learning Resources:**

1. https://nptel.ac.in/courses/106/106/106106144/
2. http://peterindia.net/OperatingSystems.html

**III B.Tech II Semester**

| | MACHINE LEARNING (Open Elective-II) | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**Course Objectives:**

The course is introduced for students to

- Understand basic concepts of Machine Learning
- Study different learning algorithms
- Illustrate evaluation of learning algorithms

**Course Out comes (CO):**

After completion of the course, students will be able to

- Identify machine learning techniques suitable for a given problem
- Solve the problems using various machine learning techniques
- Design application using machine learning techniques
- To understand and explore Supervised Learning techniques
- To understand and explore unsupervised learning techniques

**UNIT- I Introduction to Machine Learning & Preparing to Model** Lecture 9Hrs

Introduction: What is Human Learning? Types of Human Learning, what is Machine Learning? Types of Machine Learning, Problems Not to Be Solved Using Machine Learning, Applications of Machine Learning, State-of-The-Art Languages/Tools in Machine Learning, Issues in Machine Learning Preparing to Model: Introduction, Machine Learning Activities, Basic Types of Data in Machine Learning, Exploring Structure of Data, Data Quality and Remediation, Data Pre-Processing

**UNIT- II Modelling and Evaluation &Basics of Feature Engineering** Lecture 9Hrs

Introduction, selecting a Model, training a Model (for Supervised Learning), Model Representation and Interpretability, Evaluating Performance of a Model, Improving Performance of a Model Basics of Feature Engineering: Introduction, Feature Transformation, Feature Subset Selection

**UNIT-III Bayesian Concept Learning & Supervised Learning: Classification** Lecture10Hrs

Introduction, Why Bayesian Methods are Important? Bayes' Theorem, Bayes' Theorem and Concept Learning, Bayesian Belief Network.

Supervised Learning: Classification: Introduction**,** Example of Supervised Learning**,** Classification Model**,** Classification Learning Steps**,** Common Classification Algorithms-*k*-Nearest Neighbour(*k*NN), Decision tree, Random forest model, Support vector machines

**UNIT- IV Supervised Learning: Regression** Lecture 10Hrs

Introduction, Example of Regression, Common Regression Algorithms-Simple linear regression, Multiple linear regression, Assumptions in Regression Analysis, Main Problems in Regression Analysis, Improving Accuracy of the Linear Regression Model, Polynomial Regression Model, Logistic Regression, Maximum Likelihood Estimation.

**UNIT-V Unsupervised Learning** Lecture 9Hrs

Introduction, Unsupervised vs Supervised Learning, Application of Unsupervised Learning, Clustering – Clustering as a machine learning task, Different types of clustering techniques, Partitioning methods, *K*- Medoids: a representative object-based technique, Hierarchical clustering, Density-based methods-DBSCAN Finding Pattern using Association Rule- Definition of common terms, Association rule, The apriori algorithm for association rule learning, Build the apriori principle rules

**Text books:**

1.Machine Learning, Saik at Dutt, Subramanian Chandra mouli, Amit Kumar Das, Pearson, 2019.

**Reference Books:**

1. Ethern Alpaydin, "Introduction to Machine Learning", MIT Press, 2004.
2. Stephen Marsland, "Machine Learning -An Algorithmic Perspective", Second Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2014.

1.Andreas C. Müller and Sarah Guido "Introduction to Machine Learning with Python: A Guide for Data Scientists", Oreilly.

**Online Learning Resources:**

- Andrew Ng, "Machine Learning B.Techning"
- https://www.deeplearning.ai/machine-learning- B.Techning/
- Shai Shalev-Shwartz , Shai Ben-David, "Understanding Machine Learning: From Theory to Algorithms" , Cambridge University Press https://www.cse.huji.ac.il/~shais/UnderstandingMachineLearning/index.html

**III B.Tech II Semester**

| | **Big Data & Cloud Computing Lab (Professional Core)** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|---|
| | | **0** | **0** | **3** | **1.5** |

**Course Objectives:**

- To provide hands-on experience in working with big data tools and cloud computing environments.
- To equip students with practical skills in data ingestion, transformation, analysis, and visualization using Hadoop and Spark ecosystems.
- To enable deployment and management of cloud services using AWS, Azure, or GCP.
- To expose students to cloud-native storage, computing, and container orchestration techniques.
- To integrate big data workflows with cloud infrastructure for scalable, distributed data processing.

**Course Outcomes:**

- Students will be able to implement big data pipelines and cloud-based solutions using tools like Hadoop, Spark, and cloud platforms such as AWS, Azure, or GCP.
- Students gain proficiency in managing distributed data processing, scalable storage, cloud service provisioning, and deploying applications using containers and orchestration platforms.
- Students will understand the synergy between big data technologies and cloud computing to solve real-world problems efficiently.

**List of Lab Experiments:**

1. Installation and Configuration of Hadoop Cluster (Single Node & Multi-node)
   Hadoop HDFS setup, NameNode & DataNode configuration
2. Working with HDFS: File Operations
   Upload, read, delete, and replicate files in HDFS
3. MapReduce Programming Basics
   Word count, sorting, and filtering examples in Java/Python
4. Apache Hive & Pig for Querying Large Datasets
   Creation of tables, data loading, and running queries
5. Apache Spark Basics: RDDs and DataFrames
   Implement Spark transformations and actions
6. Data Preprocessing and Machine Learning using PySpark MLlib
   Classification or regression using MLlib pipelines
7. Introduction to Cloud Computing and AWS/Azure/GCP Console
   Creating virtual machines, basic compute and storage services
8. Cloud Storage and Database Services
   Using S3 (AWS), Blob (Azure), or GCP buckets and Cloud SQL/NoSQL
9. Deploying Big Data Workloads on Cloud (EMR, HDInsight, Dataproc)
   Running Hadoop/Spark jobs in cloud-managed services
10. Cloud Function/Serverless Deployment
11. Building and deploying a serverless function (e.g., AWS Lambda)
    Containerization with Docker
12. Building, running, and managing Docker containers
    Orchestration with Kubernetes in the Cloud

Deploy and manage a containerized application using GKE/EKS/AKS

**Text Books:**

1. Tom White, Hadoop: The Definitive Guide, O'Reilly Media.
2. Rajkumar Buyya et al., Mastering Cloud Computing, McGraw-Hill Education.
3. Holden Karau et al., Learning Spark: Lightning-Fast Big Data Analysis, O'Reilly Media.

**Reference Books:**

1. Vignesh Prajapati, Big Data Analytics with R and Hadoop, Packt Publishing.
2. Benjamin Bengfort, Data Analytics with Hadoop, O'Reilly.
3. Srinivasan & J.Shrinivasan, Cloud Computing – A Hands-on Approach, Wiley India.

**III B.Tech II Semester**

| | Full Stack AI Lab (Professional Core) | L | T | P | C |
|---|---|---|---|---|---|
| | | 0 | 0 | 3 | 1.5 |

**Course Objectives:**

- To provide practical experience in building end-to-end AI applications using full stack development principles.
- To enable integration of machine learning models with frontend and backend systems.
- To develop deployment skills using REST APIs, databases, and modern frameworks.
- To equip students with tools and practices for model versioning, scaling, and monitoring in production environments.
- To foster a deep understanding of full-cycle AI workflows from data ingestion to inference.

**Course Outcomes:**

- Students will be capable of building complete AI-powered applications that include data processing, model training, backend integration, and frontend presentation.
- Students will learn how to deploy AI models using web frameworks (like Flask or FastAPI), integrate with cloud services and databases, and deliver user-centric intelligent systems.
- Students also be able to monitor, scale, and maintain deployed AI models in real-world scenarios.

**List of Lab Experiments:**

1. Setting Up a Full Stack AI Project Environment
   Install Python, Node.js, MongoDB, and frontend stack
2. Data Ingestion and Preprocessing Using Pandas and NumPy
   Clean and prepare data for training
3. Training a Basic Machine Learning Model (e.g., Classification)
   Train a logistic regression or decision tree model
4. Creating RESTful APIs for Model Inference Using Flask/FastAPI
   Build API endpoints for predictions
5. Frontend Development with React.js or HTML/JS
   Create a UI to submit input and display prediction results
6. Connecting Frontend to Backend via API Calls
   Use fetch/axios to connect to Python API
7. Storing and Retrieving Predictions Using MongoDB or SQL
   Save prediction logs to database
8. Model Deployment on Cloud Platform (Heroku/AWS/GCP)
   Host backend + model + frontend on cloud
9. Containerizing the AI App Using Docker
   Write Dockerfile, build image, and run containers
10. Version Control and CI/CD for AI Projects
11. Use GitHub, GitHub Actions for automated deployment
    Model Monitoring and Logging
12. Track usage, inputs, and outputs for debugging
    Build a Complete Full Stack AI Web Application

Example: Sentiment Analyzer, Fake News Detector, AI Chatbot

**Text Books:**

1. Aurélien Géron – Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, O'Reilly.
2. Miguel Grinberg – Flask Web Development, O'Reilly.
3. Vasan Subramanian – Full Stack Web Development with Python and React, Apress.

**Reference Books:**

1. Prateek Joshi – Building Machine Learning Systems with Python, Packt.
2. David Julian – Designing Machine Learning Systems with Python, O'Reilly.
3. Mark Bates – Programming the Web with JavaScript, No Starch Press.

**Online Courses:**

1. Full Stack Deep Learning Bootcamp
2. Build AI Web Apps with Python and Flask – freeCodeCamp

| III B.Tech<br>II Semester | SOFTSKILLS | L | T | P | C |
|---|---|---|---|---|---|
| | | 1 | 0 | 2 | 2 |

**(Common to All Branches of Engineering)**

| Course Code | Soft Skills | L | T | P | C |
|---|---|---|---|---|---|
| | | 0 | 1 | 2 | 2 |
| **Pre-requisite** | | **SemesterIV/V** | | | |

Course Objectives:

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

Course Outcomes (CO):

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

**SYLLABUS**

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

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

**Activities:**

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

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

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

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

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

| UNIT – II | **Critical Thinking** | Lecture Hrs |
|---|---|---|

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

**Activities**:

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

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

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

**Activities:**

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

Case Study & Group Discussion

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

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

**Activities**:

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

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

| UNIT – V | **Corporate Etiquette** | Lecture Hrs |
|---|---|---|

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

**Activities**

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

**NOTE-:**

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

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

**Prescribed Books**:

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

**Reference Books**

1. Sharma, Prashant, *Soft Skills: Personality Development for Life Success*, BPB Publications 2018.
2. Alex K,*Soft Skills*S.Chand& Co, 2012 (Revised edition)
3. Gajendra Singh Chauhan& Sangeetha Sharma,*Soft Skills: An Integrated Approach to Maximise Personality*Published by Wiley, 2013
4. Pillai, Sabina & Fernandez Agna, *Soft Skills and Employability Skills*, Cambridge University Press, 2018

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

Online Learning Resources:

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

**III B.Tech II Semester**

| | **Technical Report Writing & IPR** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|---|
| | | **2** | **0** | **0** | **0** |

**Course Objectives**:·

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

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

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

**UNIT – I:**

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

**UNIT – II:**

Technical Research Paper Writing: Abstract- Objectives-Limitations-Review

of Literature- Problemsand Framing Research Questions- Synopsis

**UNIT – III:**

Process of research: publication mechanism: types of journals- indexing-seminars-

conferences- proof reading –plagiarism style; seminar & conference paper writing;

Methodology-discussion-results- citation rules

**IT – IV:**

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

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

**UNIT – V:**

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

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

**Textbooks:**

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

**Reference Books:**

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

**Online Resources**

1. **https://theconceptwriters.com.pk/principles-of-technical-writing/**
2. **https://www.ewh.ieee.org/soc/emcs/acstrial/newsletters/summer10/TechPaperWriting.html**

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

**IV B.Tech I Semester**

| | **GENERATIVE AI & PROMPT ENGINEERING (Professional Core)** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|---|
| | | **3** | **0** | **0** | **3** |

**Course Objectives**

- Understand the foundations and working of Generative AI models.
- Explore various generative models like GANs, VAEs, and LLMs.
- Learn prompt engineering techniques to effectively interact with language models.
- Design applications using LLMs with precise control through prompting.
- Understand ethical and societal implications of using Generative AI.

Course Outcomes (COs)

1. Explain the fundamentals of Generative AI, compare model architectures (GANs, VAEs, Transformers), and evaluate their use in generating text, images, and other media.
2. Apply prompt engineering techniques including few-shot learning, output formatting, and debugging to control and guide generative model outputs.
3. Analyze the architecture and capabilities of large language models (LLMs), and build NLP applications using prompt engineering and fine-tuning techniques.
4. Design complex multi-step prompting workflows using tools like LangChain and LlamaIndex, and generate structured or multimodal outputs safely and effectively.
5. Assess the ethical, legal, and societal implications of generative AI, and evaluate its responsible use across fields like healthcare, education, and law.

**Unit I: Introduction to Generative AI**

Overview of Generative AI and Applications, Generative vs Discriminative Models, Latent Space and Data Generation Concepts, Architectures: GANs, VAEs, Autoregressive Models, Generative AI in Text, Image, Audio, and Video, LLMs: Pretrained Transformers as, Generators, Training Challenges and Evaluation of Generative Models, Case Studies: Image Synthesis, Text Generation.

**Unit II: Prompt Engineering Fundamentals**

Introduction to Prompt Engineering, Prompt Formats: Zero-shot, One-shot, Few-shot, Prompt Tuning vs Prompt Programming, In-Context Learning & Chain-of-Thought Prompting, Role of Instructions

and Examples in Prompts, Controlling Output Style, Tone, and Format, Prompt Failure Cases and Debugging, Prompt Engineering for Coding, Text Completion, Q&A

**Unit III: Generative Models in NLP**

Transformer Architecture Recap (BERT, GPT), GPT-3/4, PaLM, Claude, and LLaMA Architectures, Text Generation Pipelines and APIs (OpenAI, HuggingFace), Prompt Engineering with GPT Models, Fine-tuning vs Instruct Tuning, Retrieval-Augmented Generation (RAG), Evaluation Metrics: BLEU, ROUGE, Perplexity, Building LLM-based Apps with LangChain.

**Unit IV: Advanced Prompt Engineering & Tools**

Role of Temperature, Top-k, Top-p Sampling, Structured Outputs: Tables, JSON, Function Calls, Agentic Prompting and Multi-step Reasoning, Prompt Chaining and Memory Handling, Prompt Templates for Automation (LangChain, LlamaIndex), Prompt Engineering for Multimodal Models (DALL·E, Gemini, Sora), Safety Layers & Guardrails in Prompting,AutoGPT, BabyAGI, and Agentic Workflow Building.

**Unit V: Ethics, Risks, and Applications of Generative AI**

Risks: Hallucination, Toxicity, Bias, Deepfakes and Misinformation Challenges, Copyright, IP, and Data Privacy in Generated Content, Evaluation of Responsible AI Outputs, Red Teaming and Safety Testing, Applications in Education, Medicine, Art, and Law, Regulatory Landscape for Generative AI, Future Trends and Research Directions

**Textbooks**

1. "Deep Learning with Python", François Chollet, Manning, 2nd Edition
2. "Generative Deep Learning", David Foster, O'Reilly, 2nd Edition
3. "Building Systems with ChatGPT", Emmanuel Ameisen (O'Reilly Short Reads)
4. "The Art of Prompt Engineering", Nathan Hunter (Free online eBook)

**Reference Books & Papers**

1. Vaswani et al., Attention is All You Need
2. OpenAI Technical Reports on GPT Models
3. Papers from NeurIPS, ACL, ICML related to XAI and LLMs
4. LangChain Documentation

**IV B.Tech I Semester**

| | Management Course- II | L | T | P | C |
|---|---|---|---|---|---|
| | | 2 | 0 | 0 | 2 |

**BUSINESS ETHICS AND CORPORATE GOVERNANCE**

**(w.e.f academic year 2023-2024)**

| Subject Code | Title of the Subject | L | T | P | C |
|---|---|---|---|---|---|
| | **BUSINESS ETHICS AND CORPORATE GOVERNANCE** | 2 | 0 | 0 | 2 |

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

**Syllabus**

**UNIT-I: Ethics**

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

**LEARNING OUTCOMES:-** After completion of this unit student will

- Understand the meaning of loyalty and ethical Behavior
- Explain various types of Ethics
- Analyze issues & crisis of management

**UNIT-II: ETHICS IN MANAGEMENT**

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

**LEARNING OUTCOMES:-** After completion of this unit student will

- Understand the meaning of Ethics in various areas of management
- Compare and contrast professional ethics and technical ethics
- Develop ethical values in self and organization

**UNIT-III : CORPORATE CULTURE**

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

**LEARNING OUTCOMES:-** After completion of this unit student will

- Define corporate culture
- Understand the key elements of corporate culture
- Analyze organization leadership and corporate culture

**UNIT- IV: LEGAL FRAME WORK**

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

**LEARNING OUTCOMES:-** After completion of this unit student will

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

**UNIT -V: CORPORATE GOVERNANCE**

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

**LEARNING OUTCOMES:-** After completion of this unit student will

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

**Text books.**

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

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

**Reference books**

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

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

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

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

| **COURSE OUTCOMES:** At the end of the course, students will be able to | | **BTL** |
|---|---|---|
| CO1 | Understand the Ethics and different types of Ethics. | L2 |
| CO2 | Understand business ethics and ethical practices in management | L2 |

| | | |
|---|---|---|
| CO3 | Understand the role of ethics in management | L2 |
| CO4 | Apply the knowledge of professional ethics & technical ethics | L3 |
| CO5 | Analyze corporate law, ethics, codes & principles | L4 |
| CO6 | Evaluate corporate governance & corporate scams | L5 |

BTL = Bloom's Taxonomy Level

ONLINE RESOURCES:

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

**E-Business**

**(Elective-2 VII - SEMESTER)**
**(w.e.f. Academic Year – 2023-2024)**

| Subject Code | Title of the Subject | L | T | P | C |
|---|---|---|---|---|---|
| | E-Business | 2 | 0 | 0 | 2 |

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

**Syllabus**

**Unit-I: Electronic Business**

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

**Learning Outcomes: -**After completion of this unit student

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

**Unit-II: Electronic Markets and Business Models**

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

**Learning Outcomes: -**After completion of this unit student will

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

**Unit-III: Electronic Payment Systems:**

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

**Learning Outcomes: -**After completion of this unit student will

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

**Unit-IV:E-Security**

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

**Learning Outcomes: -**After completion of this unit student will

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

**Unit-V:E-Marketing:**

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

**Learning Outcomes: -**After completion of this unit student will

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

**Text Books:**

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

**References:**

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

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

BTL = Bloom's Taxonomy Level

**Online Resources:**

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

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

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

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

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

**(w.e.f academic year 2023-2024)**

| Subject Code | Title of the Subject | L | T | P | C |
|---|---|---|---|---|---|
| | Management Science | 2 | 0 | 0 | 2 |

| **COURSE OBJECTIVES :** The objectives of this course are | |
|---|---|
| 1 | To provide fundamental knowledge on Management, Administration, Organization & its concepts. |
| 2 | To make the students understand the role of management in Production |
| 3 | To impart the concept of HRM in order to have an idea on Recruitment, Selection, |

| | |
|---|---|
| | Training & Development, job evaluation and Merit rating concepts |
| 4 | To create awareness on identify Strategic Management areas & the PERT/CPM for better Project Management |
| 5 | To make the students aware of the contemporary issues in modern management |

**UNIT- IINTRODUCTION TO MANAGEMENT**

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

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

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

**UNIT - II OPERATIONS MANAGEMENT**

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

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

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

**UNIT - III HUMAN RESOURCES MANAGEMENT (HRM)**

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

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

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

**UNIT - IV STRATEGIC & PROJECT MANAGEMENT**

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

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

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

**UNIT - V CONTEMPORARY ISSUES IN MANAGEMENT**

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

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

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

**Text Books:**

**1. Frederick S. Hillier, Mark S. Hillier.** ***Introduction to Management Science,*** **October 26, 2023**

2. A.R Aryasri, *Management Science*, TMH, 2019

**References:**

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

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

| | | |
|---|---|---|
| | technology. | |

BTL = Blooms Taxonomy Level

ONLINE RESOUECES:

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

**IV B.Tech I Semester**

| | **EXPLAINABLE AI &MODEL INTERPRETABILITY (Professional Elective-IV)** | **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:**

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

- 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**

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**

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**

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**

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**

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.

**Textbooks:**

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

**IV B.Tech I Semester**

| | **AI for Robotics (Professional Elective-IV)** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|---|
| | | **3** | **0** | **0** | **3** |

**Course Objectives**

- Introduce the fundamental principles of robotics and artificial intelligence integration.
- Understand robot perception, localization, mapping, motion planning, and control using AI algorithms.
- Apply machine learning and deep learning techniques in robotic environments.
- Explore the use of reinforcement learning, behavior-based AI, and neural networks in autonomous robots.
- Enable students to build intelligent robots that can perceive, learn, and adapt to dynamic environments.

**Course Outcomes**

- Demonstrate an understanding of how AI techniques are applied in robot control and autonomy.
- Apply vision, perception, and sensor fusion techniques for real-time robotic applications.
- Implement path planning and navigation algorithms in dynamic environments.
- Analyze and apply learning-based models such as reinforcement learning and deep neural networks in robotics.
- Evaluate AI-enabled robotic systems based on their performance, efficiency, and adaptability.

**UNIT I – Fundamentals of Robotics and AI**

Introduction to Robotics: Types and Components, Overview of Artificial Intelligence and Machine Learning, Relationship between Robotics and AI, Sensors and Actuators in Robotics, Embedded Systems and Microcontrollers in Robotics, Architecture of Autonomous Robots, Programming Tools: ROS (Robot Operating System), Python, C++, Applications of AI in Robotics – Overview

**UNIT II – Perception and Sensor Fusion**

Computer Vision for Robotics: Basics and Techniques, Depth Sensing, RGB-D Cameras, LIDAR, and Ultrasonic Sensors, Feature Extraction and Object Recognition, Kalman Filter and Extended Kalman Filter, Particle Filter and Sensor Fusion Techniques, SLAM (Simultaneous Localization and Mapping) – Concepts, Visual SLAM and LiDAR-based SLAM, 3D Mapping and Scene Reconstruction.

**UNIT III – Motion Planning and Navigation**

Path Planning Algorithms – Dijkstra, A*, RRT, Obstacle Detection and Avoidance, Robot Kinematics and Dynamics, Trajectory Generation and Optimization, Localization Techniques – GPS, Wi-Fi, Odometry, Autonomous Navigation in Indoor and Outdoor Environments, Multi-Robot Coordination and Swarm Intelligence, Integration of Perception and Planning Systems

**UNIT IV – AI Techniques in Robotics**

Supervised and Unsupervised Learning for Robotics, Neural Networks and Deep Learning Models for Robot Vision, Reinforcement Learning – Q-Learning and Deep Q Networks, Policy Gradient and Actor-Critic Methods, Behavior-Based Robotics and Finite State Machines, Imitation Learning and Learning from Demonstration, Transfer Learning for Robotic Tasks, Safety and Generalization in AI Models for Robots

**UNIT V – Advanced Applications and Ethical Considerations**

Humanoid and Service Robots with AI, AI in Industrial, Healthcare, and Assistive Robotics, Edge AI and Real-Time Inference in Robots, Human-Robot Interaction and Social Intelligence, Autonomous Vehicles and Delivery Drones, AI in Robotics Competitions (RoboCup, DARPA), Ethical Issues in AI-Enabled Robotics, Future Trends: Neuromorphic and Quantum Robotics

**Textbooks**

1. "Artificial Intelligence for Robotics" by Robin R. Murphy
2. "Probabilistic Robotics" by Sebastian Thrun, Wolfram Burgard, Dieter Fox
3. "Introduction to Autonomous Robots" by Nikolaus Correll, Bradley Hayes, et al.

**Reference Books**

1. "Robot Operating System (ROS) for Absolute Beginners" by Lentin Joseph
2. "Modern Robotics: Mechanics, Planning, and Control" by Kevin M. Lynch and Frank C. Park
3. "Learning for Adaptive and Reactive Robot Control" by Aude Billard, Jean-Jacques Slotine
4. IEEE Transactions and Springer Journals on Robotics and Intelligent Systems

**Online Courses**

1. AI for Robotics – Udacity (by Sebastian Thrun)
2. Modern Robotics: Mechanics, Planning, and Control – Coursera (Northwestern University)
3. Deep Learning for Robotics – edX

**IV B.Tech I Semester**

| | AI IN CYBERSECURITY<br>(Professional Elective-IV) | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**Course Objectives:**

- To introduce the fundamental concepts of AI and their applications in cybersecurity.
- To understand AI-driven techniques for threat detection, classification, and mitigation.
- To explore machine learning and deep learning methods used for malware and intrusion detection.
- To equip students with skills in building intelligent security systems.
- To examine ethical, legal, and privacy aspects in AI-driven cybersecurity.

**Course Outcomes:**

- Understand AI principles and their relevance in cybersecurity.
- Apply machine learning techniques to detect and respond to threats.
- Analyze security incidents using intelligent tools and models.
- Evaluate and implement AI models for malware detection and anomaly analysis.
- Design AI-based cybersecurity frameworks for real-world scenarios.

**UNIT I: Introduction to AI in Cybersecurity**

Role of AI in Modern Cybersecurity, Overview of Cyber Threats and Attack Vectors, Fundamentals of Machine Learning for Security, AI vs Traditional Security Techniques, AI-Based Cyber Defense Lifecycle, Threat Intelligence with AI, Cybersecurity Data Types and Challenges, Case Studies of AI-Driven Attacks and Defenses

**UNIT II: Machine Learning for Cyber Threat Detection**

Supervised Learning for Intrusion Detection, Unsupervised Learning for Anomaly Detection, Feature Engineering from Network Traffic, Classification Algorithms: SVM, Decision Trees, Random Forests, Clustering Techniques: K-Means, DBSCAN, Ensemble Models and Model Evaluation Metrics, Real-Time Threat Detection Pipelines, Data Imbalance and Adversarial Sampling

**UNIT III: Deep Learning in Cybersecurity**

Neural Networks for Threat Classification, CNNs for Malware Detection from Binary Files, RNNs/LSTMs for Sequential Log Analysis, Autoencoders for Anomaly Detection,GANs in Malware Evasion and Defense,Transfer Learning for Threat Signature Extraction, Deep Learning vs Traditional Models: A Comparative Study,Real-World Use Cases and Limitations

**UNIT IV: AI for Specific Security Domains**

AI for Phishing and Spam Detection, AI in Cloud Security and Edge Devices, Botnet and DDoS Attack Detection**,** AI-Driven Endpoint Security, Natural Language Processing for Threat Intelligence, Behavioral Biometrics and Fraud Detection, AI in Social Engineering Attack Prevention, Security Information and Event Management (SIEM) with AI

**UNIT V: Challenges, Ethics & Future of AI in Cybersecurity**

Explainable AI (XAI) in Cybersecurity, Adversarial Attacks and Defenses in AI Systems, Data Privacy and Federated Learning, Legal and Ethical Issues in AI Security Solutions, AI Model Bias and Fairness in Security Decisions, Securing AI Models Against Manipulation, Building Scalable AI-Powered SOCs, Future Trends: Autonomous Security, AI-Augmented Threat Hunting

**Textbooks:**

1. Clarence Chio & David Freeman, "Machine Learning and Security", O'Reilly Media.
2. Xiaofeng Chen et al., "Artificial Intelligence and Big Data Analytics for Cybersecurity", Springer.
3. Mark Stamp, "Information Security: Principles and Practice", Wiley.

**Reference Books:**

1. Sumeet Dua & Xian Du, "Data Mining and Machine Learning in Cybersecurity", CRC Press.
2. Shai Shalev-Shwartz & Shai Ben-David, "Understanding Machine Learning", Cambridge University Press.
3. Zhiwei Lin & Yang Xiang, "Cyber Security Intelligence and Analytics", Springer.
4. Bhavani Thuraisingham, "Data Mining for Malware Detection", CRC Press.

**Online Learning Resources:**

- Coursera – "AI for Cybersecurity" by University of Colorado
- Udemy – "Machine Learning for Cybersecurity"
- edX – "Cybersecurity MicroMasters" by RIT

**IV B.Tech I Semester**

| | AI-DRIVEN SOFTWARE ENGINEERING & DEVOPS (Professional Elective-IV) | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**Course Objectives:**

- To introduce the principles and practices of AI-driven software engineering and DevOps.
- To explore how AI techniques can automate and optimize software development workflows.
- To study intelligent tools for code generation, testing, monitoring, and deployment.
- To equip students with skills in AI-powered CI/CD pipelines and operations.
- To foster an understanding of ethical implications and reliability in intelligent software systems.

**Course Outcomes:**

- Understand AI's role in modern software development and operations.
- Apply machine learning techniques to automate software engineering tasks.
- Design and manage intelligent CI/CD and DevOps workflows.
- Evaluate AI tools in software testing, refactoring, and monitoring.
- Implement AI-based solutions for predictive maintenance and decision support in DevOps.

**UNIT I: Foundations of AI in Software Engineering**

Overview of Traditional vs AI-driven Software Development, AI Opportunities in Software Lifecycle Phases, Introduction to ML/DL Models in Engineering Tasks, Code Representation and Learning from Code, NLP for Source Code Understanding, Software Knowledge Graphs and Reasoning, Datasets and Benchmarks for Software Engineering AI, Case Studies of AI-Enhanced Development Tools

**UNIT II: AI in Code Generation and Refactoring**

Program Synthesis and Code Completion Models, Large Language Models (e.g., Codex, CodeBERT) in IDEs, Code Clone Detection and Automated Refactoring, Learning-Based Bug Detection and Code Smell Identification, AI in Software Architecture Recommendations, Embedding Techniques for Source Code, Prompt Engineering for Software Tasks, Reliability and Safety in Generated Code

**UNIT III: Intelligent Testing, QA, and Debugging**

Test Case Generation Using AI, Automated Unit Testing, Regression Testing with ML, Learning Bug Patterns from Repositories, AI-Based Static and Dynamic Code Analysis, Fault Localization and Automated Debugging, Quality Assurance Metrics Enhanced by AI, Reinforcement Learning for Test Prioritization, Ethics and Bias in AI-Driven Testing – (E)

**UNIT IV: AI in DevOps Automation and CI/CD**

DevOps Fundamentals and Integration with AI, Intelligent CI/CD Pipeline Design, Predictive Build Failure and Log Analysis, AI in Infrastructure-as-Code and Deployment Orchestration, Self-Healing Systems and AIOps Concepts, Log Analytics and Anomaly Detection in Production, AI in Monitoring, Tracing, and Feedback Loops, DevSecOps and AI for Security Automation

**UNIT V: Advanced Topics and Ethical Considerations**

Explainability and Transparency in AI-Driven Tools, Ethical and Legal Aspects in Automated Engineering**,** Human-AI Collaboration in Software Teams, Risk Management in Autonomous Code Deployment, AI for Technical Debt Prediction and Management, AI for Developer Productivity Analytics, Research Trends and Challenges in AI for SE, Capstone: Building a Smart DevOps Workflow

**Textbooks:**

1. Tim Menzies, Diomidis Spinellis, and Thomas Zimmermann, "Perspectives on Data Science for Software Engineering", Morgan Kaufmann.
2. André van der Hoek, Reid Holmes, "Software Engineering for Machine Learning", Springer.
3. Len Bass, Ingo Weber, Liming Zhu, "DevOps: A Software Architect's Perspective", Addison-Wesley.

**Reference Books:**

1. Carlos Eduardo Parnin et al., "AI for Software Engineering: Foundations, Advances, and Trends", Springer.
2. Luciano Baresi et al., "Machine Learning Techniques for Software Quality Evaluation", Springer.
3. Gene Kim, Jez Humble, and Nicole Forsgren, "Accelerate: The Science of Lean Software and DevOps", IT Revolution.

**Online Learning Resources:**

- Coursera – "AI for Software Engineering" by DeepLearning.AI
- edX – "DevOps for Developers" by Microsoft
- GitHub Copilot and OpenAI Codex documentation
- PapersWithCode – AI for Software Engineering benchmarks
- MIT OCW – "Software Systems" and "DevOps and CI/CD"
- Udemy – "AI-Powered DevOps Pipelines and Automation"
- Google Cloud – AIOps and MLOps tutorials

**IV B.Tech I Semester**

| | AI for Smart Cities & IoT Systems (Professional Elective-V) | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**Course Objective:**

1. To understand the foundational concepts of smart cities and IoT architectures integrated with AI technologies.
2. To explore AI-driven solutions for urban mobility, transportation, and traffic management systems.
3. To apply AI and IoT techniques for efficient energy, waste, and water management in smart urban environments.
4. To examine AI applications in smart healthcare, surveillance, and public safety systems.
5. To design, deploy, and evaluate AIoT systems with an understanding of real-time processing, governance, and future challenges.

**Course Outcomes:**

1. Describe the architecture and components of smart cities and explain how AI and IoT integrate to optimize urban planning and services.
2. Apply AI models in transportation systems to improve traffic flow, public mobility, and autonomous vehicle operations.
3. Develop AI and IoT solutions for sustainable energy, waste, and water management in smart city ecosystems.
4. Analyze AI-based healthcare, surveillance, and emergency response applications, considering privacy and ethical aspects.
5. Design and deploy AIoT systems using edge/cloud platforms and evaluate them using appropriate governance and performance metrics.

**Unit I: Introduction to AI in Smart Cities and IoT Systems**

Smart City Concepts: Components, Infrastructure, and Urban Needs, Overview of IoT and AI Integration, Smart City Frameworks (India, Singapore, EU, etc.), IoT Architecture: Sensing, Network, Processing, and Application Layers, Role of AI in Urban Planning and Resource Optimization, Case Studies on AI in Smart Cities, Edge, Fog, and Cloud Computing Concepts for Smart Systems

**Unit II: AI Applications in Smart Transportation and Mobility**

Traffic Monitoring and Congestion Prediction using AI, Intelligent Traffic Signal Control using Reinforcement Learning, Autonomous Vehicles and AI Algorithms, Vehicle Detection and License Plate Recognition using CV, Public Transport Optimization using Predictive Analytics, Smart Parking and Navigation Systems, Use of Drones and AI for Traffic Surveillance

**Unit III: AI and IoT for Smart Energy, Waste, and Water Management**

AI for Smart Grids and Energy Consumption Prediction, Load Balancing and Demand Forecasting using ML, Waste Segregation and Collection Automation using CV, Water Quality Monitoring Systems using IoT Sensors, Leak Detection and Anomaly Detection Models, Smart Metering and Energy Theft Detection, Sustainability and Carbon Monitoring AI Models

**Unit IV: Smart Healthcare, Surveillance, and Public Safety**

IoT-based Health Monitoring and Alert Systems, Predictive Healthcare and Disease Outbreak Detection, AI for CCTV Surveillance, Crowd Monitoring, and Violence Detection, NLP for Emergency Response and Chatbot Assistance, Smart Ambulance Routing and Response Optimization, COVID-19 Contact Tracing and Monitoring via AI & IoT, Data Privacy, Security & Ethical Issues in Surveillance Systems

**Unit V: AIoT System Design, Deployment, and Governance**

AI Model Deployment on Edge Devices (Raspberry Pi, Jetson Nano), Smart City Dashboards and Data Visualization, Real-time Streaming and Analytics Platforms (Apache Kafka, Spark), Cloud Integration: AWS IoT, Google Cloud AI, Azure IoT Suite, Governance Frameworks, Data Privacy, and Policy Standards, Evaluation Metrics for Smart City Projects, Future Trends in AIoT and Smart Urban Living

**Text Books:**

1. Pethuru Raj & Anupama C. Raman, The Internet of Things: Enabling Technologies, Platforms, and Use Cases, CRC Press.
2. Janaka Ekanayake, Smart Grid: Technology and Applications, Wiley.
3. Rajkumar Buyya, Fog and Edge Computing: Principles and Paradigms, Wiley.
4. Adrian McEwen, Hakim Cassimally, Designing the Internet of Things, Wiley.

**Reference Books:**

1. Mahalik N. P., Sensor Networks and Applications, McGraw Hill.
2. Kim F. Taylor, Urban Artificial Intelligence and Governance, Springer.
3. Dastbaz, J. & Pattinson, C., Smart Cities: Innovation and Sustainability, Springer.
4. Research papers from IEEE Smart Cities, AIoT Journal, and Springer Urban Tech.

**Online Courses:**

1. Coursera – Smart Cities: Management of Smart Urban Infrastructures (EPFL)
2. edX – Internet of Things (IoT) Program – Curtin University

**IV B.Tech I Semester**

| | ML Ops & AI Model Deployment (Professional Elective-V) | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**Course Objective:**

- To understand the principles and best practices of operationalizing machine learning models in production environments.
- To explore the life cycle of AI model development, deployment, monitoring, and maintenance using modern MLOps frameworks.
- To develop skills in CI/CD for ML, reproducibility, model versioning, and containerization using Docker and Kubernetes.
- To deploy machine learning models using cloud-native services and track their performance using real-time metrics.
- To address scalability, reliability, and ethical considerations in ML model deployment.

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

1. Illustrate the lifecycle and pipeline components of MLOps and implement basic version control and orchestration for ML workflows.
2. Package ML models using appropriate tools and deploy them using Docker and Kubernetes environments with effective resource management.
3. Develop and deploy machine learning models as APIs using FastAPI/Flask and configure for real-time or batch inference scenarios.
4. Monitor and log ML systems using modern tools and detect data/model drift with strategies for continuous evaluation and feedback.
5. Implement end-to-end MLOps solutions using cloud platforms and CI/CD tools, and analyze deployment challenges in real-world use cases.

**UNIT I: Introduction to MLOps and Deployment Pipelines**
Definition and need of MLOps, ML system lifecycle and pipeline components, DevOps vs. MLOps: key differences, CI/CD for ML projects, Data versioning and model lineage, Introduction to DVC, Git, and MLFlow, Workflow orchestration using Apache Airflow, Automated testing in ML pipelines,

**UNIT II: Model Packaging and Environment Management.**

Packaging ML models using Pickle, Joblib, ONNX, Python virtual environments, Conda, Pipenv, Introduction to Docker for ML workloads, Building Dockerfiles for ML apps, Using Kubernetes for orchestration, Security, logging, and resource management, Docker Compose and Helm charts for deployment, Hands-on: Containerize and deploy a scikit-learn model

**UNIT III: Model Serving and APIs**
RESTful API design for ML models, Model deployment using FastAPI and Flask, TensorFlow Serving, TorchServe basics, Introduction to gRPC for ML deployment, Asynchronous inference and batch vs real-time serving, Load testing and benchmarking, Authentication and authorization in model APIs, Deploying models on edge devices

**UNIT IV: Monitoring, Logging, and Continuous Evaluation**
Importance of monitoring and alerting in MLOps, Data drift and model drift detection, Logging prediction results and metadata, Prometheus, Grafana, and ELK Stack, A/B testing and canary deployments, Shadow deployments and rollback strategies, Feedback loops for continuous learning, Integration with external monitoring tools

**UNIT V: Cloud-native MLOps and Case Studies**
ML deployment on AWS SageMaker, Azure ML, Google AI Platform, CI/CD using GitHub Actions, Jenkins, and GitLab CI, AutoML and model registry, Real-world case study: End-to-end MLOps pipeline, Challenges and limitations in enterprise ML deployment, Responsible AI in production systems, Future trends in MLOps, Capstone Project Planning

**Text Books:**

1. Introducing MLOps: How to Scale Machine Learning Projects with DevOps Tools – Mark Treveil, Alok Shukla, O'Reilly Media.
2. Machine Learning Engineering – Andriy Burkov, TrueShelf Publishing.
3. Designing Machine Learning Systems – Chip Huyen, O'Reilly Media.

**Reference Books:**

1. Practical MLOps – Noah Gift, O'Reilly Media
2. Kubeflow for Machine Learning – Trevor Grant et al., O'Reilly
3. Hands-On MLOps: Implement Machine Learning in Production – Munn, Meza, Vohra, Packt Publishing
4. Research papers from arXiv, MLSys Conference, and ICML Industry Track

**Online Courses:**

1. Coursera – MLOps Specialization by DeepLearning.AI
2. Google Cloud – MLOps: Continuous Delivery and Automation Pipelines
3. Udemy – MLOps: ML Pipelines, CI/CD, and Model Deployment

**IV B.Tech I Semester**

| | Data Wrangling (Professional Elective-V) | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**Course Objectives:**

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

**Course Outcomes:**

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

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

**UNIT I: Introduction to Data Wrangling and Data Acquisition**

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

**UNIT II: Handling Missing, Noisy, and Inconsistent Data**

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

**UNIT III: Data Transformation and Feature Engineering**

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

**UNIT IV: Data Integration, Joining, and Workflows**

Merging and Joining Datasets (Inner, Outer, Left, Right), Concatenation and Appending DataFrames, Data Consistency and Referential Integrity, Resolving Schema Mismatches, Designing Reusable Data

Wrangling Functions, Automating Workflows with Functions and Pipelines, Data Lineage and Documentation, Case Study: End-to-End Data Wrangling Pipeline.

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

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

**Textbooks:**

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

**Reference Books:**

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

**Online Learning Resources:**

1. Data Wrangling with pandas (Datacamp): https://www.datacamp.com/courses/data-manipulation-with-pandas
2. Coursera: Data Wrangling, Analysis and AB Testing with SQL – *https://www.coursera.org/learn/data-wrangling-analysis-abtesting*
3. edX: Data Wrangling with R – https://online.rice.edu/courses/data-wrangling-r

**IV B.Tech I Semester**

| | Healthcare AI (Professional Elective-V) | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**Course Objectives:**

- To provide a foundational understanding of AI applications in healthcare.
- To familiarize students with medical data types, preprocessing, and ethical considerations.
- To explore ML and DL algorithms tailored for diagnosis, prognosis, and treatment recommendations.
- To expose students to real-world healthcare systems and AI solutions like predictive modeling, EHRs, and medical imaging.
- To enable students to design, evaluate, and deploy AI-driven healthcare applications.

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

- Understand the scope, challenges, and benefits of AI in healthcare.
- Apply data preprocessing and modeling techniques specific to biomedical data.
- Analyze the performance of ML/DL models in clinical contexts.
- Develop AI-driven applications for tasks like disease diagnosis, drug discovery, and patient monitoring.
- Evaluate ethical, legal, and societal implications of AI in healthcare.

**UNIT I: Introduction to AI in Healthcare**

Overview of Healthcare Systems and Data Ecosystem , AI in Clinical Decision Support Systems (CDSS), Types of Medical Data: EHRs, Imaging, Genomic, Sensor Data, Applications of AI in Diagnosis, Prognosis, and Monitoring, Use Cases: Radiology, Pathology, Oncology, Cardiology, Limitations and Challenges of AI in Healthcare, AI for Telemedicine and Remote Patient Monitoring.

**UNIT II: Medical Data Preprocessing and Feature Engineering**

Data Cleaning, Imputation, and Normalization for Clinical Data, Handling Missing Values, Outliers, and Bias, Feature Engineering from EHRs and Time-Series Data, Text Mining for Medical Notes using NLP, Encoding Diagnosis and Procedure Codes (ICD, CPT), Temporal Pattern Extraction from Clinical Sequences, Data Privacy, Anonymization, and HIPAA Compliance.

**UNIT III: Machine Learning & Deep Learning in Healthcare**

Supervised Learning for Risk Prediction and Classification, Unsupervised Learning for Patient Segmentation, Deep Learning for Medical Imaging: CNNs, Transfer Learning, Recurrent Neural Networks for Time-series Clinical Data, Survival Analysis and Time-to-Event Prediction, Model Evaluation Metrics: Sensitivity, Specificity, AUC, Handling Imbalanced Datasets in Healthcare, Interpretability in Medical ML Models (LIME, SHAP)

**UNIT IV: Specialized Healthcare AI Applications**

AI for Disease Diagnosis: Diabetes, Cancer, Heart Disease, AI in Medical Imaging: X-ray, MRI, CT Scan Analysis, Predictive Modeling for ICU Admission & Mortality Risk, AI in Genomics and

Personalized Medicine, Drug Discovery and Repurposing with AI, Chatbots and Virtual Health Assistants, Remote Monitoring using IoT & Wearables + AI.

**UNIT V: Ethics, Regulation, and Future Directions in Healthcare AI**

Ethical AI in Healthcare: Bias, Fairness, and Accountability, Regulatory Landscape: FDA Approval, CE Marking, Explainable AI and Clinical Trust, Federated Learning for Privacy-Preserving AI, Clinical Trials and AI Decision-Support Tools, Case Studies: Google DeepMind, IBM Watson Health, PathAI, Responsible Deployment of AI in Healthcare Settings.

**Textbooks:**

1. Jiang, Fei et al. – Artificial Intelligence in Healthcare: Past, Present and Future.
2. Kevin Frick – Introduction to Healthcare AI.
3. Eric Topol – Deep Medicine: How Artificial Intelligence Can Make Healthcare Human Again.

**Reference Books:**

1. Mathias Goyen – AI in Medical Imaging.
2. Bertalan Meskó – The Guide to the Future of Medicine: Technology and The Human Touch.
3. Peter Szolovits – Artificial Intelligence in Medicine (Morgan Kaufmann).

**Online Learning Resources:**

1. Coursera: AI for Medicine Specialization (offered by DeepLearning.AI) https://www.coursera.org/specializations/ai-for-medicine
2. HarvardX: Data Science in Healthcare (edX) https://online-learning.harvard.edu/course/data-science-healthcare

**IV B.Tech I Sem**

| 23A05704a | DATABASE MANAGEMENT SYSTEMS (Open Elective-III) | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**Course Objectives:** The main objective of the course is to

- Introduce database management systems and to give a good formal foundation on the relational model of data and usage of Relational Algebra
- Introduce the concepts of basic SQL as a universal Database language
- Demonstrate the principles behind systematic database design approaches by covering conceptual design, logical design through normalization
- Provide an overview of physical design of a database system, by discussing Database indexing techniques and storage techniques

**Course Out comes:** After completion of the course, students will be able to

**CO1:** Understand the basic concepts of database management systems (L2)

**CO2:** Analyze a given database application scenario to use ER model for conceptual design of the database (L4)

**CO3:** Utilize SQL proficiently to address diverse query challenges (L3).

**CO4:** Employ normalization methods to enhance database structure (L3)

**CO5:** Assess and implement transaction processing, concurrency control and database recovery protocols in databases. (L4)

**UNIT I: Introduction:** Data base system, Characteristics (Database Vs File System), Database Users, Advantages of Database systems, Database applications. Brief introduction of different Data Models; Concepts of Schema, Instance and data independence; Three tier schema architecture for data independence; Database system structure, environment, Centralized and Client Server architecture for the database.

**Entity Relationship Model:** Introduction, Representation of entities, attributes, entity set, relationship, relationship set, constraints, sub classes, super class, inheritance, specialization, generalization using ER Diagrams.

**Unit II: Relational Model:** Introduction to relational model, concepts of domain, attribute, tuple, relation, importance of null values, constraints (Domain, Key constraints, integrity constraints) and their importance, Relational Algebra, Relational Calculus. BASIC SQL: Simple Data base schema, data types, table definitions (create, alter), different DML operations (insert, delete, update).

**UNIT III: SQL:** Basic SQL querying (select and project) using where clause, arithmetic & logical operations, SQL functions(Date and Time, Numeric, String conversion).Creating tables with relationship, implementation of key and integrity constraints, nested queries, sub queries, grouping,

aggregation, ordering, implementation of different types of joins, view(updatable and non-updatable), relational set operations.

**UNIT IV: Schema Refinement (Normalization):**Purpose of Normalization or schema refinement, concept of functional dependency, normal forms based on functional dependency Lossless join and dependency preserving decomposition, (1NF, 2NF and 3 NF), concept of surrogate key, Boyce- Codd normal form(BCNF), MVD, Fourth normal form(4NF), Fifth Normal Form (5NF).

**UNIT V:Transaction Concept:** Transaction State, ACID properties, Concurrent Executions, Serializability, Recoverability, Implementation of Isolation, Testing for Serializability, lock based, time stamp based, optimistic, concurrency protocols, Deadlocks, Failure Classification, Storage, Recovery and Atomicity, Recovery algorithm.

**Introduction to Indexing Techniques:** B+ Trees, operations on B+Trees, Hash Based Indexing:

**Textbooks:**

1. Database Management Systems, 3rd edition, Raghurama Krishnan, Johannes Gehrke, TMH (For Chapters 2, 3, 4)
2. Database System Concepts,5th edition, Silberschatz, Korth, Sudarsan,TMH (For Chapter 1 and Chapter 5)

**Reference Books:**

1. Introduction to Database Systems, 8thedition, C J Date, Pearson.
2. Database Management System, 6th edition, RamezElmasri, Shamkant B. Navathe, Pearson
3. Database Principles Fundamentals of Design Implementation and Management, Corlos Coronel, Steven Morris, Peter Robb, Cengage Learning.

**Web- Resources:**

1. https://nptel.ac.in/courses/106/105/106105175/
2. https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_012758066672820224 56_shared/overview

**IV B.Tech I Sem**

| 23A05704b | CYBER SECURITY (Open Elective-III) | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**Course Objectives:**

The course is designed to provide awareness on different cyber crimes, cyber offenses, tools and methods used in cybercrime.

**Course Outcomes:**

After completion of the course, students will be able to

- Classify the cybercrimes and understand the Indian ITA 2000
- Analyse the vulnerabilities in any computing system and find the solutions
- Predict the security threats of the future
- Investigate the protection mechanisms
- Design security solutions for organizations

**UNIT- I** Introduction to Cyber crime Lecture 8Hrs

Introduction, Cybercrime, and Information Security, Who are Cybercriminals, Classifications of Cybercrimes, And Cybercrime: The legal Perspectives and Indian Perspective, Cybercrime and the Indian ITA 2000, A Global Perspective on Cybercrimes.

**UNIT- II** Cyber Offenses: How Criminals Plan Them Lecture 9Hrs

Introduction, How Criminals plan the Attacks, Social Engineering, Cyber stalking, Cyber cafe and Cybercrimes, Botnets: The Fuel for Cybercrime, Attack Vector, Cloud Computing

**UNIT- III** Cyber crime: Mobile and Wireless Devices Lecture 9Hrs

Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication service Security, Attacks on Mobile/Cell Phones,

Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile, Organizational Security Policies an Measures in Mobile Computing Era, Laptops.

**UNIT- IV** Tools and Methods Used in Cyber crime Lecture 8Hrs

Introduction, Proxy Servers and Anonymizers, Phishing, Password Cracking, Key loggers and Spywares, Virus and Worms, Trojan Horse and Backdoors, Steganography, DoS and DDoS attacks, SQL Injection, Buffer Overflow.

**UNIT- V** Cyber Security: Organizational Implications Lecture 8Hrs

Introduction, Cost of Cybercrimes and IPR issues, Web threats for Organizations, Security and Privacy Implications, Social media marketing: Security Risks and Perils for Organizations, Social Computing and the associated challenges for Organizations.

**Textbooks:**

1. Cyber Security: Under standing Cyber Crimes, Computer Forensics and Legal Perspectives, Nina Godbole and Sunil Belapure, Wiley INDIA.

**Reference Books:**

1. Cyber Security Essentials, James Graham, Richard Howard and Ryan Otson, CRC Press.

2. Introduction to Cyber Security , Chwan –Hwa (john) Wu ,J. DavidIrwin.CRC Press T&F Group

**Online Learning Resources:**

http://nptel.ac.in/courses/106105031/40

http://nptel.ac.in/courses/106105031/39

http://nptel.ac.in/courses/106105031/38

**IV B.Tech I Sem**

| | | L | T | P | C |
|---|---|---|---|---|---|
| **23A05705a** | **COMPUTER NETWORKS (Open Elective-IV)** | **3** | **0** | **0** | **3** |

**Course Objectives:**
The course is designed to

- Understand the basic concepts of Computer Networks.
- Introduce the layered approach for design of computer networks
- Expose the network protocols used in Internet environment
- Explain the format of headers of IP, TCP and UDP
- Familiarize with the applications of Internet
- Elucidate the design issues for a computer network

**Course Outcomes:**

After completion of the course, students will be able to

- Identify the software and hardware components of a computer network
- Design software for a computer network
- Develop new routing, and congestion control algorithms
- Assess critically the existing routing protocols
- Explain the functionality of each layer of a computer network
- Choose the appropriate transport protocol based on the application requirements

**UNIT- I Computer Networks and the Internet**

What Is the Internet? The Network Edge, The Network Core, Delay, Loss, and Throughput in Packe Switched Networks(Textbook 2), Reference Models, Example Networks, Guided Transmission Media, Wireless Transmission(Textbook 1)

**UNIT- II The Data Link Layer, Access Networks, and LANs**

Data Link Layer Design Issues, Error Detection and Correction, Elementary Data Link Protocols, Sliding Window Protocols (Textbook 1) Introduction to the Link Layer, Error-Detection and -Correction Techniques, Multiple Access Links and Protocols, Switched Local Area Networks

Link Virtualization: A Network as a Link Layer, Data Center Networking, Retrospective: A Day in the Life of a Web Page Request (Textbook 2)

**UNIT -III The Network Layer**

Routing Algorithms, Internetworking, The Network Layer in The Internet (Textbook 1)

**UNIT IV The Transport Layer**

Connectionless Transport: UDP (Textbook 2), The Internet Transport Protocols: TCP, Congestion Control (Textbook 1)

**UNIT V Principles of Network Applications**

Principles of Network Applications, The Web and HTTP, Electronic Mail in the Internet, DNS—The Internet's Directory Service, Peer-to-Peer Applications Video Streaming and Content Distribution Networks (Textbook 2)

**Text books:**

1. Andrew S.Tanenbaum, David j.wetherall, Computer Networks, 5th Edition, PEARSON.
2. James F. Kurose, Keith W. Ross, "Computer Networking: A Top-Down Approach", 6th edition, Pearson, 2019.

**Reference Books:**

1. Forouzan, Data communications and Networking, 5th Edition, Mc Graw Hill Publication.
2. Youlu Zheng, Shakil Akthar, "Networks for Computer Scientists and Engineers", Oxford Publishers, 2016.

**Online Learning Resources:**
https://nptel.ac.in/courses/106105183/25

http://www.nptelvideos.in/2012/11/computer-networks.html
https://nptel.ac.in/courses/106105183/3

**IV B.Tech I Sem**

| 23A05705b | INTERNET OF THINGS (Open Elective-IV) | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**Course Objectives:**

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

**Course Out comes:**

After completion of the course, students will be able to

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

**UNIT-I Introduction to IoT** Lecture 8Hrs

Definition and Characteristics of IoT, physical design of IoT, IoT protocols, IoT communication models, IoT Communication APIs, Communication protocols, Embedded Systems, IoT Levels and Templates

**UNIT- II Prototyping IoT Objects using Microprocessor/Microcontroller** Lecture 9Hrs

Working principles of sensors and actuators, setting up the board – Programming for IoT, Reading from Sensors, Communication: communication through Bluetooth, Wi-Fi.

**UNIT- III IoT Architecture and Protocols** Lecture 8Hrs

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

**UNIT-IV Device Discovery and Cloud Services for IoT** Lecture 8Hrs

Device discovery capabilities- Registering a device, Deregister a device, Introduction to Cloud Storage models and communication APIs Web-Server, Web server for IoT.

**UNIT-V UAV IoT** Lecture 10Hrs

Introduction to Unmanned Aerial Vehicles/Drones, Drone Types, Applications: Defense, Civil, Environmental Monitoring; UAV elements and sensors- Arms, motors, Electronic Speed Controller(ESC), GPS, IMU, Ultra sonic sensors; UAV Software – Arudpilot, Mission Planner, Internet of Drones(IoD)- Case study Flyt Base.

**Text books:**

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

**Reference Books:**

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

7. Building Your Own Drones: A Beginners' Guide to Drones, UAVs, and ROVs, John Baichtal

**Online Learning Resources:**

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

**IV B.Tech I Sem**

| | PROMPT ENGINEERING<br>Skill Enhancement Course | L | T | P | C |
|---|---|---|---|---|---|
| | | 0 | 1 | 2 | 2 |

**Course Objective:**

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

**Course Out comes:**

- Under standing the fundamentals and evolution of prompt engineering.

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

**Module 1: Introduction to Prompt Engineering**

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

**Module 2: Types of Prompts and Their Applications**

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

**Module 3: Strategies for Effective Prompting**

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

**Module 4: Fine-Tuning and Optimizing with Prompts**

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

**Module 5: Evaluation and Bias Mitigation**

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

**Module 6: Real-World Applications and Case Studies**

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

**Text books:**

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

**Reference Books:**

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

**Online Resource link :**

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

**(Common to All Branches of Engineering)**

**R-23**

| **Course Code** | **Gender Sensitization** | | **L** | **T** | **P** | **C** |
|---|---|---|---|---|---|---|
| | | | **0** | **0** | **2** | **0** |
| **Pre-requisite** | | **Semester** | | | | |

Course Objectives:

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

Course Outcomes (CO):

| **COs** | **Statements** | **Blooms level** |
|---|---|---|
| **CO1** | Understand the basic concepts of gender and its related terminology | L1, L2, |
| **CO2** | ntify the biological, sociological, psychological and legal aspects of gender. | L1, L2 |
| **CO3** | Use the knowledge in understanding how gender discrimination works in our society and how to counter it. | L3 |
| **CO4** | Analyzethe gendered division of labour and its relation to politics and | L4 |

| | | |
|---|---|---|
| | economics. | |
| **CO5** | Appraise how gender-role beliefs and sharing behaviour are associated with more well-being in all culture and gender groups | L5 |
| **CO6** | Develop students' sensibility with regard to issues of gender in contemporary India | L3 |

## SYLLABUS

**Unit-1UNDERSTANDING GENDER**

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

**Unit-2GENDER ROLES AND RELATIONS**

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

**Unit-3GENDER AND LABOUR**

Division and Valuation of Labour-Housework: The Invisible Labor- "My Mother doesn't Work." "Share the Load."-Work: Its Politics and Economics -Fact and Fiction- Unrecognized and Unaccounted work -Gender Development Issues-Gender, Governance and Sustainable Development-Gender and Human Rights-Gender and Mainstreaming

**Unit-4GENDER-BASED VIOLENCE**

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

**Unit-5GENDER AND CULTURE**

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

**Prescribed Books**

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

**Reference Books**

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

Online Resources:

1. Understanding Gender

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

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

2. Gender Roles and Relations

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

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

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

3. Gender and Labour

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

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

4. **GENDER-BASED VIOLENCE**

https://eige.europa.eu/gender-based-violence/what-is-gender-based-violence?language_content_entity=en

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

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

5. **GENDER AND CULTURE**

https://gender.study/psychology-of-gender/culture-impact-gender-roles-identities/

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

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

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

# OPEN ELECTIVES

**III B.Tech I Semester**

| Course Code | **GREEN BUILDINGS** | L | T | P | C |
|---|---|---|---|---|---|
| **23A01505a** | **(OPEN ELECTIVE - I)** | 3 | 0 | 0 | 3 |

**Course Objectives :**
**The objectives of this course are to make the student:**

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

**Course Outcomes (COs)**
**Upon successful completion of the course, students will be able to:**

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

CO - PO Articulation Matrix

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

**UNIT – I**

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

**UNIT – II**

Green Building Concepts and Practices– Indian Green Building Council, Green Building Movement in India, Benefits Experienced in Green Buildings, Launch of Green Building Rating Systems, Residential Sector, Market Transformation; Green Building Opportunities and Benefits: Opportunities of Green Buildings, Green Building Features, Material and Resources, Water Efficiency, Optimum Energy Efficiency, Typical Energy-Saving Approaches in Buildings, LEED India Rating System, and Energy Efficiency.

**UNIT – III**

Green Building Design– Introduction, Reduction in Energy Demand, Onsite Sources and Sinks, Maximizing System Efficiency, Steps to Reduce Energy Demand and Use Onsite Sources and Sinks, Use of Renewable Energy Sources, Eco-Friendly Captive Power Generation for Factories, Building Requirements.

**UNIT – IV**

Air Conditioning– Introduction, CII Godrej Green Business Centre, Design Philosophy, Design Interventions, Energy Modeling, HVAC System Design, Chiller Selection, Pump Selection, Selection of Cooling towers, Selection of Air Handling Units, Pre-Cooling of Fresh Air, Interior Lighting Systems, Key Features of The Building, Eco-Friendly Captive Power Generation for Factories, Building Requirements.

**UNIT – V**

Material Conservation– Handling of Non-Process Waste, Waste Reduction During Construction, Materials With Recycled Content, Local Materials, Material Reuse, Certified

| |
|---|
| Wood, Rapidly Renewable Building Materials and Furniture. Indoor Environment Quality and Occupational Health– Air Conditioning, Indoor Air Quality, Sick Building Syndrome, tobacco Smoke. |
| **TEXT BOOKS:** |
| 1. Handbook on Green Practices published by Indian Society of Heating Refrigerating and Air conditioning Engineers, 2009.<br>2. Green Building Hand Book by tom woolley and Sam kimings, 2009. |
| **REFRENCE BOOKS:** |
| 1. Complete Guide to Green Buildings by Trish riley<br>**2.** Standard for the design for High Performance Green Buildings by Kent Peterson, 2009<br>3. Energy Conservation Building Code –ECBC-2020, published by BEE |
| **Online Learning Resources:** |
| https://archive.nptel.ac.in/courses/105/102/105102195/ |

**III B.Tech – I Semester**

| Course Code | **CONSTRUCTION TECHNOLOGY AND MANAGEMENT (OPEN ELECTIVE – I)** | L | T | P | C |
|---|---|---|---|---|---|
| **23A01505b** | | 3 | 0 | 0 | 3 |
| | | | | | |

***Course Objectives:***

**The objectives of this course are to make the student :**

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

***Course Outcomes (COs):***

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

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

**CO – PO Articulation Matrix**

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

**UNIT – I**

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

**UNIT – II**

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

**UNIT – III**

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

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

**III B.Tech I Semester**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**ELECTRICAL SAFETY PRACTICES AND STANDARDS**
**(Open Elective-I)**

**Course Outcomes:**

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

**UNIT I**

**Introduction To Electrical Safety**:

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**:

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**:

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:**

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**:

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

*REFERENCES:*

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.

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

**SUSTAINBLE ENERGY TECHNOLOGIES**

**(Open Elective-I)**

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

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

**UNIT – 1**

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

**SOLAR PV MODULES AND PV SYSTEMS:**

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

**UNIT – 2**

**STORAGE IN PV SYSTEMS:**

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

**UNIT – 3**

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

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

**UNIT – 4**

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

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

**UNIT – 5**

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

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

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

**Text Books:**

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

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

**References:**

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

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

3. Renewable Energy Technologies -Ramesh & Kumar /Narosa

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

**Online Learning Resources:**

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

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

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

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

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

## ELECTRONIC CIRCUITS

**(Open Elective –I)**

**Course Objectives:**

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

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

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

**UNIT-I**

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

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

**UNIT-II**

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

**UNIT-III**

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

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

**UNIT-IV**

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

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

**UNIT-V**

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

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

**TEXT BOOKS:**

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

**REFERENCE BOOKS:**

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

**III B.Tech I Sem**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**MATHEMATICS FOR MACHINE LEARNING AND AI**
**(Open Elective 1)**

**Course Objectives:**

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

**Course Outcomes:**

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

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

## Course Articulation Matrix:

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

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

**UNIT I: Linear Algebra for Machine Learning(08)**

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

**UNIT II: Probability and Statistics for AI(08)**

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

**UNIT III: Optimization Techniques for ML(08)**

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

**UNIT IV: Vector Calculus & Transformations(08)**

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

**UNIT V: Graph Theory for AI(08)**

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

**Textbooks:**

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

**Reference Books:**

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

**Web References:**

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

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

**III B.Tech I Sem**

| | | |
|---|---|---|
| | **MATERIALS CHARACTERIZATION TECHNIQUES**<br>(Common to all branches) (Open Elective-Interdisciplinary)<br>**(Open Elective-I)** | Credits<br>3-0-0:3 |

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

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

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

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

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

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

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

**UNIT IV Spectroscopy techniques 9H**

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

**UNIT V Electrical & Magnetic Characterization techniques 9H**

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

**Textbooks:**

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

**Reference Books:**

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

**NPTEL courses link** :

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

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

Course Articulation Matrix:

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO5** | 3 | 3 | 1 | 1 | - | | | | | | | |

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

**III B.Tech I Sem**

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

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

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

## Mapping between Course Outcomes and Programme Outcomes

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

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

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

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

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

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

**Text books**

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

**Reference Books:**

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

**III B.Tech I Sem**

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

Course Objectives:

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

| Course Outcomes (CO): | Blooms Level |
|---|---|
| By the end of the program students will be able to | |
| ▪ Identify the basics of English grammar and its importance | L1, L2 |
| ▪ Explain the use of grammatical structures in sentences | L1, L2 |
| ▪ Demonstrate the ability to use various concepts in grammar and vocabulary and their applications in everyday use and in competitive exams | L3 |
| ▪ Analyze an unknown passage and reach conclusions about it. | L4 |
| ▪ Choose the appropriate form of verbs in framing sentences | L5 |
| ▪ Develop speed reading and comprehending ability thereby perform better in competitive exams | L3 |

| UNIT - I | **GRAMMAR-1** | Lecture Hrs |
|---|---|---|
| Nouns-classification-errors-Pronouns-types-errors-Adjectives-types-errors-Articles-definite-indefinite-Degrees of Comparison-Adverbs-types- errors-Conjunctions-usage-Prepositions-usage-Tag Questions, types-identifying errors- Practice | | |
| UNIT - II | **GRAMMAR-2** | Lecture Hrs |
| Verbs-tenses- structure-usages- negatives- positives- time adverbs-Sequence of tenses--If Clause-Voice-active voice and passive voice- reported Speech-Agreement- subject and verb-Modals-Spotting Errors-Practices | | |
| UNIT - III | **VERBAL ABILITY** | Lecture Hrs |
| Sentence completion-Verbal analogies-Word groups-Instructions-Critical reasoning-Verbal deduction-Select appropriate pair-Reading Comprehension-Paragraph-Jumbles-Selecting the proper statement by reading a given paragraph. | | |
| UNIT - IV | **READING COMPREHENSION AND VOCUBULARY** | Lecture Hrs |
| Competitive Vocabulary :Word Building – Memory techniques-Synonyms, Antonyms, Affixes-Prefix &Suffix-One word substitutes-Compound words-Phrasal Verbs-Idioms and Phrases-Homophones-Linking Words-Modifiers-Intensifiers - Mastering Competitive Vocabulary- Cracking the unknowing passage-speed reading techniques- Skimming & Scanning-types of answering–Elimination methods | | |
| UNIT - V | **WRITING FOR COMPETITIVE EXAMINATIONS** | Lecture Hrs |

| |
|---|
| Punctuation- Spelling rules- Word order-Sub Skills of Writing- Paragraph meaning-salient features-types - Note-making, Note-taking, summarizing-precise writing- Paraphrasing-Expansion of proverbs-Essay writing-types |
| **Textbooks:** |
| 1. **Wren & Martin, *English for Competitive Examinations*, S.Chand & Co, 2021**<br>2. *Objective English for Competitive Examination*, Tata McGraw Hill, New Delhi, 2014. |
| **Reference Books:**<br>1. Hari Mohan Prasad, *Objective English for Competitive Examination*, Tata McGraw Hill, New Delhi, 2014.<br>2. Philip Sunil Solomon, *English for Success in Competitive Exams*, Oxford 2016<br>3. Shalini Verma , *Word Power Made Handy*, S Chand Publications<br>4. Neira, Anjana Dev & Co. *Creative Writing: A Beginner's Manual*. Pearson Education India, 2008.<br>5. Abhishek Jain,Vocabulary Learning Techniques Vol.I&II,RR Global Publishers 2013.<br>6. Michel Swan, *Practical English Usage*,Oxford,2006. |

**Online Resources**

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

| Course Code | ENTREPRENEURSHIP AND NEW VENTURE CREATION (Open Elective-I) | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

| **COURSE OBJECTIVES:** The objectives of this course are | |
|---|---|
| 1 | To foster an entrepreneurial mind-set for venture creation and intrapreneurial leadership. |
| 2 | To encourage creativity and innovation |
| 3 | To enable them to learn pitching and presentation skills |
| 4 | To make the students understand MVP development and validation techniques to determine Product-Market fit and Initiate Solution design, Prototype for Proof of Concept. |
| 5 | To enhance the ability of analyzing Customer and Market segmentation, estimate Market size, develop and validate Customer Persona |

**UNIT-I: Entrepreneurship Fundamentals and context**

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 – 16industries to choose from), Venture Activity

**LEARNING OUTCOMES**

At the end of the Unit, the learners will be able to

- Understand theconcept of Entrepreneur and Entrepreneurship in India
- Analyze recent trends in Entrepreneurship role in economic development
- Develop a creative mind set and personality in starting a business.

**Unit II: Problem & Customer Identification**

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.

**LEARNING OUTCOMES**

At the end of the Unit, the learners will be able to

- Understand the problem and Customer identification.
- Analyze problem and validating with potential customer

- Evaluate customer segmentation and customer personas

**Unit III: Solution design, Prototyping & Opportunity Assessment and Sizing**

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

**LEARNING OUTCOMES**

At the end if the Unit, the learners will be able to

- Analyze jobs-to-be-done
- Evaluate customer needs to create a strong value proposition
- Design and draw prototyping and MVP

**UNIT-IV: Business & Financial Model, Go-to-Market Plan**

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.

**LEARNING OUTCOMES**

At the end of the Unit, the learners will be able to:

- Understand lean approach in business models
- Apply business plan, sales plan and financial plan
- Analyze financial planning, marketing channels of distribution.
- Design their own venture and source of funds.

**UNIT-V: Scale Outlook and Venture Pitch readiness**

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.

**LEARNING OUTCOMES**

At the end of the Unit, the learners will be able to

- Understand aspiration for scale
- Analyze venture idea and its key components
- Evaluate and build investors ready pitch

**TEXT BOOKS**

1. Robert D. Hisrich, Michael P. Peters, Dean A. Shepherd, Sabyasachi Sinha . *Entrepreneurship*, McGrawHill, 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*
3. *Transforms Organizations and Inspires Innovation*, Harper Business.(2019)
4. Namita Thapar (2022) The Dolphin and the Shark: Stories on Entrepreneurship, Penguin Books Limited
5. Saras D. Sarasvathy, (2008) Effectuation: Elements of Entrepreneurial Expertise, Elgar Publishing Ltd.

**E-RESOURCES**

Learning resource- Ignite 5.0 Course Wadhwani platform (Includes 200+ components of

custom created modular content + 500+ components of the most relevant curated content)

| **COURSE OUTCOMES:** At the end of the course, students will be able to | | **BTL** |
|---|---|---|
| CO1 | Develop an entrepreneurial mindset and appreciate the concept of entrepreneurship | L3 |
| CO2 | Comprehend the process of problem-opportunity identification through design thinking, identify market potential and customers while developing a compelling value proposition solution | L3 |
| CO3 | Analyze and refine business models to ensure sustainability and profitability | L3 |
| CO4 | Build Prototype for Proof of Concept and validate MVP of their practice venture idea | L4 |
| CO5 | Create business plan, conduct financial analysis and feasibility analysis to assess the financial viability of a venture | L5 |
| CO6 | Prepare and deliver an investible pitch deck of their practice venture to attract stakeholders | L6 |

BTL: Bloom’s Taxonomy Level

**III B.Tech. II Semester**

| Course Code | **DISASTER MANAGEMENT (Open Elective – II)** | L | T | P | C |
|---|---|---|---|---|---|
| **23A01606a** | | 3 | 0 | 0 | 3 |

***Course Objectives:***

**The objectives of this course are to make the student :**

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

***Course Outcomes:***

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

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

CO – PO Articulation Matrix

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

**UNIT – I**

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– Climate Change and Its Impact On Tropical Cyclones, Nature of Cyclonic Wind, Velocities and Pressure, Cyclone Effects, Storm Surges, Floods, and Landslides. Behavior of Structuresin 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– 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– 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– 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.

**REFRENCE BOOKS:**

1. Ben Wisner, J.C. Gaillard, andIlanKelman (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. BimalKanti Paul, *Environmental Hazards and Disasters: Contexts, Perspectives and*

| |
|---|
| *Management*, 2nd Edition, Wiley-Blackwell, 2020. |
| **Online Learning Resources:** |
| https://nptel.ac.in/courses/124107010<br>https://onlinecourses.swayam2.ac.in/cec19_hs20/preview |

**III B.Tech – II Semester**

| Course Code | **SUSTAINABILITY IN ENGINEERING PRACTICES (OE – II)** | L | T | P | C |
|---|---|---|---|---|---|
| **23A01606b** | | 3 | 0 | 0 | 3 |

***Course Objectives:***

**The objectives of this course are to make the student :**

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

***Course Outcomes:***

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

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

CO – PO Articulation Matrix

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

**UNIT – I**

**INTRODUCTION**

Introduction and Definition of Sustainability - Carbon Cycle - Role of Construction Material: Concrete and Steel, Etc. - $CO_2$Contribution From Cement and Other Construction Materials.

**UNIT – II**

**MATERIALS USED in SUSTAINABLE CONSTRUCTION**

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**

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**

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**

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.

**REFRENCE BOOKS:**

1. Craig A. Langston & Grace K.C. Ding, Sustainable Practicesin 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/

**III B.Tech. II Semester**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

## RENEWABLE ENERGY SOURCES
## (Open Elective-II)

Course Outcomes (CO): At the end of the course the student will be able to:

CO 1: Understand principle operation of various renewable energy sources. L1
CO 2: Identify site selection of various renewable energy sources. L2
CO 3: Analyze various factors affecting on solar energy measurements, wind energy conversion techniques, Geothermal, Biomasss, Tidal Wave and Fuel cell energies L3
CO 4: Design of Solar PV modules and considerations of horizontal and vertical axis Wind energy systems. L5
CO 5: Apply the concepts of Geo Thermal Energy, Ocean Energy, Bio mass and Fuel Cells for generation of power. L4

**UNIT I Solar Energy:**

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:**

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:**

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:**

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

**UNIT – V Miscellaneous Energy Technologies:**

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:

1. https://nptel.ac.in/courses/103103206
2. https://nptel.ac.in/courses/108108078

**III B. Tech -II Sem** **L T P C**
**3 0 0 3**

**AUTOMATION AND ROBOTICS**
(Open Elective – II)

| | |
|---|---|
| **Course objectives:** The objectives of the course are to | |
| 1 | Fundamentals of industrial automation, production types, automation strategies, and hardware elements used in modern manufacturing processes. |
| 2 | Understanding of automated manufacturing systems, and strategies for improving productivity and flexibility in industrial automation. |
| 3 | Knowledge of industrial automation and robotics, sensors, and end-effector design for modern manufacturing environments. |
| 4 | Explain industrial automation and robotics, and trajectory planning for intelligent and efficient manufacturing applications. |
| 5 | Familiarity of industrial automation and robotics, and practical applications in manufacturing processes. |

| | | |
|---|---|---|
| **COURSE OUTCOMES** On successful completion of this course the student will be able to | | |
| 1 | derstand and analyze the structure and functions of automated manufacturing systems, and evaluate hardware components for efficient production. | *L2,L4,L5* |
| 2 | alyze and design automated flow lines with or without buffer storage, perform quantitative evaluations, apply assembly line balancing techniques. | L4,L5,L6 |
| 3 | assify robot configurations, select suitable actuators and sensors, analyze and apply automation and robotics principles to optimize production efficiency and flexibility. | L2,L3,L4 |
| 4 | ply 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. | L3,L4,L5 |
| 5 | sign, program, and implement robotic systems, understand and apply robotics technology to manufacturing tasks. | L1,L3,L6 |

**UNIT-I**

**Introduction to Automation:**

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**:

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:**

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:**

Manipulator Kinematics, Homogenous transformations as applicable to rotation and transition - 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:**

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.
3.

**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=PLRLB5WCqU54UJG45UnazSYmnmhl-gt76o

**https://www.youtube.com/watch?v=6f3bvIhSWyM&list=PLRLB5WCqU54X5Vy4DwjfSODT3ZJgwEjyE**

**III B.Tech II Sem**

**L – T – P – C** **3 – 0 – 0 – 3**

## DIGITAL ELECTRONICS
## (Open Elective –II)

**Course Objectives:**

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

**Course Outcomes:**

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

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

**UNIT-I**

**Logic Simplification and Combinational Logic Design**: 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**: 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:** Decoders, Encoders, Priority Encoder, Multiplexers, Demultiplexers, Comparators, Implementations of Logic Functions using Decoders and Multiplexers.

**UNIT-IV**

**Sequential Logic Design**: 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:**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.

**III B.Tech II Sem**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

## OPTIMIZATION TECHNIQUES
## (Open Elective -II)

**Course Outcomes:**

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

| COs | Statements | Blooms level |
|---|---|---|
| **CO1** | Understand the meaning, purpose, tools of Operations Research and linear programming in solving practical problems in industry. | L2, L3 |
| **CO2** | Interpret the transportation models' solutions and infer solutions to the real-world problems. | L3, L5 |
| **CO3** | Develop mathematical skills to analyze and solve nonlinear programming models arising from a wide range of applications. | L3 |
| **CO4** | Apply the concept of non-linear programming for solving the problems involving non-linear constraints and objectives | L2, L3 |
| **CO5** | Apply the concept of unconstrained geometric programming for solving the problems involving non-linear constraints and objectives. | L3,L5 |

### Course Articulation Matrix:

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

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

**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

**III B.Tech II Sem**

| | **PHYSICS OF ELECTRONIC MATERIALS AND DEVICES**<br>(Common to all branches)<br>Open Elective-II | Credits<br>3-0-0:3 |
|---|---|---|

| **Course Objectives** | |
|---|---|
| 1 | To make the students to understand the concept of crystal growth, defects in crystals and thin films. |
| 2 | To provide insight into various semiconducting materials and their properties. |
| 3 | To develop a strong foundation in semiconductor physics and device engineering. |
| 4 | To elucidate excitonic and luminescent processes in solid-state materials. |
| 5 | To understand the principles, technologies, and applications of modern display systems. |

## Syllabus:

**UNIT-I Fundamentals of Materials Science** **9H**

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** **9H**

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:** **9H**

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

**UNIT IV Excitons and Luminescence:** **9H**

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 :** **9H**

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

**Textbooks:**

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, DhanpatRai 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**

| | Course Outcomes | Blooms Level |
|---|---|---|
| **CO1** | Understand crystal growth and thin film preparation | L1,L2 |
| **CO2** | Summarize the basic concepts of semiconductors | L1,L2 |
| **CO3** | Illustrate the working of various semiconductor devices | L1,L2, L3 |
| **CO4** | Analyze various luminescent phenomena and the devices based on these concepts | L1,L2, L3 |
| **CO5** | Explain the working of different display devices | L1,L2 |

**Course Articulation Matrix:**

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

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

**III B.Tech –II Sem**

| | **CHEMISTRY OF POLYMERS AND APPLICATIONS**<br>(Common to all branches)<br>Open Elective-II | Credits<br>3-0-0:3 |
|---|---|---|

| **Course Objectives** | |
|---|---|
| 1 | To understand the basic principles of polymers |
| 2 | To understand natural polymers and their applications. |
| 3 | To impart knowledge to the students about synthetic polymers, their preparation and importance. |
| 4 | To enumerate the applications of hydogel polymers |
| 5 | To enumerate applications of conducting and degradable polymers in engineering. |

| **Course Outcomes** | |
|---|---|
| CO1 | Classify the polymers, Explain polymerization mechanism, Differentiate addition, condensation polymerizations, Describe measurement of molecular weight of polymer |
| CO2 | Describe the physical and chemical properties of natural polymers and Modified cellulosics. |
| CO3 | Differentiate Bulk, solution, Suspension and emulsion polymerization, Describe fibers and elastomers, Identify the thermosetting and thermo polymers. |
| CO4 | Identify types of polymer networks, Describe methods involve in hydrogel preparation, Explain applications of hydrogels in drug delivery, |
| CO5 | Explain classification and mechanism of conducting and degradable polymers. |

**Mapping between Course Outcomes and Programme Outcomes**

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

**Unit – I: Polymers-Basics and Characterization:-**

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**

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**

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**

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:**

**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. A Text book of Polymer science, Billmayer
2. Polymer Chemistry – G.S.Mishra
3. Polymer Chemistry – Gowarikar

**References Books:**

1. Organic polymer Chemistry, K.J.Saunders, Chapman and Hall
2.Advanced Organic Chemistry, B.Miller, Prentice Hall
3. Polymer Science and Technology by Premamoy Ghosh, 3rd edition, McGraw-Hill, 2010.

**III B.Tech –II Sem**

| | **ACADEMIC WRITING AND PUBLIC SPEAKING (Common to All Branches of Engineering) OPEN ELECTIVE - II** | **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 develop analytical skills
- To deliver effective public speeches

| Course Outcomes (CO): | Blooms Level |
|---|---|
| By the end of the program students will be able to | |
| • Understand various elements of Academic Writing | L1, L2 |
| • Identify sources and avoid plagiarism | L1, L2 |
| • Demonstrate the knowledge in writing a Research paper | L3 |
| • Analyse different types of essays | L4 |
| • Assess the speeches of others and know the positive strengths of speakers | L5 |
| • Build confidence in giving an impactful presentation to the audience | L3 |

| UNIT - I | Introduction to Academic Writing | Lecture Hrs |
|---|---|---|

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** | Lecture Hrs |
|---|---|---|

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** | Lecture Hrs |
|---|---|---|

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 | Lecture Hrs |
|---|---|---|

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 | Lecture Hrs |
|---|---|---|

Body Language – Facial Expressions-Kinesics – Oculesics – Proxemics – Haptics – Chronomics - Paralanguage - Signs

**Textbooks:**

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

**ference Books:**

1. Alice Savage, Masoud Shafiei *Effective Academic Writing,**2Ed.,***2014 .sserP 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. phttps://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/

**IV B.Tech – I Semester**

| Course Code | **BUILDING MATERIALS AND SERVICES (OPEN ELECTIVE – III)** | L | T | P | C |
|---|---|---|---|---|---|
| **23A01705a** | | 3 | 0 | 0 | 3 |
| | | | | | |

***Course Objectives:***

**The objectives of this course are to make the student :**

1. To understand the properties, classifications, and applications of building materials like stones, bricks, tiles, wood, aluminum, glass, paints, and plastics.
2. To analyze the composition, manufacturing process, and properties of cement and admixtures.
3. To apply knowledge of building components such as lintels, arches, walls, stairs, floors, roofs, foundations, and joinery.
4. To evaluate masonry, mortars, finishing techniques, and formwork systems.
5. To assess various building services including plumbing, ventilation, air conditioning, acoustics, and fire protection.

***Course Outcomes:***

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

1. Understand the properties, classifications, and applications of building materials like stones, bricks, tiles, wood, aluminum, glass, paints, and plastics.
2. Analyze the composition, manufacturing process, and properties of cement and admixtures.
3. Apply knowledge of building components such as lintels, arches, walls, stairs, floors, roofs, foundations, and joinery.
4. Evaluate masonry, mortars, finishing techniques, and formwork systems.
5. Assess various building services including plumbing, ventilation, air conditioning, acoustics, and fire protection.

CO – PO Articulation Matrix

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

**UNIT – I**

StonesandBricks, Tiles: Building Stones – Classifications and Quarrying – Properties – Structural Requirements – Dressing. Bricks – CompositionofBrick Earth – Manufacture and Structural Requirements, Fly Ash, Ceramics. Timber, Aluminum, Glass, PaintsandPlastics: Wood - Structure – Types and Properties – Seasoning – Defects; Alternate Materials for Timber – GI / Fibre – Reinforced Glass Bricks, Steel & Aluminum, Plastics.

**UNIT – II**

Cement &Admixtures: Types of Cement - Ingredients of Cement – Manufacture – Chemical Composition – Hydration - Field & Lab Tests – Fineness – Consistency – Initial &Final Setting – Soundness . Admixtures – Mineral & Chemical Admixtures – Uses

**UNIT – III**

Building Components: Lintels, Arches, Walls, Vaults – Stair Cases – Types of Floors, Types of Roofs – Flat, Curved, Trussed; Foundations – Types; Damp Proof Course; Joinery – Doors – Windows – Materials – Types.

**UNIT – IV**

| |
|---|
| Mortars, MasonryandFinishing's Mortars: Lime and Cement Mortars Brick Masonry – Types – Bonds; Stone Masonry – Types; Composite Masonry – Brick-Stone Composite; Concrete, Reinforced Brick. Finishers: Plastering, Pointing, Painting, Claddings – Types – Tiles – ACP.form Work: Types: Requirements – Standards – Scaffolding – Design; Shoring, Underpinning. |
| **UNIT – V** |
| Building Services: Plumbing Services: Water Distribution, Sanitary – Lines &Fittings; Ventilations: Functional Requirements Systems of Ventilations. Air-Conditioning - Essentials andTypes; Acoustics – Characteristic – Absorption – Acoustic Design; Fire Protection – Fire Hazards – Classification of Fire Resistant Materials and Constructions. |
| **TEXT BOOKS:** |
| 1. Building Materials and Construction – Arora&Bindra, Dhanpat Roy Publications.<br>2. Building Materials and Construction by G C Sahu, Joygopal Jena McGraw hill Pvt Ltd 2015. |
| **REFRENCE BOOKS:** |
| 1. Building Construction by B. C. Punmia, Ashok Kumar Jain andArun Kumar Jain - Laxmi Publications (P) ltd., New Delh<br>2. P. C. Varghese, Building Materials, Prentice Hall of India, 2015.<br>3. N.Subramanian ,"Building Materials Testing and Sustainability", Oxford Higher Education, 2019.<br>4. R. Chudley, Construction Technology, Longman Publishing Group, 1973.<br>5. S. K. Duggal, Building Materials, Oxford & IBH Publishing Co. Ltd., New Delhi, 2019 |
| **Online Learning Resources:** |
| https://archive.nptel.ac.in/courses/105/102/105102088/ |

**IV B.Tech – I Semester**

| Course Code | **ENVIRONMENTAL IMPACT ASSESSMENT (OPEN ELECTIVE – III)** | L | T | P | C |
|---|---|---|---|---|---|
| **23A01705b** | | 3 | 0 | 0 | 3 |

**Course Objectives:**

**The objectives of this course are to make the student to:**

1. Understand the principles, methodologies, and significance of Environmental Impact Assessment (EIA).
2. Analyze the impact of developmental activities on land use, soil, and water resources.
3. Evaluate the impact of development on vegetation, wildlife, and assess environmental risks.
4. Develop environmental audit procedures and assess compliance with environmental regulations.
5. Understand and apply environmental acts, notifications, and legal frameworks in EIA studies.

**Course Outcomes (COs):**

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

1. Apply various methodologies for conducting Environmental Impact Assessments.
2. Analyze the impact of land-use changes on soil, water, and air quality.
3. Evaluate the environmental impact on vegetation, wildlife, and conduct risk assessments.
4. Develop environmental audit reports and assess compliance with environmental policies.
5. Interpret and apply environmental acts and regulations related to EIA.

CO – PO Articulation Matrix

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

**UNIT – I**

**Concepts and methodologies of EIA**

Initial Environmental Examination, Elements of EIA, - Factors Affecting E-I-A Impact Evaluation and Analysis, Preparation of Environmental Base Map, Classification of Environmental Parameters- Criteria for The Selection of EIA Methodology, E I A Methods, Ad-Hoc Methods, Matrix Methods, Network Method Environmental Media Quality Index Method, Overlay Methods and Cost/Benefit Analysis.

**UNIT – II**

**Impact of Developmental Activities and Land Use**

Introduction and Methodology for The Assessment of Soil and Ground Water, Delineation of Study Area, Identification of Actives. Procurement of Relevant Soil Quality, Impact Prediction, Assessment of Impact Significance, Identification and Incorporation of Mitigation Measures. E I Ain Surface Water, Air and Biological Environment: Methodology for The Assessment of Impacts On Surface Water Environment, Air Pollution Sources, Generalized Approach for Assessment of Air Pollution Impact.

**UNIT – III**

**Assessment of Impact On Vegetation, Wildlife and Risk Assessment**

Introduction - Assessment of Impact of Development Activities On Vegetation and Wildlife,

Environmental Impact of Deforestation – Causes and Effects of Deforestation - Risk Assessment and Treatment of Uncertainty-Key Stages in Performing An Environmental Risk Assessment- Advantages of Environmental Risk Assessment.

**UNIT – IV**

**Environmental Audit**

Introduction - Environmental Audit & Environmental Legislation Objectives of Environmental Audit, Types of Environmental Audit, Audit Protocol, Stages of Environmental Audit, Onsite Activities, Evaluation of Audit Data and Preparation of Audit Report

**UNIT – V**

**Environmental Acts and Notifications**

The Environmental Protection Act, The Water Preservation Act, The Air (Prevention &Control of Pollution Act), Wild Life Act - Provisions in The EIA Notification, Procedure for Environmental Clearance, Procedure for Conducting Environmental Impact Assessment Report- Evaluation of EIA Report. Environmental Legislation Objectives, Evaluation of Audit Data and Preparation of Audit Report. Post Audit Activities, ConceptofISO and ISO 14000.

**TEXT BOOKS:**

1. Environmental Impact Assessment Methodologies, by Y. Anjaneyulu, B. S. Publication, Hyderabad 2nd edition 2011
2. Environmental Impact Assessment, by Canter Larry W., McGraw-Hill education Edi (1996)

**REFRENCE BOOKS:**

1. Environmental Engineering, by Peavy, H. S, Rowe, D. R, Tchobanoglous, G.Mc-Graw Hill International Editions, New York 1985.
2. Environmental Science and Engineering, by Suresh K. Dhaneja, S.K., Katania& Sons Publication, New Delhi
3. Environmental Science and Engineering, by J. Glynn and Gary W. Hein Ke, Prentice Hall Publishers.
4. Environmental Pollution and Control, by H. S. Bhatia, Galgotia Publication (P) Ltd, Delhi

**Online Learning Resources:**

https://archive.nptel.ac.in/courses/124/107/124107160/

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

## SMART GRID TECHNOLOGIES
**(Open Elective- III)**

Course Outcomes:

CO1: Understanding the Concept and Evolution of Smart Grids. L2

CO2: Analyzing Wide Area Monitoring System and Synchrophasor Technology. L4
CO3: Applying Smart Metering and Advanced Metering Infrastructure (AMI) Concepts. L3
CO4: Evaluating Information and Communication Technology (ICT) Systems in Smart Grids. L5
CO5: Designing Smart Grid Applications and Cybersecurity Measures. L6

**UNIT I Introduction to Smart Grid :**
Evolution of Electric Grid – Need for Smart Grid – Difference between conventional & smart grid – Overview of enabling technologies – International experience in Smart Grid deployment efforts – Smart Grid road map for India – Smart Grid Architecture.

**UNIT II Wide Area Monitoring System :**
Fundamentals of Synchro phasor Technology – concept and benefits of Wide Area Monitoring System – Structure and functions of Phasor Measuring Unit (PMU) and Phasor Data Concentrator (PDC) – Road Map for Synchrophasor applications (NAPSI) – Operational experience and Blackout analysis using PMU - Case study on PMU.

**UNIT III Smart Meters:**
Features and functions of Smart Meters – Functional specification – category of Smart Meters – Automatic Meter Reading (AMR) and Advanced Metering Infrastructure (AMI) drivers and benefits – AMI protocol – Demand Side Integration: Peak load, Outage and Power Quality management.

**UNIT IV Information and Communication Technology:**
Overview of Smart Grid Communication system – Modulation and Demodulation Techniques: Radio Communication – Mobile Communication – Power Line Communication – Optical Fibre Communication – Communication Protocol for Smart Grid.

UNIT V
Smart Grid Applications and Cyber Security: Applications : Overview and concept of Renewable Integration – Introduction to distributed generation - Role of Protective Relaying in Smart Grid – House Area Network – Advanced Energy Storage Technology: Flow battery – Fuel cell – SMES – Super capacitors – Plug – in Hybrid electric Vehicles - Cyber Security: Security issues in DG, Distribution Automation, AMI, Electric Vehicle Management Systems – Approach to assessment of smart grid cyber security risks – Methodologies. Cyber Security requirements – Smart Grid Information Model.

TEXT BOOKS:

1. James Momoh, "SMART GRID : Fundamentals of Design and Analysis", John Wiley and Sons, New York, 2012.
2. Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, Jianzhong Wu, Akihiko Yokoyama, "Smart Grid: Technology and Applications", John Wiley & Sons, New Jersey, 2012.

REFERENCES:

1. Power Grid Corporation of India Limited, "Smart Grid Primer", 1st Edition, Power Grid Corporation of India Limited, Bangalore, India, 2013.

2. Fereidoon.P.Sioshansi, "Smart Grid – Integrating Renewable, Distributed and Efficient Energy", 1st Edition, Academic Press, USA, 2011.

3. Stuart Borlase, "Smart Grids: Infrastructure, Technology and Solutions", 1st Edition, CRC Press Publication, England, 2013.

4. Phadke A G, Thorp J S, "Synchronized Phasor Measurements and Their Applications", 1st Edition, Springer, Newyork, 2012.

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

## 3D PRINTING TECHNOLOGIES
## (Open Elective-III).

| **Course objectives:** The objectives of the course are to | |
|---|---|
| 1 | **Understand** the fundamental concepts of prototyping and distinguish between traditional and rapid prototyping methods. |
| 2 | **Demonstrate** the working principles, materials, and applications of solid-, liquid-, and powder-based RP |

| | |
|---|---|
| | systems. |
| 3 | **Define** the processes and classifications of rapid tooling and reverse engineering techniques. |
| 4 | **Identify** common errors in 3D printing and evaluate pre-processing, processing, and post-processing issues. |
| 5 | **Familiarize** RP-related software and its role in applications such as design, manufacturing, and medical fields. |

| **Course Outcomes:** On successful completion of the course, the student will be able to, | | |
|---|---|---|
| 1 | Define and explain the evolution and need for rapid prototyping in modern product development. | L1,L2,L6 |
| 2 | Compare and contrast various 3D printing technologies based on working principles, materials, and limitations. | L2,L4 |
| 3 | Apply knowledge of rapid tooling and reverse engineering techniques for industrial and design applications. | L3,L5,L6 |
| 4 | Diagnose and interpret different types of errors encountered in 3D printing processes and recommend solutions. | L2,L3,L5, |
| 5 | Use RP-specific software tools to manipulate STL files and prepare models for printing in real-world scenarios. | L1,L3,L6 |

**UNIT I Introduction to 3D Printing**
Introduction to Prototyping, Traditional Prototyping Vs. Rapid Prototyping (RP), Need for time compression in product development, Usage of RP parts, Generic RP process, Distinction between RP and CNC, other related technologies, Classification of RP.

**UNIT II Solid and Liquid Based RP Systems**
Working Principle, Materials, Advantages, Limitations and Applications of Fusion Deposition Modelling (FDM), Laminated Object Manufacturing (LOM), Stereo lithography (SLA), Direct Light Projection System (DLP) and Solid Ground Curing (SGC).

**UNIT III Powder Based & Other RP Systems**
Powder Based RP Systems: Working Principle, Materials, Advantages, Limitations and Applications of Selective Laser Sintering (SLS), Direct Metal Laser Sintering (DMLS), Laser Engineered Net Shaping (LENS) and Electron Beam Melting (EBM).
Other RP Systems: Working Principle, Materials, Advantages, Limitations and Applications of Three Dimensional Printing (3DP), Ballastic Particle Manufacturing (BPM) and Shape Deposition Manufacturing (SDM).

**UNIT IV Rapid Tooling & Reverse Engineering**
Rapid Tooling: Conventional Tooling Vs. Rapid Tooling, Classification of Rapid Tooling, Direct and Indirect Tooling Methods, Soft and Hard Tooling methods.
Reverse Engineering (RE): Meaning, Use, RE – The Generic Process, Phases of RE Scanning, Contact Scanners and Noncontact Scanners, Point Processing, Application Geometric Model, Development

**UNIT V**
**Errors in 3D Printing and Applications:**
Pre-processing, processing and post-processing errors, Part building errors in SLA, SLS, etc. Software: Need for software, MIMICS, Magics, SurgiGuide, 3-matic, 3D-Doctor, Simplant, Velocity2, VoXim, Solid View, 3DView, etc., software, Preparation of CAD models, Problems with STL files, STL file manipulation, RP data formats: SLC, CLI, RPI, LEAF, IGES, HP/GL, CT, STEP. Applications: Design, Engineering Analysis and planning applications, Rapid Tooling, Reverse Engineering, Medical Applications of RP.

**Textbooks:**

1. Chee Kai Chua and Kah Fai Leong, "3D Printing and Additive Manufacturing Principles and Applications" 5/e, World Scientific Publications, 2017.
2. Ian Gibson, David W Rosen, Brent Stucker, "Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing", Springer, 2/e, 2010.

**Reference Books:**

1. Frank W.Liou, "Rapid Prototyping & Engineering Applications", CRC Press, Taylor & Francis Group, 2011.
2. Rafiq Noorani, "Rapid Prototyping: Principles and Applications in Manufacturing", John Wiley&Sons, 2006.

**Online Learning Resources**:

- NPTEL Course on Rapid Manufacturing.
- https://nptel.ac.in/courses/112/104/112104265/
- https://www.hubs.com/knowledge-base/introduction-fdm-3d-printing/
- https://slideplayer.com/slide/6927137/
- https://www.mdpi.com/2073-4360/12/6/1334
- https://www.centropiaggio.unipi.it/sites/default/files/course/material/2013-11-29%20-
- %20FDM.pdf
- https://lecturenotes.in/subject/197
- https://www.cet.edu.in/noticefiles/258_Lecture%20Notes%20on%20RP-ilovepdfcompressed.pdf
- https://www.vssut.ac.in/lecture_notes/lecture1517967201.pdf
- https://www.youtube.com/watch?v=NkC8TNts4B4.

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

## MICROPROCESSORS AND MICROCONTROLLERS

**(Open Elective –III)**

**Course Objectives:**

1. To comprehend the architecture, operation, and configurations of the 8086 microprocessors.
2. To get familiar with 8086 programming concepts, instruction set, and assembly language development tools.

3. To study the interfacing of 8086 with memory, peripherals, and controllers for various applications.
4. To learn the architecture, instruction set, and programming of the 8051 microcontrollers.
5. To understand microcontroller interfacing techniques, peripheral programming, and processor comparisons.

**Course Outcomes:**

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

1. Gain knowledge on the architecture, operation, and configurations of the 8086 microprocessors.
2. Get familiar with 8086 programming concepts, instruction set, and assembly language development tools.
3. Know the interfacing of 8086 with memory, peripherals, and controllers for various applications.
4. Learn the architecture, instruction set, and programming of the 8051 microcontrollers.
5. Understand microcontroller interfacing techniques, peripheral programming, and processor comparisons.

**UNIT I**

**8086 Architecture**: Main features, pin diagram/description, 8086 microprocessor family, internal architecture, bus interfacing unit, execution unit, interrupts and interrupt response, 8086 system timing, minimum mode and maximum mode configuration.

**UNIT II**

**8086 Programming**: Program development steps, instructions, addressing modes, assembler directives, writing simple programs with an assembler, assembly language program development tools.

**UNIT III**

**8086 Interfacing**: Semiconductor memories interfacing (RAM, ROM), Intel 8255 programmable peripheral interface, Interfacing switches and LEDS, Interfacing seven segment displays, software and hardware interrupt applications, Intel 8251 USART architecture and interfacing, Intel 8237a DMA controller, stepper motor, A/D and D/A converters, Need for 8259 programmable interrupt controllers.

**UNIT IV**

Microcontroller - Architecture of 8051 – Special Function Registers(SFRs) - I/O Pins Ports and Circuits - Instruction set - Addressing modes - Assembly language programming.

**UNIT V**

Interfacing Microcontroller - Programming 8051 Timers - Serial Port Programming - Interrupts Programming – LCD & Keyboard Interfacing - ADC, DAC & Sensor Interfacing - External Memory Interface- Stepper Motor and Waveform generation - Comparison of Microprocessor, Microcontroller, PIC and ARM processors

**Textbooks**:

1. Microprocessors and Interfacing – Programming and Hardware by Douglas V Hall, SSSP Rao, Tata McGraw Hill Education Private Limited, 3rdEdition,1994.
2. K M Bhurchandi, A K Ray, Advanced Microprocessors and Peripherals, 3rd edition, McGraw Hill Education, 2017.
3. Raj Kamal, Microcontrollers: Architecture, Programming, Interfacing and System Design, 2nd edition, Pearson, 2012.

**References:**

1. Ramesh S Gaonkar, Microprocessor Architecture Programming and Applications with the 8085, 6th edition, Penram International Publishing, 2013.
2. Kenneth J. Ayala, The 8051 Microcontroller, 3rd edition, Cengage Learning, 2004.

**IV B.Tech I Sem**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

## WAVELET TRANSFORMS AND ITS APPLICATIONS

**(Open Elective-III)**

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

| COs | Statements | Blooms level |
|---|---|---|
| **CO1** | Understand wavelets and wavelet basis and characterize continuous and discrete wavelet transforms | L2, L3 |
| **CO2** | Illustrate the multi resolution analysis ad scaling functions | L3, L5 |
| **CO3** | Implement discrete wavelet transforms with multirate digital filters | L3 |
| **CO4** | Understand multi resolution analysis and identify various wavelets and evaluate their time- frequency resolution properties. | L2, L3 |
| **CO5** | Design certain classes of wavelets to specification and justify the basis of the application of wavelet transforms to different fields | L3,L5 |

Course Articulation Matrix:

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

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

**UNIT – I: Wavelets (08)**

Wavelets and Wavelet Expansion Systems - Wavelet Expansion- Wavelet Transform- Wavelet System- More Specific Characteristics of Wavelet Systems -Haar Scaling Functions and Wavelets - effectiveness of Wavelet Analysis -The Discrete Wavelet Transform- The Discrete-Time and Continuous Wavelet Transforms.

**UNIT – II: A Multiresolution Formulation of Wavelet Systems (08)**

Signal Spaces -The Scaling Function -Multiresolution Analysis - The Wavelet Functions - The Discrete Wavelet Transform- A Parseval's Theorem - Display of the Discrete Wavelet Transform and the Wavelet Expansion.

**UNIT – III Filter Banks and the Discrete Wavelet Transform (08)**

Analysis - From Fine Scale to Coarse Scale- Filtering and Down-Sampling or Decimating -Synthesis - From Coarse Scale to Fine Scale -Filtering and Up-Sampling or Stretching - Input Coefficients - Lattices and Lifting - -Different Points of View.

**UNIT – IV Time-Frequency and Complexity (08)**

Multiresolution versus Time-Frequency Analysis- Periodic versus Nonperiodic Discrete Wavelet Transforms -The Discrete Wavelet Transform versus the Discrete-Time Wavelet Transform- Numerical Complexity of the Discrete Wavelet Transform.

**UNIT-V Bases and Matrix Examples** **(08)**

Bases, Orthogonal Bases, and Biorthogonal Bases -Matrix Examples - Fourier Series Example - Sine Expansion Example - Frames and Tight Frames - Matrix Examples -Sine Expansion as a Tight Frame Example.

**TEXT BOOK:**

1. C. Sidney Burrus, Ramesh A. Gopinath, "Introduction to Wavelets and Wavelets Transforms", Prentice Hall, (1997).
2. James S. Walker, "A Primer on Wavelets and their Scientific Applications", CRC Press, (1999)..

**REFERENCES:**

1. RaghuveerRao, "Wavelet Transforms", Pearson Education, Asia
2. C. S. Burrus, Ramose and A. Gopinath, Introduction to Wavelets and Wavelet Transform, Prentice Hall Inc.

1. http://users.rowan.edu/~polikar/WAVELETS/WTtutorial.html

2. http://www.wavelet.org/

3. http://www.math.hawaii.edu/~dave/Web/Amara's%20Wavelet%20Page.htm

4. https://jqichina.wordpress.com/wp-content/uploads/2012/02/ten-lectures-of-waveletsefbc88e5b08fe6b3a2e58d81e8aeb2efbc891.pdf

**IV B.Tech I Sem**

| | | |
|---|---|---|
| | **SMART MATERIALS AND DEVICES**<br>(Common to all branches)<br>**Open Elective-III** | Credits<br>3-0-0:3 |

| Course Objectives | |
|---|---|
| 1 | To provide exposure to smart materials and their engineering applications. |
| 2 | To impart knowledge on the basics and phenomenon behind the working of smart materials |
| 3 | To explain the properties exhibited by smart materials |
| 4 | To educate various techniques used to synthesize and characterize smart materials |
| 5 | To identify the required smart material for distinct applications/devices |

**UNIT I Introduction to Smart Materials** **9H**

Historical account of the discovery and development of smart materials, Shape memory materials, chromoactive materials, magnetorheological materials, photoactive materials, Polymers and polymer composites (Basics).

**UNIT II Properties of Smart Materials** **9H**

Optical, Electrical, Dielectric, Piezoelectric, Ferroelectric, Pyroelectric and Magnetic properties of smart materials.

**UNIT III Synthesis of Smart Materials** **9H**

Chemical route: Chemical vapour deposition, Sol-gel technique, Hydrothermal method, Mechanical alloying and Thin film deposition techniques: Chemical etching, Spray pyrolysis.

**UNIT IV Characterization Techniques** **9H**

Powder X-ray diffraction, Raman spectroscopy (RS), UV-Visible spectroscopy, Scanning electron microscopy (SEM), Transmission electron microscopy (TEM), Atomic force microscopy (AFM).

**UNIT V Smart Materials based Devices** **9H**

Devices based on smart materials: Shape memory alloys in robotic hands, piezoelectric based devices, MEMS and intelligent devices.

**Textbooks:**

1. YaserDahman, Nanotechnology and Functional Materials for Engineers-, Elsevier, 2017
2. E. Zschech,C. Whelan, T. Mikolajick, Materials for Information Technology: Devices, Interconnects and Packaging Springer-Verlag London Limited 2005.

**Reference Books:**

1. Gauenzi,P.,Smart Structures, Wiley, 2009.
2. MahmoodAliofkhazraei, Handbook of functional nanomaterials, Vol (1&2), Nova Publishers, 2014
3. **Handbook of Smart Materials, Technologies, and Devices: Applications of Industry,4.0,**Chaudhery MustansarHussain, Paolo Di Sia, Springer,2022.
4.**Fundamentals of Smart Materials,**Mohsen Shahinpoor, Royal Society of Chemistry, 2020

**NPTEL course link:** https://onlinecourses.nptel.ac.in/noc22_me17/preview

| | Course Outcomes | Blooms Level |
|---|---|---|
| **CO1** | Identify key discoveries that led to modern applications of shape memory materials, describe the two phases in shape memory alloys. | L1,L2, L3, L4 |
| **CO2** | Describe how different external stimuli (light, electricity, heat, stress, and | L1,L2, L3 |

| | | |
|---|---|---|
| | magnetism) influence smart material properties. | |
| **CO3** | Summarize various types of synthesis of smart materials | L1,L2, L3 |
| **CO4** | Analyze various characterization techniques used for smart materials | L1,L2, L3 |
| **CO5** | Interpret the importance of smart materials in various devices | L1,L2 |

**Course Articulation Matrix:**

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

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

**IV B.Tech I Sem**

| | | |
|---|---|---|
| | **GREEN CHEMISTRY AND CATALYSIS FOR SUSTAINABLE ENVIRONMENT**<br>(Common to all branches)<br>**Open Elective-III** | Credits<br>3-0-0:3 |

| Course Objectives | |
|---|---|
| 1 | **TO UNDERSTAND PRINCIPLE AND CONCEPTS OF GREEN CHEMISTRY.** |
| 2 | **TO UNDERSTAND THE TYPES OF CATALYSIS AND INDUSTRIAL APPLICATIONS.** |
| 3 | **TO APPLY GREEN SOLVENTS IN CHEMICAL SYNTHESIS.** |
| 4 | **TO ENUMERATE DIFFERENT SOURCED OF GREEN ENERGY.** |
| 5 | **TO APPLY ALTERNATIVE GREENER METHODS FOE CHEMICAL REACTIONS** |

| Course Outcomes | |
|---|---|
| CO1 | Apply the Green chemistry Principles for day to day life as well as synthesis, describe the sustainable development and green chemistry, Explain economic and un-economic reactions, Demonstrate Polymer recycling. |
| CO2 | Explain Heterogeneous catalyst and its applications in Chemical and Pharmaceutical Industries, Differentiate Homogeneous and Heterogeneous catalysis, Identify the importance of Bio and Photo Catalysis, Discuss Transition metal and Phase transfer Catalysis |
| CO3 | Demonstrate Green solvents and importance, Discuss Supercritical carbondioxide, Explain Supercritical water, recycling of green solvents. |
| CO4 | Describe importance of Biomass and Solar Power, Illustrate Sonochemistry, Apply Green Chemistry for Sustainable Development; discuss the importance of Renewable resources, mechanochemical synthesis. |
| CO5 | Discuss Alternative green methods like Photoredox catalysis, single electron transfer reactions (SET), Photochemical Reactions, Microwave-assisted Reactions and Sonochemical reactions, examples and applications. |

**Mapping between Course Outcomes and Programme Outcomes**

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

## UNIT 1: PRINCIPLES AND CONCEPTS OF GREEN CHEMISTRY

Introduction, Green chemistry Principles, sustainable development and green chemistry, E factor, atom economy, atom economic Reactions: Rearrangement and addition reactions and atom un-economic reactions: Substitution, elimination and Wittig reactions, Reducing Toxicity. Waste - problems and Prevention: Design for degradation, Polymer recycling

## UNIT 2: CATALYSIS AND GREEN CHEMISTRY

Introduction, Types of catalysis, Heterogeneous catalysis: Basics of Heterogeneous Catalysis, Zeolite and the Bulk Chemical Industry, Heterogeneous Catalysis in the Fine Chemical and Pharmaceutical Industries, Catalytic Converters, Homogeneous catalysis: Transition Metal Catalysts with Phosphine

Ligands, Greener Lewis Acids, and Phase transfer catalysis, Bio-catalysis and Photo-catalysis with examples.

**UNIT 3: GREEN SOLVENTS IN CHEMICAL SYNTHESIS**

Green Solvents: Concept, Tools and techniques for solvent selection, supercritical fluids: Super critical carbondioxide, super critical water, Polyethylene glycol (PEG), Ionic liquids, Recyling of green solvents.

**UNIT 4: EMERGING GREENER TECHNOLOGIES**

Biomass as renewable resource, Energy: Energy from Biomass, Solar Power, Chemicals from Renewable Feedstock's, Chemicals from Fatty Acids, Polymers from Renewable Resources, Alternative Economies: The Syngas Economy, The Biorefinery, Design for energy efficiency, Mechanochemical synthesis.

**UNIT 5: ALTERNATIVE GREENER METHODS**

Photochemical Reactions - Examples, Advantages and Challenges, Photoredox catalysis, single electron transfer reactions (SET), Examples of Photochemical Reactions, Microwave-assisted Reactions and Sonochemical reactions, examples and applications.

**Text Books :**

1. **M. LANCASTER, GREEN CHEMISTRY AN INTRODUCTORY TEXT, ROYAL SOCIETY OF CHEMISTRY, 2002.**

2. **PAUL T. ANASTAS AND JOHN C. WARNER, GREEN CHEMISTRY THEORY AND PRACTICE, 4$^{TH}$ EDITION,**

   **OXFORD UNIVERSITY PRESS, USA**

**References :**

1. **Green Chemistry for Environmental Sustainability, First Edition, Sanjay K. Sharma and AckmezMudhoo, CRC Press, 2010.**
2. **Edited by AlvisePerosa and Maurizio Selva , Hand Book of Green chemistry Volume 8:**

   **Green Nanoscience, wiley-VCH, 2013.**

| Course Code | EMPLOYABILITY SKILLS<br>OPEN ELECTIVE-III | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**Course Objectives:**

- To encourage all round development of the students by focusing on productive skills
- To make the students aware of Goal setting and writing skills
- To enable them to know the importance of presentation skills in achieving desired goals.
- To help them develop organizational skills through group activities

To function effectively with heterogeneous teams

| **Course Outcomes (CO):** | **Blooms Level** |
|---|---|
| CO1: Understand the importance of goals and try to achieve them | L1, L2 |
| CO2: Explain the significance of self-management | L1, L2 |
| CO3: Apply the knowledge of writing skills in preparing eye-catchy resumes | L3 |
| CO4: Analyse various forms of Presentation skills | L4 |
| CO5: Judge the group behaviour appropriately | L5 |
| CO6: Develop skills required for employability. | L3, L6 |

| UNIT - I | **Goal Setting and Self-Management** | Lecture Hrs |
|---|---|---|

Definition, importance, types of Goal Setting – SMART Goal Setting – Advantages-Motivation – Intrinsic and Extrinsic Motivation – Self-Management - Knowing about self – SWOC Analysis

| UNIT - II | **Writing Skills** | Lecture Hrs |
|---|---|---|

Definition, significance, types of writing skills – Resume writing Vs CV Writing - E-Mail writing, Cover Letters - E-Mail Etiquette -SoP (Statement of Purpose)

| UNIT - III | **Technical Presentation Skills** | Lecture Hrs |
|---|---|---|

Nature, meaning & significance of Presentation Skills – Planning, Preparation, Presentation, Stage Dynamics –Anxiety in Public speaking (Glossophobia)- PPT & Poster Presentation

| UNIT - IV | **Group Presentation Skills** | Lecture Hrs |
|---|---|---|

Body Language – Group Behaviour - Team Dynamics – Leadership Skills – Personality Manifestation-Group Discussion-Debate –Corporate Etiquette

| UNIT - V | **Job Cracking Skills** | Lecture Hrs |
|---|---|---|

Nature, characteristics, importance & types of Interviews – Job Interviews – Skills for success – Job searching skills - STAR method - FAQs- Answering Strategies – Mock Interviews

**Textbooks:**

1. Sabina Pillai, Agna Fernandez. *Soft Skills & Employability Skills*,2014.Cambridge Publisher.

2.**Alka Wadkar**. ***Life Skills for Success*, Sage Publications, 2016.**

**Reference Books**:

1. **Gangadhar Joshi**. ***Campus to Corporate Paperback* , Sage Publications. 2015**
2. Sherfield Montogomery Moody,*Cornerstone Developing Soft Skills*, Pearson Publications. 4 Ed. 2008
3. Shikha Kapoor. *Personality Development and Soft Skills - Preparing for Tomorrow* .1 Edition, Wiley, 2017.
4. M. Sen Gupta, *Skills for Employability*, Innovative Publication, 2019.
5. Steve Duck and David T McMahan**,** *The Basics f Communication Skills A Relational Perspective*, Sage press, 2012.

Online Learning Resources:

**10.** https://youtu.be/gkLsn4ddmTs
**11.** https://youtu.be/2bf9K2rRWwo
**12.** https://youtu.be/FchfE3c2jzc
**13.** https://youtu.be/xBaLgJZ0t6A?list=PLzf4HHlsQFwJZel_j2PUy0pwjVUgj7KlJ

| |
|---|
| **14.** https://www.youtube.com/c/skillopedia/videos<br>**15.** https://onlinecourses.nptel.ac.in/noc25_hs96/preview<br>**16.** https://onlinecourses.nptel.ac.in/noc21_hs76/preview<br>**17.** https://archive.nptel.ac.in/courses/109/107/109107172/#<br>**18.** https://archive.nptel.ac.in/courses/109/104/109104107/ |

**IV B.Tech – I Semester**

| Course Code | **GEO-SPATIAL TECHNOLOGIES (OPEN ELECTIVE – IV)** | L | T | P | C |
|---|---|---|---|---|---|
| **23A01706a** | | 3 | 0 | 0 | 3 |
| | | | | | |

***Course Objectives:***

**The objectives of this course are to make the student :**

1. To understand raster-based spatial analysis techniques, including query, overlay, and cost-distance analysis.
2. To analyze vector-based spatial analysis techniques such as topology, overlay, and proximity analysis.
3. To apply network analysis techniques for geocoding, shortest path analysis, and location-allocation problems.
4. To evaluate surface and geostatistical analysis methods, including terrain modeling, watershed analysis, and spatial interpolation.
5. To assess GIS customization, Web GIS, and mobile mapping techniques for real-world applications.

***Course Outcomes:***

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

1. Understand raster-based spatial analysis techniques, including query, overlay, and cost-distance analysis.
2. Analyze vector-based spatial analysis techniques such as topology, overlay, and proximity analysis.
3. Apply network analysis techniques for geocoding, shortest path analysis, and location-allocation problems.
4. Evaluate surface andgeostatistical analysis methods, including terrain modeling, watershed analysis, and spatial interpolation.
5. Assess GIS customization, Web GIS, and mobile mapping techniques for real-world applications.

CO – PO Articulation Matrix

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

**UNIT – I**

**RASTER ANALYSIS**

Raster Data Exploration: Query Analysis - Local Operations: Map Algebra, Reclassification, Logical and Arithmetic Overlay Operations—Neighborhood - Operations: Aggregation, Filtering – Extended Neighborhood-Operations- Zonal Operations - Statistical Analysis – Cost-Distance Analysis-Least Cost Path.

**UNIT – II**

**VECTOR ANALYSIS**

Non-Topological Analysis: Attribute Database Query, Structured Query Language, Co-Ordinate Transformation, Summary Statistics, Calculation of Area, Perimeter and Distance – topological Analysis: Reclassification, Aggregation, Overlay Analysis: Point-In-Polygon, Line-In-Polygon, Polygon-On-Polygon: Clip, Erase, Identity, Union, Intersection – Proximity

| |
|---|
| Analysis: Buffering |
| **UNIT – III** |
| **NETWORK ANALYSIS**<br>Network – Introduction - Network Data Model – Elements of Network - Building A Network Database - Geocoding – Address Matching - Shortest Path in A Network – Time and Distance Based Shortest Path Analysis – Driving Directions – Closest Facility Analysis – Catchment / Service Area Analysis-Location-Allocation Analysis |
| **UNIT – IV** |
| **SURFACE and GEOSTATISTICAL ANALYSIS**<br>Surface Data – Sources of X,Y, Z Data – DEM, TIN – Terrain Analysis – Slope, Aspect, Viewshed, Watershed Analysis: Watershed Boundary, Flow Direction, Flow Accumulation, Drainage Network, Spatial Interpolation: IDW, Spline, Kriging, Variogram. |
| **UNIT – V** |
| **CUSTOMISATION, WEB GIS, MOBILE MAPPING**<br>Customisation of GIS: Need, Uses, Scripting Languages –Embedded Scripts – Use of Python Script - Web GIS: Web GIS Architecture, Advantages of Web GIS, Web Applications-Location Based Services: Emergency and Business Solutions - Big Data Analytics. |
| **TEXT BOOKS:** |
| 1. Kang – Tsung Chang, Introduction to Geographical Information System, 4th Ed., Tata McGraw Hill Edition, 2008.<br>2. Lo, C.P. andYeung, Albert K.W., Concepts and Techniques of Geographic Information Systems Prentice Hall, 2002. |
| **REFRENCE BOOKS:** |
| 1. Michael N. Demers, Fundamentals of Geographic Information Systems, Wiley,2009<br>2. Ian Heywood, Sarah Cornelius, Steve Carver, Srinivasaraju, "An Introduction to Geographical Information Systems, Pearson Education, 2nd Edition, 2007.<br>3. John Peter Wilson, The Handbook of Geographic Information Science, Blackwell Pub.,2008 |
| **Online Learning Resources:** |
| https://archive.nptel.ac.in/courses/105/105/105105202/<br>https://onlinecourses.nptel.ac.in/noc19_cs76/preview |

**IV B.Tech – I Semester**

| Course Code | | L | T | P | C |
|---|---|---|---|---|---|
| **23A01706b** | **SOLID WASTE MANAGEMENT (OPEN ELECTIVE – IV )** | 3 | 0 | 0 | 3 |

***Course Objectives:***

**The objectives of this course are to make the student :**

1. To understand the types, sources, and characteristics of solid waste, along with regulatory frameworks.
2. To analyze engineering systems for solid waste collection, storage, and transportation.
3. To apply resource and energy recovery techniques for sustainable solid waste management.
4. To evaluate landfill design, construction, and environmental impact mitigation strategies.
5. To assess hazardous waste management techniques, including biomedical and e-waste disposal.

***Course Outcomes:***

1. Understand the types, sources, and characteristics of solid waste, along with regulatory frameworks.
2. Analyze engineering systems for solid waste collection, storage, and transportation.
3. Apply resource and energy recovery techniques for sustainable solid waste management.
4. Evaluate landfill design, construction, and environmental impact mitigation strategies.
5. Assess hazardous waste management techniques, including biomedical and e-waste

CO – PO Articulation Matrix

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

**UNIT – I**

Solid Waste: Definitions, Types of Solid Wastes, Sources of Solid Wastes, Characteristics, and Perspectives; Properties of Solid Wastes, Sampling of Solid Wastes, Elements of Solid Waste Management - Integrated Solid Waste Management, Solid Waste Management Rules 2016.

**UNIT – II**

Engineering SystemsforSolid Waste Management: Solid Waste Generation; On-Site Handling, Storage and Processing; Collection of Solid Wastes; Stationary Container System and Hauled Container Systems – Route Planning - Transfer and Transport; Processing Techniques;

**UNIT – III**

Engineering Systems for Resource and Energy Recovery: Processing Techniques; Materials Recovery Systems; Recovery of Biological Conversion Products – Composting, Pre and Post Processing, Types of Composting, Critical Parameters, Problems With Composing - Recovery of Thermal Conversion Products; Pyrolisis, Gasification, RDF - Recovery of Energy From Conversion Products; Materials and Energy Recovery Systems.

**UNIT – IV**

Landfills: Evolution of Landfills – Types and Construction of Landfills – Design Considerations – Life of Landfills- Landfill Problems – Lining of Landfills – Types of Liners – Leachate Pollution and Control – Monitoring Landfills – Landfills Reclamation.

**UNIT – V**

Hazardous Waste Management: – Sources and Characteristics, Effects On Environment, Risk Assessment – Disposal of Hazardous Wastes – Secured Landfills, Incineration - Monitoring – Biomedical Waste Disposal, E-Waste Management, Nuclear Wastes, Industrial Waste Management

**TEXT BOOKS:**

1. Tchobanoglous G, Theisen H and Vigil SA 'Integrated Solid Waste Management, Engineering Principles and Management Issues' McGraw-Hill, 1993.
2. Vesilind PA, Worrell W and Reinhart D, 'Solid Waste Engineering' Brooks/Cole Thomson Learning Inc., 2002.

**REFRENCE BOOKS:**

1. Peavy, H.S, Rowe, D.R., and G. Tchobanoglous, 'Environmental Engineering', McGraw Hill Inc., New York, 1985.
2. Qian X, Koerner RM and Gray DH, 'Geotechnical Aspects of Landfill Design and Construction' Prentice Hall, 2002.

**Online Learning Resources:**

https://archive.nptel.ac.in/courses/105/103/105103205/
https://archive.nptel.ac.in/courses/120/108/120108005/

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

## ELECTRIC VEHICLES
**(Open Elective -IV)**

**Course Objectives:** To make the student
- Remember and understand the differences between conventional Vehicle and Electric Vehicles, electro mobility and environmental issues of EVs.
- Analyze various EV configurations, parameters of EV systems and Electric vehicle dynamics.
- Analyze the basic construction, operation and characteristics of fuel cells and battery charging techniques in HEV systems.
- Design and analyze the various control structures for Electric vehicle.

**Course Outcomes (CO):** Student will be able to
CO 1: To understand and differentiate between Conventional Vehicle and Electric Vehicles, electro mobility and environmental issues of EVs. -L2
CO 2: Understand Various dynamics of Electric Vehicles. -L2
CO 3: To remember and understand various configurations in parameters of EV system and dynamic aspects of EV. -L1
CO 4: To analyze fuel cell technologies in EV and HEV systems. -L3
CO 5: To analyze the battery charging and controls required of EVs. -L3

**UNIT I Introduction to EV Systems and Energy Sources:**
Past, Present and Future of EV - EV Concept- EV Technology- State-of-the Art of EVs- EV configuration- EV system- Fixed and Variable gearing- Single and multiple motor drive- In-wheel drives- EV parameters: Weight, size, force and energy, performance parameters. Electro mobility and the environment- History of Electric power trains- Carbon emissions from fuels- Green houses and pollutants- Comparison of conventional, battery, hybrid and fuel cell electric systems.

**UNIT II EV Propulsion and Dynamics:**
Choice of electric propulsion system- Block diagram- Concept of EV Motors- Single and multi-motor configurations- Fixed and variable geared transmission- In-wheel motor configuration- Classification - Electric motors used in current vehicle applications - Recent EV Motors- Vehicle load factors- Vehicle acceleration.

**UNIT III Fuel Cells:**
Introduction of fuel cells- Basic operation- Model - Voltage, power and efficiency- Power plant system – Characteristics- Sizing - Example of fuel cell electric vehicle - Introduction to HEV- Brake specific fuel consumption - Comparison of Series-Parallel hybrid systems- Examples.

**UNIT IV Battery Charging and Control:**
Battery charging: Basic requirements- Charger architecture- Charger functions- Wireless charging- Power factor correction.
Control: Introduction- Modeling of electro mechanical system- Feedback controller design approach- PI controller's designing- Torque-loop, Speed control loop compensation- Acceleration of battery electric vehicle.

**UNIT V Energy Storage Technologies:**
Role of Energy Storage Systems- Thermal- Mechanical-Chemical- Electrochemical- Electrical - Efficiency of energy storage systems- Super capacitors-Superconducting Magnetic Energy Storage (SMES)- SOC- SoH -fuel cells - G2V- V2G- Energy storage in Micro-grid and Smart grid- Energy Management with storage systems- Battery SCADA

**Textbooks:**

1.C.C Chan, K.T Chau: Modern Electric Vehicle Technology, Oxford University Press Inc., New York 2001,1st Edition

2.Ali Emadi, "Advanced Electric Drive Vehicles", CRC Press, 2017,1st Edition

**Reference Books:**

1.Electric and Hybrid Vehicles Design Fundamentals, Iqbal Husain, CRC Press 2021, 3rd Edition.

2.Francisco Díaz-González, Andreas Sumper, Oriol Gomis-Bellmunt," Energy Storage in Power Systems" Wiley Publication, ISBN: 978-1-118-97130-7, Mar 2016,1st Edition

3.A.G.Ter-Gazarian, "Energy Storage for Power Systems", the Institution of Engineering and Technology (IET) Publication, UK, (ISBN – 978-1-84919-219-4), Second Edition, 2011.

4.Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, "Modern Elelctric, Hybrid Elelctric and Fuel Cell Vehicles: Fundamentals, Theory and Design", CRC Press, 2004,1st Edition

5.James Larminie, John Lowry, "Electric Vehicle Technology Explained", Wiley, 2003,2nd Edition.

**Online Learning Resources:**

1. https://nptel.ac.in/courses/108/102/108102121/
2. https://nptel.ac.in/syllabus/108103009

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

## TOTAL QUALITY MANAGEMENT
## (Open Elective-IV).

| **Course objectives:** The objectives of the course are to | |
|---|---|
| 1 | Familiarize the basic concepts of Total Quality Management. |
| 2 | Expose with various quality issues in Inspection. |

| | |
|---|---|
| 3 | Gain Knowledge on quality control and its applications to real time.. |
| 4 | Understand the extent of customer satisfaction by the application of various quality concepts. |
| 5 | Demonstrate the importance of Quality standards in Production |

| **Course Outcomes:** On successful completion of the course, the student will be able to, | | |
|---|---|---|
| 1 | Define and develop on quality Management philosophies and analyze quality costs frameworks. | L1,L3,L4 |
| 2 | Understanding of the historical development of Total Quality Management (TQM), implementation, and real-world applications through case studies. | L2, L3,L6 |
| 3 | Evaluate the cost of poor quality, process effectiveness and efficiency to analyze areas for improvement. | L2,L4,L5 |
| 4 | Apply benchmarking and business process reengineering to improve management processes. | L3,L5,L6 |
| 5 | Demonstrate the set of indications to evaluate performance excellence of an organization | L1,L2,L5 |

**UNIT – I Introduction:**
Definition of Quality, Dimensions of Quality, Definition of Total quality management, Quality Planning, Quality costs – Analysis, Techniques for Quality costs, Basic concepts of Total Quality Management.

**UNIT - II Historical Review:**
Historical Review: Quality council, Quality statements, Strategic Planning, Deming Philosophy, Barriers of TQM Implementation, Benefits of TQM, Characteristics of successful quality leader, Contributions of Gurus of TQM, Case studies.

**UNIT – III TQM Principles:**
Customer Satisfaction – Customer Perception of Quality, Customer Complaints, Service Quality, Customer Retention, Employee Involvement – Motivation, Empowerment teams, Continuous Process Improvement – Juran Trilogy, PDSA Cycle, Kaizen, Supplier Partnership – Partnering, sourcing, Supplier Selection, Supplier Rating, Relationship Development, Performance Measures Basic Concepts, Strategy, Performance Measure Case studies.

**UNIT - IV TQM Tools:**
Benchmarking – Reasons to Benchmark, Benchmarking Process, Quality Function Deployment (QFD) – House of Quality, QFD Process, Benefits, Taguchi Quality Loss Function, Total Productive Maintenance (TPM) – Concept, Improvement Needs, FMEA – Stages of FMEA, The seven tools of quality, Process capability, Concept of Six Sigma, New Seven management tools, Case studies.

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

**Text Books:**

1.Dale H Besterfield, Total Quality Management, Fourth Edition, Pearson Education, 2015.
2.Subburaj Ramaswamy, Total Quality Management, Tata Mcgraw Hill Publishing Company Ltd., 2005.
3.Joel E.Ross , Total Quality Management, Third Eition, CRC Press, 2017.

**Reference Books:**

1.Narayana V and Sreenivasan N.S, Quality Management – Concepts and Tasks, New Age International, 1996.
2.Robert L.Flood, Beyond TQM, First Edition, John Wiley & Sons Ltd, 1993.

3.Richard S. Leavenworth & Eugene Lodewick Grant, Statistical Quality Control, Seventh Edition, Tata Mcgraw Hill, 2015
4.Samuel Ho , TQM – An Integrated Approach, Kogan Page Ltd, USA, 1995.

**Online Learning Resources:**

- https://www.youtube.com/watch?v=VD6tXadibk0
- https://www.investopedia.com/terms/t/total-quality-management-tqm.asp
- https://blog.capterra.com/what-is-total-quality-management/
- https://nptel.ac.in/courses/110/104/110104080/
- https://onlinecourses.nptel.ac.in/noc21_mg03/preview
- https://nptel.ac.in/courses/110/104/110104085/
- https://nptel.ac.in/noc/courses/noc18/SEM2/noc18-mg39/

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

## TRANSDUCERS AND SENSORS
**(Open Elective –IV)**

**Course Objectives:**

1. To understand characteristics of Instrumentation System and the operating principle of motion transducers.
2. To explore working principles, and applications of different temperature transducers and Piezo-electric sensors.
3. To provide knowledge on flow transducers and their applications.
4. To study the working principles of pressure transducers.

5. To introduce working principle and applications of force and sound transducers.

**Course Outcomes:**

**After completing the course, the student will be able to,**

1. Understand characteristics of Instrumentation System and the operating principle of motion transducers.
2. Explore working principles, and applications of different temperature transducers and Piezo-electric sensors.
3. Gain knowledge on flow transducers and their applications.
4. Learn the working principles of pressure transducers.
5. Understand the working principle and applications of force and sound transducers.

**UNIT I**

**Introduction:** General Configuration and Functional Description of measuring instruments, Static and Dynamic Characteristics of Instrumentation System, Errors in Instrumentation System, Active and Passive Transducers and their Classification.

**Motion Transducers:** Resistive strain gauge, LVDT, RVDT, Capacitive transducers, Piezo-electric transducers, seismic displacement pick-ups, vibrometers and accelerometers.

**UNIT II**

**Temperature Transducers:** Standards and calibration, fluid expansion and metal expansion type transducers - bimetallic strip, Thermometer, Thermistor, RTD, Thermocouple and their characteristics.

Hall effect transducers, Digital transducers, Proximity devices, Bio-sensors, Smart sensors, Piezo-electric sensors.

**UNIT III**

**Flow Transducers:** Bernoulli's principle and continuity, Orifice plate, Nozzle plate, Venture tube, Rotameter, Anemometers, Electromagnetic flow meter, Impeller meter and Turbid flow meter.

**UNIT IV**

**Pressure Transducers:** Standards and calibration, different types of manometers, elastic transducers, diaphragm bellows, bourdon tube, capacitive and resistive pressure transducers, high and low pressure measurement.

**UNIT V**

**Force and Sound Transducers:** Proving ring, hydraulic and pneumatic load cell, dynamometer and gyroscopes. Sound level meter, sound characteristics, Microphone**.**

**TEXT BOOKS**

1. A.K. Sawhney, "A course in Electrical and Electronics Measurements and Instrumentation", Dhanpat Rai& Co. 3rd edition Delhi, 2010.
2. Rangan C.S, Sarma G.R and Mani V S V, "Instrumentation Devices and Systems", TATA McGraw Hill publications, 2007.

**REFERENCE BOOKS**

1. Doebelin. E.O, "Measurement Systems Application and Design",McGraw Hill International, New York, 2004.
2. Nakra B.C andChaudharyK.K , "Instrumentation Measurement and Analysis", Second Edition, Tata McGraw-Hill Publication Ltd.2006.

**IV B.Tech I Sem**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

## FINANCIAL MATHEMATICS
## (Open Elective-IV)

**Course Objectives:**

1. To provide mathematical foundations for financial modelling, risk assessment and asset pricing.
2. To introduce stochastic models and their applications in pricing derivatives and interest rate modelling.
3. To develop analytical skills for fixed-income securities, credit risk, and investment strategies.
4. To equip students with computational techniques for pricing financial derivatives.

**Course Outcomes:**

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

| COs | Statements | Blooms level |
|---|---|---|
| **CO1** | Explain fundamental financial concepts, including arbitrage, valuation, and risk. | L2 (Understand) |
| **CO2** | Apply stochastic models, including Brownian motion and Stochastic Differential Equations (SDEs), in financial contexts. | L3 (Apply) |
| **CO3** | Analyze mathematical techniques for pricing options and financial derivatives. | L4 (Analyze) |
| **CO4** | Evaluate interest rate models and bond pricing methodologies. | L5 (Evaluate) |
| **CO5** | Utilize computational techniques such as Monte Carlo simulations for financial modeling. | L3 (Apply) |

## Course Articulation Matrix:

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

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

**UNIT-I: Asset Pricing and Risk Management (08)**

Fundamental financial concepts: Returns, arbitrage, valuation, and pricing. Asset/Liability management, investment income, capital budgeting, and contingent cash flows. One-period model: Securities, payoffs, and the no-arbitrage principle. Option contracts: Speculation and hedging strategies, CAP Model, Efficient market hypothesis.

**UNIT-II: Stochastic Models in Finance (08)**

Random Walks and Brownian Motion. Introduction to Stochastic Differential Equations (SDEs): Drift and diffusion. Ito calculus: Ito's Lemma, Ito Integral, and Ito Isometry.

**UNIT-III: Interest Rate and Credit Modelling (08)**

Interest rate models and bond markets. Short-rate models: Vasicek, Cox-Ingersoll-Ross (CIR), Hull & White models, Credit risk modelling: Hazard function and hazard rate.

**UNIT-IV: Fixed-Income Securities and Bond Pricing (08)**

Characteristics of fixed-income products: Yield, duration, and convexity. Yield curves, forward rates, and zero-coupon bonds. Stochastic interest rate models and bond pricing PDE. Yield curve fitting and calibration techniques, Mortgage Backed Securities.

**UNIT-V: Exotic Options and Computational Finance (08)**

Stochastic volatility models and the Feynman-Kac theorem.Exotic options: Barriers, Asians, and Look backs. Monte Carlo methods for derivative pricing, Black-Scholes-Merton model: Derivation and applications.

**Textbooks:**

1. Ales Cerny, *Mathematical Techniques in Finance: Tools for Incomplete Markets*, Princeton University Press.
2. S.R. Pliska, *Introduction to Mathematical Finance: Discrete-Time Models*, Cambridge University Press.

**Reference Books:**

1. IoannisKaratzas& Steven E. Shreve, *Methods of Mathematical Finance*, Springer, New York.
2. John C. Hull, *Options, Futures, and Other Derivatives*, Pearson.

**Web References:**

- MIT– Mathematics for Machine Learning https://ocw.mit.edu
- Coursera – Financial Engineering and Risk Management (Columbia University) https://www.coursera.org/
- National Stock Exchange (NSE) India – Financial Derivatives https://www.nseindia.com/

**IV B.Tech I Sem**

| | **SENSORS AND ACTUATORS FOR ENGINEERING APPLICATIONS** **(Open Elective-IV)** (Common to all branches) | **L** | **T** | **P** | **C** |
|---|---|---|---|---|---|
| | | **3** | **0** | **0** | **3** |

**COURSE OBJECTIVES**

| | |
|---|---|
| 1 | To provide exposure to various kinds of sensors and actuators and their engineering applications. |
| 2 | To impart knowledge on the basic laws and phenomenon behind the working of sensors and actuators |
| 3 | To explain the operating principles of various sensors and actuators |
| 4 | To educate the fabrication of sensors |
| 5 | To explain the required sensor and actuator for interdisciplinary application |

**UNIT I Introduction to Sensors and Actuators 9H**

Sensors: Types of sensors: temperature, pressure, strain, active and passive sensors, General characteristics of sensors (Principles only), Deposition: Chemical Vapor Deposition, Pattern: photolithography and Etching: Dry and Wet Etching.

Actuators: Functional diagram of actuators, Types of actuators and their basic principle of working: Pneumatic, Electromagnetic, Piezo-electric and Piezo-resistive actuators, Applications of Actuators.

**UNIT II Temperature and Mechanical Sensors 9H**

Temperature Sensors: Types of temperature sensors and their basic principle of working: Thermo-resistive sensors: Thermistors, Thermo-electric sensors: Thermocouples, PN junction temperature sensors

Mechanical Sensors: Types of Mechanical sensors and their basic principle of working: Force sensors: Strain gauges, Tactile sensors, Pressure sensors: Piezoresistive, Variable Reluctance Sensor (VRP).

**UNIT III Optical and Acoustic Sensors 9H**

Optical Sensors: Basic principle and working of: Photodiodes, Phototransistors and Photo resistors based sensors, Photomultipliers, Infrared sensors: thermal, Passive Infra-Red, Fiber based sensors and Thermopiles

Acoustic Sensors: Principle and working of Ultrasonic sensors, Piezo-electric resonators, Microphones

**UNIT IV Magnetic and Electromagnetic Sensors 9H**

Motors as actuators (linear, rotational, stepping motors), magnetic valves, inductive sensors (LVDT, RVDT, and Proximity), Hall Effect sensors, Magneto-resistive sensors, Magnetostrictive sensors and actuators.

**UNIT V Chemical and Radiation Sensors 9H**

Chemical Sensors: Principle and working of Electro-chemical, Thermo-chemical, Gas, pH, Humidity and moisture sensors.

Radiation Sensors: Principle and working of Ionization detectors, Scintillation detectors, Semiconductor radiation detectors and Microwave sensors (resonant, reflection, transmission)

**Textbooks:**

1. Sensors and Actuators – Clarence W. de Silva, CRC Press, 2nd Edition, 2015
2. Sensors and Actuators, D.A.Hall and C.E.Millar, CRC Press, 1999

**Reference Books:**

1. Sensors and Transducers- D.Patranabhis, Prentice Hall of India (Pvt) Ltd. 2003
2. Measurement, Instrumentation, and Sensors Handbook-John G.Webster, CRC press 1999
3. Sensors – A Comprehensive Sensors- Henry Bolte, John Wiley.

4. Handbook of modern sensors, Springer, Stefan Johann Rupitsch.

**NPTEL course link: https://onlinecourses.nptel.ac.in/noc21_ee32/preview**

| | Course Outcomes | Blooms Level |
|---|---|---|
| **CO1** | Classify different types of Sensors and Actuators along with their characteristics | L1,L2 |
| **CO2** | Summarize various types of Temperature and Mechanical sensors | L1,L2 |
| **CO3** | Illustrates various types of optical and mechanical sensors | L1,L2 |
| **CO4** | Analyze various types of Optical and Acoustic Sensors | L1,L2, L3 |
| **CO5** | Interpret the importance of smart materials in various devices | L1,L2 |

**Course Articulation Matrix**:

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

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

**IV B.Tech I Sem**

| | **CHEMISTRY OF NANOMATERIALS AND APPLICATIONS (Open Elective-IV)** (Common to all branches) | **L** | **T** | **P** | **C** |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

| **Course Objectives** | |
|---|---|
| 1 | To understand basics and characterization of nanomaterials. |
| 2 | To understand synthetic methods of nanomatrials. |

| | |
|---|---|
| 3 | To apply various techniques for charterization of nanomaterials. |
| 4 | To understand Studies of Nano-structured Materials |
| 5 | To enumerate the applications of advanced nanomaterials in engineering |

| **Course Outcomes** | |
|---|---|
| CO1 | Classify the nanostructure materials; describe scope of nanoscience and importance technology. |
| CO2 | Describe the top-down approach, Explain aerosol synthesis and plasma arc technique, Differentiate chemical vapor deposition method and electrode position method, Discuss about highenergy ball milling. |
| CO3 | Discuss different technique for characterization of nanomaterial, Explain electron microscopy techniques for characterization of nanomaterial, Describe BET method for surface area analysis. |
| CO4 | Explain synthesis and properties and applications of nanaomaterials, Discuss about fullerenes and carbon nanotubes, Differentiate nanomagnetic materials and thermoelectric materials, nonlinear optical materials. |
| CO5 | Illustrate advance engineering applications of Water treatment, sensors, electronic devices, medical domain, civil engineering, chemical engineering, metallurgy and mechanical engineering, food science, agriculture, pollutants degradation. |

**Mapping between Course Outcomes and Programme Outcomes**

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

**Unit – I**

**Basics and Characterization of Nanomaterials:** Introduction**,** Scope of nanoscience and nanotecnology, nanoscience in nature, classification of nanostructured materials, importance of nanomaterials.

**Unit – II**

**Synthesis of nanomaterials :**Top-Down approach**,** Inert gas condensation, arc discharge method, aerosol synthesis, plasma arc technique, ion sputtering, laser ablation, laser pyrolysis, and chemical vapour deposition method, electrodeposition method, highenergy ball milling method.

Synthetic Methods**:** Bottom-Up approach**,** Sol-gel synthesis, microemulsions or reverse micelles, co-precipitation method, solvothermal synthesis, hydrothermal synthesis, microwave heating synthesis and sonochemical synthesis.

**UNIT-III**

**Techniques for characterization:** Diffraction technique, spectroscopy techniques, electron microscopy techniques for the characterization of nanomaterials, BET method for surface area analysis, dynamic light scattering for particle size determination.

**UNIT-IV**

**Studies of Nano-structured Materials:** Synthesis, properties and applications of the following nanomaterials -fullerenes, carbon nanotubes, 2D-nanomaterial (Graphene), core-shell, magnetic nanoparticles, thermoelectric materials, non-linear optical materials.

**UNIT-V**

**Advanced Engineering Applications of Nanomaterials:** Applications of Nano Particle, nanorods, nano wires, Water treatment, sensors, electronic devices, medical domain, civil engineering, chemical engineering, metallurgy and mechanical engineering, food science, agriculture, pollutants degradation.

**TEXT BOOKS:**

1. **NANO: The Essentials:** T Pradeep, MaGraw-Hill, 2007.
2. **Textbook of Nanoscience and nanotechnology:** B S Murty, P Shankar, BaldevRai, BB Rath and James Murday, Univ. Press, 2012.

**REFERENCE BOOKS:**

1. Concepts of Nanochemistry; LudovicoCademrtiri and Geoffrey A. Ozin& Geoffrey A. Ozin, Wiley-VCH, 2011.
2. **Nanostructures &Nanomaterials; Synthesis, Properties & Applications:** Guozhong Cao, Imperial College Press, 2007.

**Nanomaterials**

**IV B.Tech I Sem**

| | **LITERARY VIBES**<br>**(Open Elective-IV)**<br>(Common to all branches) | **L** | **T** | **P** | **C** |
|---|---|---|---|---|---|

| **Course Objectives** | |
|---|---|
| 1 | To inculcate passion for aesthetic sense and reading skills |
| 2 | To encourage respecting others' experiences and creative writing |
| 3 | To explore emotions, communication skills and critical thinking |
| 4 | To educate how books serve as the reflection of history and society |
| 5 | To provide practical wisdom and duty of responding to events of the times |

| Course Outcomes | | Blooms Level |
|---|---|---|
| CO1 | Identify genres, literary techniques and creative uses of language in literary texts. | L1, L2 |
| CO2 | Explain the relevance of themes found in literary texts to contemporary, personal and cultural values and to historical forces | L1, L2 |
| CO3 | Apply knowledge and understanding of literary texts when responding to others' problems and their own and make evidence-based arguments | L3 |
| CO4 | Analyze the underlying meanings of the text by using the elements of literary texts | L4 |
| CO5 | Evaluate their own work and that of others critically | L5 |
| CO6 | Develop as creative, effective, independent and reflective students who are able to make informed choices in process and performance | L3 |

**UNIT I: Poetry**

1. Ulysses- Alfred Lord Tennyson
2. Ain't I woman?-Sojourner Truth
3. The Second Coming-W.B. Yeats
4. Where the Mind is Without Fear-Rabindranath Tagore

**UNIT II: Drama: *Twelfth Night*- William Shakespeare**

1. Shakespeare -life and works
1. Plot & sub-plot and Historical background of the play
2. Themes and Criticism
3. Style and literary elements
4. Characters and characterization

**UNIT III: Short Story**

1. The Luncheon - Somerset Maugham
2. The Happy Prince-Oscar Wild
3. Three Questions – Leo Tolstoy
4. Grief –Antony Chekov

**UNIT IV: Prose: Essay and Autobiography**

1. My struggle for an Education-Booker T Washington
2. The Essentials of Education-Richard Livingston
3. The story of My Life-Helen Keller
4. Student Mobs-JB Priestly

**UNIT V: Novel: *Hard Times*- Charles Dickens**

1. Charles Dickens-Life and works
2. Plot and Historical background of the novel
3. Themes and criticism
4. Style and literary elements
5. Characters and characterization

**Text Books:**

1. Charles Dickens.*Hard Times.*(Sangam Abridged Texts) Vantage Press, 1983
2. DENT JC.*William Shakespeare. Twelfth Night***.** Oxford University Press,2016.

**References:**

1. WJ Long.*History of English Literature***,** Rupa Publications India; First Edition (4 October 2015)
2. RK Kaushik And SC Bhatia. *Essays, Short Stories and One Act Plays*, Oxford University Press .2018.

3. Dhanvel, SP. *English and Soft Skills*, Orient Blackswan,2017.

*4. New Horizon*, Pearson publications, New Delhi 2014

5. Vimala Ramarao, *Explorations Volume*-II, Prasaranga Bangalore University,2014**.**

*6.* Dev Neira, Anjana & Co. *Creative Writing: A Beginner's Manual.*Pearson India, 2008.

**Online Resources**

**https://www.litcharts.com/poetry/alfred-lord-tennyson/ulysses**
**https://www.litcharts.com/lit/ain-t-i-a-woman/summary-and-analysis**
**https://englishliterature.education/articles/poetry-analysis/the-second-coming-by-w-b-yeats-critical-analysis-summary-and-line-by-line-explanation/#google_vignette**
**https://sirjitutorials.com/where-the-mind-is-without-fear-poem-notes-explanation/**
**https://www.litcharts.com/lit/twelfth-night/themes**
**https://smartenglishnotes.com/2021/11/28/the-luncheon-summary-characters-themes-and-irony/**

# HONOURS

| HONOURS DEGREE | Advanced Machine Learning & AI Systems | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**Course Objectives:**

- To deepen understanding of advanced machine learning concepts including ensemble learning, probabilistic models, and deep neural architectures.
- To explore scalable machine learning algorithms and their applications in real-world AI systems.
- To equip students with knowledge of interpretability, fairness, and trust in AI.
- To understand deployment, monitoring, and life-cycle management of AI systems.
- To apply machine learning in advanced domains such as natural language processing, vision, and multi-agent systems.

**Course Outcomes (COs):**

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

1. Apply and evaluate ensemble learning, SVMs, probabilistic models, and clustering techniques to solve complex machine learning problems.
2. Design and implement deep learning architectures including CNNs, RNNs, and transformers for vision and sequential data tasks.
3. Analyze and integrate explainability, fairness, and robustness techniques to build trustworthy and ethical AI systems.
4. Develop scalable ML pipelines and deploy models in production with proper monitoring, tuning, and retraining mechanisms.
5. Implement AI techniques in advanced applications such as natural language processing, computer vision, reinforcement learning, and multi-agent systems.

**UNIT I: Advanced Supervised and Unsupervised Learning**

Ensemble Learning: Bagging, Boosting, Random Forests, Support Vector Machines: Kernels and Multi-Class SVMs, Probabilistic Graphical Models: Bayesian Networks, HMMs, Expectation-Maximization and Variational Inference, Clustering: Hierarchical, DBSCAN, Gaussian Mixture Models.

**UNIT II: Deep Learning Architectures**

Deep Neural Networks and Optimization Challenges, Convolutional Neural Networks (CNNs), Recurrent Neural Networks (RNNs), LSTMs, GRUs, Autoencoders, Variational Autoencoders, Attention Mechanisms and Transformer Architectures

**UNIT III: Interpretability, Fairness, and Trust in AI**

Explainable AI: LIME, SHAP, Saliency Maps, Adversarial Examples and Robustness Techniques, Fairness Metrics and Bias Mitigation. Trustworthy AI Design and Ethical Considerations, Model Compression and Distillation

**UNIT IV: Scalable and Production ML Systems**

ML Pipelines, Feature Stores, and Model Versioning, Distributed Training with TensorFlow and PyTorch, Hyperparameter Tuning at Scale (Ray Tune, Optuna),Model Deployment with Docker, FastAPI, Flask, Monitoring, Drift Detection, and Model Retraining

**UNIT V: Advanced Applications and Multi-Agent AI**

Natural Language Understanding with Transformers (BERT, GPT), Vision-based AI Systems (YOLO, Mask R-CNN), Reinforcement Learning and Policy Gradients, AI in Robotics and Autonomous Agents, Multi-Agent Systems and Decentralized Learning

**Textbooks:**

1. Aurélien Géron – Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, 3rd Edition, O'Reilly
2. Ian Goodfellow, Yoshua Bengio, Aaron Courville – Deep Learning, MIT Press

**Reference Books:**

1. Kevin P. Murphy – Machine Learning: A Probabilistic Perspective, MIT Press
2. Trevor Hastie, Robert Tibshirani, Jerome Friedman – The Elements of Statistical Learning, Springer
3. Chris Bishop – Pattern Recognition and Machine Learning, Springer
4. Ethem Alpaydin – Introduction to Machine Learning, MIT Press

**Online Courses & Resources:**

1. CS229 – Machine Learning by Stanford (Andrew Ng)
2. DeepLearning.AI – Advanced Deep Learning Specialization (Coursera)

| HONOURS DEGREE | Deep Learning & Neural Network Architectures | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**Course Objectives:**

- To introduce the fundamental concepts and mathematical foundations of deep learning.
- To explore different neural network architectures including CNNs, RNNs, LSTMs, and Transformers.
- To enable students to implement, train, and optimize deep neural networks.
- To analyze the performance and limitations of various architectures in different AI tasks.
- To develop the ability to apply deep learning models to real-world applications such as image recognition, language modeling, and autonomous systems.

**Course Outcomes (COs):**

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

- CO1: Understand the theoretical foundations of neural networks and deep learning.
- CO2: Implement and train multilayer perceptrons, CNNs, RNNs, and other architectures.
- CO3: Analyze and optimize deep learning models using advanced regularization and tuning techniques.
- CO4: Evaluate the applicability of different neural network architectures for various AI problems.
- CO5: Apply state-of-the-art models such as Transformers and GANs in real-world domains.

**UNIT I: Foundations of Neural Networks**

Introduction to Artificial Neural Networks, Biological Neuron vs. Artificial Neuron, Perceptron, Multilayer Perceptron (MLP), Activation Functions: ReLU, Sigmoid, Tanh, Softmax, Backpropagation and Gradient Descent, Loss Functions: MSE, Cross Entropy, Overfitting, Regularization (L1/L2), Dropout

**UNIT II: Convolutional Neural Networks (CNNs)**

Convolution Operation and Feature Maps, Pooling Layers: Max and Average Pooling, CNN Architectures: LeNet, AlexNet, VGG, ResNet, Transfer Learning and Fine-tuning, Image Classification, Object Detection Basics, Implementation with TensorFlow/PyTorch

**UNIT III: Recurrent Neural Networks (RNNs) and Variants**

Sequential Data and Time Series, RNN Basics and Backpropagation Through Time (BPTT), Vanishing and Exploding Gradients, LSTM and GRU Architectures, Applications in Text, Speech, and Music, Sequence-to-Sequence Models

**UNIT IV: Advanced Architectures & Optimization**

Autoencoders and Variational Autoencoders (VAEs), Generative Adversarial Networks (GANs), Deep Reinforcement Learning Overview, Batch Normalization, Early Stopping, Hyperparameter Tuning and Optimization, Performance Metrics and Evaluation

**UNIT V: Transformer Models & Applications**

Attention Mechanism and Self-Attention, Transformers and BERT Architecture, Positional Encoding, Multi-head Attention, Pre-trained Language Models and Fine-Tuning, Applications in NLP: Text Classification, Translation, Large Language Models and Transfer Learning

**Text Books:**

1. Deep Learning – Ian Goodfellow, Yoshua Bengio, and Aaron Courville (MIT Press)
2. Neural Networks and Deep Learning – Michael Nielsen (Online Book)
3. Hands-On Machine Learning with Scikit-Learn, Keras & TensorFlow – Aurélien Géron (O'Reilly)

**Reference Books:**

1. Pattern Recognition and Machine Learning – Christopher M. Bishop
2. Deep Learning for Computer Vision – Rajalingappaa Shanmugamani
3. Natural Language Processing with Transformers – Lewis Tunstall, Leandro von Werra, Thomas Wolf
4. Reinforcement Learning: An Introduction – Richard S. Sutton and Andrew G. Barto

**Recommended Online Courses:**

1. Deep Learning Specialization – Andrew Ng (Coursera)
2. CS231n: Convolutional Neural Networks for Visual Recognition (Stanford)
3. Fast.ai – Practical Deep Learning for Coders
4. Deep Learning with PyTorch (Udacity)
5. Transformers by Hugging Face (free course)

| HONOURS DEGREE | Reinforcement Learning & Decision Making | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**Course Objectives:**

- To introduce the fundamentals of reinforcement learning (RL) and its mathematical foundation.
- To understand the Markov Decision Process (MDP) framework for decision making under uncertainty.
- To explore various RL algorithms including value-based, policy-based, and model-based approaches.
- To analyze deep reinforcement learning techniques for real-world applications.
- To study the integration of reinforcement learning with planning, exploration, and control strategies.

**Course Outcomes (COs):**

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

1. Understand the fundamentals of reinforcement learning, including agent-environment interaction, types of RL, and solving decision-making problems using Markov Decision Processes and Bellman equations.
2. Apply dynamic programming and Monte Carlo methods to perform policy evaluation, policy improvement, and control in model-based RL settings.
3. Implement temporal-difference learning algorithms like TD(0), Sarsa, and Q-learning, and extend them using eligibility traces and function approximation techniques.
4. Develop and analyze policy gradient and actor-critic methods, including REINFORCE and PPO, to optimize policies in continuous and high-dimensional action spaces.
5. Employ deep reinforcement learning techniques (DQN, DDPG, A3C, SAC) and exploration strategies to solve complex tasks in robotics, games, and autonomous systems, considering safety and ethical decision-making.

**UNIT I: Introduction to Reinforcement Learning & MDPs**

Foundations of RL: Agent-Environment Interaction, Types of RL: Model-based vs. Model-free, Reward Signals, Return, and Discounting, Markov Decision Processes (MDPs), Bellman Equations and Optimality

**UNIT II: Dynamic Programming & Monte Carlo Methods**

Policy Evaluation and Policy Improvement, Value Iteration and Policy Iteration, Monte Carlo Prediction and Control, First-visit and Every-visit Methods, Limitations of DP and MC Approaches

**UNIT III: Temporal-Difference Learning & Function Approximation**

TD(0), Sarsa, and Q-Learning Algorithms, Eligibility Traces: TD(λ), Sarsa(λ), Off-policy vs. On-policy Learning, Linear Function Approximation, Generalization in RL

**UNIT IV: Policy Gradient Methods and Actor-Critic Algorithms**

Policy Gradient Theorem, REINFORCE Algorithm, Baselines and Variance Reduction,Actor-Critic Architectures, Trust Region and Proximal Policy Optimization (PPO)

**UNIT V: Deep Reinforcement Learning and Applications**

Deep Q-Networks (DQN) and Experience Replay, DDPG, A3C, and SAC Algorithms, Exploration Techniques: ε-greedy, UCB, Intrinsic Rewards, RL in Robotics, Game AI, and Autonomous Systems, Safety, Ethics, and Fairness in Decision Making

**Textbooks:**

1. Richard S. Sutton and Andrew G. Barto – Reinforcement Learning: An Introduction, 2nd Edition, MIT Press
2. Ian Goodfellow, Yoshua Bengio, Aaron Courville – Deep Learning, MIT Press

**Reference Books:**

1. David Silver's RL Course Slides & Lectures – DeepMind, University College London
2. Marco Wiering & Martijn van Otterlo (Eds.) – Reinforcement Learning: State of the Art, Springer
3. Csaba Szepesvári – Algorithms for Reinforcement Learning, Morgan & Claypool
4. Yuxi Li – Deep Reinforcement Learning: An Overview, arXiv survey

**Online Courses & Resources:**

1. DeepMind x UCL Reinforcement Learning Lectures by David Silver
2. Coursera: Reinforcement Learning Specialization – University of Alberta
3. DeepLearning.AI – Deep Reinforcement Learning with TensorFlow

| HONOURS DEGREE | AI for Robotics & Automation | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**Course Objectives:**

- To introduce the fundamental concepts of robotics and its integration with artificial intelligence (AI).
- To understand perception, motion planning, and control strategies using AI for autonomous robots.
- To explore machine learning and deep learning approaches in robotic automation.
- To develop intelligent systems capable of navigation, manipulation, and decision-making.
- To understand real-time robotic applications in industry and research.

**Course Outcomes (COs):**

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

- CO1: Explain the role of AI in robotics and the architecture of intelligent robotic systems.
- CO2: Apply computer vision and sensor fusion techniques for robotic perception.
- CO3: Design motion planning and control algorithms for robotic navigation.
- CO4: Integrate machine learning models for autonomous behavior and adaptation.
- CO5: Analyze applications of AI-powered robots in industrial automation, agriculture, healthcare, and logistics.
- CO6: Develop and evaluate simple autonomous robotic systems with real-time AI decision-making capabilities.

**UNIT I: Introduction to AI and Robotics**

Fundamentals of Robotics and Components, AI Techniques for Robotics, Types of Robots: Mobile, Industrial, Collaborative, Humanoids, Architectures for Intelligent Robots, Sensors and Actuators in Robotics

**UNIT II: Robotic Perception and Computer Vision**

Perception Pipeline in Robots, Image Processing & Object Detection, Depth Estimation, 3D Mapping (SLAM), Sensor Fusion (Camera, LiDAR, IMU), Vision-based Navigation and Obstacle Avoidance

**UNIT III: Motion Planning and Control**

Path Planning: Dijkstra, A*, RRT, PRM, Control Strategies: PID, Feedback Linearization. Trajectory Generation. Kinematics & Dynamics for Robot Manipulators. Motion Planning in Dynamic Environments

**UNIT IV: Machine Learning in Robotics**

Reinforcement Learning for Control, Supervised Learning for Object Recognition, Unsupervised Learning for Clustering and Mapping, Behavior Cloning and Imitation Learning, Online and Adaptive Learning in Robots

**UNIT V: Applications and Trends in Robotic Automation**

AI in Industrial Automation and Smart Factories, AI for Service Robots and Human-Robot Interaction (HRI), Robots in Agriculture, Healthcare, and Delivery, Ethical and Social Implications of AI in Robotics, Case Studies: Boston Dynamics, Tesla Bots, Warehouse Automation

**Textbooks:**

1. Robin R. Murphy – Introduction to AI Robotics, MIT Press
2. Peter Corke – Robotics, Vision and Control: Fundamental Algorithms in MATLAB, Springer
3. Oussama Khatib and Bruno Siciliano (Eds.) – Springer Handbook of Robotics, Springer

**Reference Books:**

1. Kevin M. Lynch & Frank C. Park – Modern Robotics: Mechanics, Planning, and Control, Cambridge University Press
2. Siegwart, Nourbakhsh, Scaramuzza – Introduction to Autonomous Mobile Robots, MIT Press
3. Stuart Russell & Peter Norvig – Artificial Intelligence: A Modern Approach, Pearson

**Online Courses & Resources:**

1. Coursera – Robotics Specialization (University of Pennsylvania)
2. edX – AI for Robotics (Columbia University)
3. Udacity – AI for Robotics by Sebastian Thrun

| HONOURS DEGREE | AI Ethics, Fairness & Explainability | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**Course Objectives:**

1. To understand the ethical challenges and responsibilities involved in building and deploying AI systems.
2. To identify and mitigate bias in AI data, algorithms, and models.
3. To explore techniques for interpretability and explainability in machine learning.
4. To critically evaluate AI systems from a legal, social, and philosophical perspective.
5. To analyze real-world case studies involving ethical dilemmas in AI deployment.

**Course Outcomes:**

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

**CO1**: Demonstrate awareness of ethical and societal concerns associated with AI technologies.

**CO2**: Detect and reduce bias in datasets and machine learning models.

**CO3**: Apply explainable AI (XAI) techniques for model transparency.

**CO4**: Evaluate AI systems based on fairness, accountability, and transparency.

**CO5**: Reflect on policy, legal, and human-centric implications of AI deployment.

**Unit I: Foundations of AI Ethics**

Introduction to AI Ethics and Responsible AI, Ethical Theories: Utilitarianism, Deontology, Virtue Ethics, Key Ethical Principles: Fairness, Accountability, Transparency, Privacy (FATP), Human-in-the-loop and Ethical Decision Making, AI and the SDGs (Sustainable Development Goals)

**Unit II: Bias in Data and Algorithms**

Types of Bias: Historical, Representation, Measurement, Aggregation, Sources of Bias in AI: Data Collection, Annotation, Model Training, Metrics for Fairness: Demographic Parity, Equal Opportunity, Predictive Parity, Bias Mitigation Techniques: Pre-processing, In-processing, Post-processing, Case Studies: COMPAS, Hiring Algorithms, Face Recognition Bias

**Unit III: Explainable AI (XAI) Techniques**

Need for Explainability and Transparency, Global vs Local Explanations, Methods: LIME, SHAP, Anchors, Integrated Gradients, Model-specific vs Model-agnostic Explanations, Visual Explanations and Human-Centric Interpretability

**Unit IV: Legal, Regulatory & Societal Aspects**

Data Protection Laws: GDPR, CCPA, Indian Digital Personal Data Protection Act, Ethical Guidelines: IEEE, UNESCO, OECD AI Principles, Algorithmic Accountability and Auditing, Intellectual Property and Liability in AI, Ethical Considerations in Surveillance, Military, and Social Scoring

**Unit V: Building Responsible AI Systems**

Designing Ethical AI Systems: Frameworks and Toolkits, Human-Centered AI and Value Alignment, Responsible AI Lifecycle and Documentation (Model Cards, Data Sheets), AI for Good and Ethical Innovation, Industry Case Studies: Google, Microsoft, IBM's AI Governance

**Textbooks:**

1. **Virginia Dignum**, Responsible Artificial Intelligence: How to Develop and Use AI in a Responsible Way, Springer, 2019.
2. **Cathryn Carson and John Zerilli**, Ethics and Data Science, O'Reilly Media, 2021.
3. **Patrick Lin, Keith Abney, Ryan Jenkins**, Robot Ethics 2.0: From Autonomous Cars to Artificial Intelligence, Oxford University Press, 2017.

**Reference Books:**

1. **Shalini Sharma, B. Ravindran**, Responsible AI: An Indian Perspective, Springer, 2023.
2. **Christopher Kuner et al.**, The GDPR: General Data Protection Regulation (EU) Regulation 2016/679, Oxford University Press.

| HONOURS DEGREE | AI & Machine Learning Lab | L | T | P | C |
|---|---|---|---|---|---|
| | | 0 | 0 | 3 | 1.5 |

**Course Objectives**

1. To provide hands-on experience in implementing AI and machine learning algorithms.
2. To develop and evaluate models using real-world datasets.
3. To introduce optimization and hyperparameter tuning techniques.
4. To build intelligent systems for classification, prediction, and clustering.

**Course Outcomes (CO)**

After completing this lab, students will be able to:

**CO1**: Implement key machine learning algorithms from scratch and using libraries.

**CO2**: Preprocess data and select suitable features for modeling.

**CO3**: Train, test, and evaluate models for accuracy and performance.

**CO4**: Apply AI techniques to solve classification, regression, and decision-making problems.

**CO5**: Develop simple AI agents and use neural networks for predictive tasks.

**Tools Required**

- Python (NumPy, Pandas, Scikit-learn, TensorFlow/Keras, OpenCV)
- Jupyter Notebook / Google Colab
- Datasets from UCI, Kaggle, Scikit-learn
- Anaconda / VS Code

**List of 12 Experiments**

1. **Data Preprocessing** – Cleaning, normalization, encoding, and splitting data.
2. **Linear Regression** – Implement simple and multiple linear regression.
3. **Logistic Regression** – Binary classification on datasets like breast cancer or Titanic.
4. **K-Nearest Neighbors (KNN)** – Classification task with evaluation metrics.
5. **Decision Trees and Random Forests** – Tree-based classification and visualization.
6. **Support Vector Machines (SVM)** – Margin classification with kernel trick.
7. **Naive Bayes** – Text classification with spam dataset.
8. **K-Means Clustering** – Unsupervised clustering with customer segmentation.
9. **Principal Component Analysis (PCA)** – Dimensionality reduction and visualization.
10. **Artificial Neural Networks (ANNs)** – Implement basic neural network using Keras.
11. **Model Evaluation & Tuning** – Use cross-validation, GridSearchCV, and confusion matrices.
12. **AI Agent Search Algorithms** – Implement A*, DFS, BFS for pathfinding problems.

| HONOURS DEGREE | Robotics & Autonomous Systems Lab | L | T | P | C |
|---|---|---|---|---|---|
| | | 0 | 0 | 3 | 1.5 |

**Course Objectives:**

- To introduce students to the fundamental concepts of robotics, control, and autonomous navigation.
- To provide hands-on experience with robotic simulation tools and real-time robot programming.
- To explore sensor integration, motion planning, and autonomous decision-making.
- To familiarize students with ROS (Robot Operating System) and robotic hardware platforms.
- To apply AI and machine learning concepts in robotics for perception and autonomy.

**Course Outcomes:**

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

- Understand and implement kinematics and control algorithms for robotic systems.
- Program robots using ROS and simulate them in environments like Gazebo or Webots.
- Integrate sensors such as LIDAR, cameras, and IMUs for perception.
- Develop algorithms for autonomous navigation, obstacle avoidance, and mapping.
- Apply AI and computer vision techniques in robotic decision-making.

**List of 12 Lab Experiments:**

1. Experiment 1: Introduction to Robot Operating System (ROS) and workspace setup.
2. Experiment 2: Build a basic ROS publisher and subscriber for robot control.
3. Experiment 3: Simulate a differential drive robot in Gazebo or Webots.
4. Experiment 4: Implement forward and inverse kinematics for a 2-link robotic arm.
5. Experiment 5: Control robot movement using PID control in simulation.
6. Experiment 6: Interface and process data from ultrasonic/IR sensors.
7. Experiment 7: Integrate and visualize LIDAR data for environment sensing.
8. Experiment 8: Implement SLAM (Simultaneous Localization and Mapping) using Gmapping or Cartographer.
9. Experiment 9: Develop a path planning algorithm using A* or Dijkstra.
10. Experiment 10: Obstacle avoidance using sensor data and reactive behavior.
11. Experiment 11: Vision-based object detection and tracking using OpenCV.
12. Experiment 12: Mini project – Build a complete pipeline for autonomous navigation in a mapped environment.

**Textbooks:**

1. Roland Siegwart, Illah Nourbakhsh, and Davide Scaramuzza, Introduction to Autonomous Mobile Robots, MIT Press.
2. John J. Craig, Introduction to Robotics: Mechanics and Control, Pearson.

| | JAVA PROGRAMMING<br>(Open Elective-I) | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

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

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

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

**CO1:** Analyze problems, design solutions using OOP principles, and implement them efficiently in Java.

**CO2:** Design and implement classes to model real-world entities, with a focus on attributes, behaviors, and relationships between objects

**CO3:** Demonstrate an understanding of inheritance hierarchies and polymorphic behaviour, including method overriding and dynamic method dispatch.

**CO4:** Apply Competence in handling exceptions and errors to write robust and fault-tolerant code.

**CO5:** Perform file input/output operations, including reading from and writing to files using Java I/O classes, graphical user interface (GUI) programming using JavaFX.

**Unit – I**

**Object Oriented Programming:** Basic concepts, Principles, Program Structure in Java: Introduction, Writing Simple Java Programs, Elements or Tokens in Java Programs, Java Statements, Command Line Arguments, User Input to Programs, Escape Sequences Comments, Programming Style. Data Types, **Variables, and Operators :**Introduction, Data Types in Java, Declaration of Variables, Data Types, Type Casting, Scope of Variable Identifier, Literal Constants, Symbolic Constants, Formatted Output with printf() Method, Static Variables and Methods, Attribute Final, **Introduction to Operators**, Precedence and Associativity of Operators, Assignment Operator ( = ), Basic Arithmetic Operators, Increment (++) and Decrement (- -) Operators, Ternary Operator, Relational Operators, Boolean Logical Operators, Bitwise Logical Operators.

**Control Statements:** Introduction, if Expression, Nested if Expressions, if–else Expressions, Ternary Operator?:, Switch Statement, Iteration Statements, while Expression, do–while Loop, for Loop, Nested for Loop, For–Each for Loop, Break Statement, Continue Statement.

**Unit II**

**Classes and Objects:** Introduction, Class Declaration and Modifiers, Class Members, Declaration of Class Objects, Assigning One Object to Another, Access Control for Class Members, Accessing

Private Members of Class, Constructor Methods for Class, Overloaded Constructor Methods, Nested Classes, Final Class and Methods, Passing Arguments by Value and by Reference, Keyword this.
**Methods:** Introduction, Defining Methods, Overloaded Methods, Overloaded Constructor Methods, Class Objects as Parameters in Methods, Access Control, Recursive Methods, Nesting of Methods, Overriding Methods, Attributes Final and Static.

**Unit III**

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

**Unit IV**

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

**Unit V**

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

**Learning Resources:**

**Textbooks:**

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

**Reference Books:**

1. The complete Reference Java, 11thedition, Herbert Schildt,TMH
2. Introduction to Java programming, 7th Edition, Y Daniel Liang, Pearson

Online Learning Resources:

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

| | Introduction to Artificial Intelligence (Open Elective-I) | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**Course Objectives:**

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

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

**Course Outcomes:**

1. Apply uninformed and informed search algorithms to solve well-defined problems using AI agents and local search strategies.
2. Analyze and implement adversarial search (game playing), constraint satisfaction techniques, and perform inference using propositional logic.
3. Represent and reason with knowledge using First-Order Logic and perform inference using unification, forward/backward chaining, and resolution techniques.
4. Develop and analyze classical and hierarchical planning algorithms for automated problem solving.
5. Apply probabilistic reasoning, Bayesian networks, and approximate inference methods to represent and handle uncertainty in intelligent systems.

**UNIT - I**

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

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

**UNIT-II**

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

**UNIT-III**

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

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

**UNIT-IV**

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

**UNIT-V**

**Probabilistic Reasoning:**

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

**TEXT BOOK:**

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

**REFERENCE BOOKS:**

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

| | **Operating Systems (Open Elective-II)** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|---|
| | | **3** | **0** | **0** | **3** |

**Course Objectives:** The course is designed to

1. Understand the fundamental principles of operating systems and their role in managing hardware and software resources.
2. Explore process management techniques, including scheduling algorithms, multithreading, and inter-process communication mechanisms.
3. Analyze memory management strategies such as paging, segmentation, and virtual memory to optimize system performance.
4. Evaluate deadlock conditions and file system structures, including resource allocation, disk scheduling, and RAID technologies.
5. Implement security and protection mechanisms to safeguard computer systems from threats and unauthorized access.

**Course Outcomes (CO):** After completion of the course, students will be able to

1. Explain core operating system functions such as process, memory, file, and device management.
2. Analyze scheduling algorithms and IPC mechanisms to enhance process efficiency.
3. Apply memory management techniques to improve system performance.
4. Assess deadlock conditions and propose solutions for resource management.
5. Design security strategies to protect systems using cryptographic methods and firewalling techniques.

**UNIT - I Operating Systems Overview, System Structures** Lecture 8Hrs

Operating Systems Overview: Introduction, Operating system functions, Operating systems operations, Computing environments, Open-Source Operating Systems System Structures: Operating System Services, User and Operating-System Interface, systems calls, Types of System Calls, system programs, Operating system Design and Implementation, Operating system structure, Operating system debugging, System Boot.

**UNIT - II Process Concept, Multithreaded Programming, Process Scheduling, Inter-process Communication** Lecture 10Hrs

Process Concept: Process scheduling, Operations on processes, Inter-process communication, Communication in client server systems. Multithreaded Programming: Multithreading models, Thread libraries, Threading issues, Examples. Process Scheduling: Basic concepts, Scheduling criteria, Scheduling algorithms, Multiple processor scheduling, Thread scheduling, Examples. Inter-process Communication: Race conditions, Critical Regions, Mutual exclusion with busy waiting, Sleep and wakeup, Semaphores, Mutexes, Monitors, Message passing, Barriers, Classical IPC Problems - Dining philosophers problem, Readers and writers problem.

**UNIT - III Memory-Management Strategies, Virtual Memory Management**

Memory-Management Strategies: Introduction, Swapping, Contiguous memory allocation, Paging, Segmentation, Examples. Virtual Memory Management: Introduction, Demand paging, Copy on-write, Page replacement, Frame allocation, Thrashing, Memory-mapped files, Kernel memory allocation, Examples.

**UNIT - IV Deadlocks, File Systems**

Deadlocks: Resources, Conditions for resource deadlocks, Ostrich algorithm, Deadlock detection And recovery, Deadlock avoidance, Deadlock prevention. File Systems: Files, Directories, File system implementation, management and optimization. Secondary-Storage Structure: Overview of disk structure, and attachment, Disk scheduling, RAID structure, Stable storage implementation.

**UNIT - V System Protection, System Security**

System Protection: Goals of protection, Principles and domain of protection, Access matrix, Access control, Revocation of access rights. System Security: Introduction, Program threats, System and network threats, Cryptography as a security, User authentication, implementing security defenses, firewalling to protect systems and networks, Computer security classification. Case Studies: Linux, Microsoft Windows.

**Textbooks:**

1. Silberschatz A, Galvin P B, and Gagne G, Operating System Concepts, 9th edition, Wiley, 2016.
2. Tanenbaum A S, Modern Operating Systems, 3rd edition, Pearson Education, 2008. (Topics: Inter-process Communication and File systems.)

**Reference Books:**

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

**Online Learning Resources:**

*https://nptel.ac.in/courses/106/106/106106144/*
*http://peterindia.net/OperatingSystems.html*

| | MACHINE LEARNING<br>(Open Elective-II) | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**Course Objectives:**

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

1. Understand the fundamental concepts of machine learning, its types, applications, and data preprocessing techniques.
2. Learn to select, train, evaluate, and improve machine learning models while applying feature engineering techniques.
3. Explore Bayesian methods for concept learning and understand various classification algorithms.
4. Understand regression techniques for predictive modeling and methods to enhance model accuracy.
5. Learn unsupervised learning techniques such as clustering and association rule mining for pattern discovery.

**Course Outcomes (CO):**

After completion of the course, students will be able to

1. Explain the significance of machine learning types, applications, and data quality in model building
2. Apply feature engineering methods to improve model performance and interpretability.Implement classification models such as k-NN, Decision Trees, and Random Forest for predictive tasks
3. Implement classification algorithms such as k-NN, Decision Trees, and Random Forests.
4. Analyze regression algorithms and improve model accuracy using optimization techniques.
5. Design clustering models using partitioning and density-based techniques for pattern recognition.

**UNIT I Introduction to Machine Learning &Preparing to Model** Lecture 9Hrs

Introduction: What is Human Learning? Types of Human Learning, what is Machine Learning?Types of Machine Learning, Problems Not to Be Solved Using Machine Learning, Applications of Machine Learning, State-of-The-Art Languages/Tools in Machine Learning, Issues in Machine Learning

Preparing to Model: Introduction, Machine Learning Activities, Basic Types of Data in Machine Learning, Exploring Structure of Data, Data Quality and Remediation, Data Pre-Processing .

**UNIT II Modelling and Evaluation &Basics of Feature Engineering**

Introduction, selecting a Model, training a Model (for Supervised Learning), Model Representation and Interpretability, Evaluating Performance of a Model, Improving Performance of a ModelBasics of Feature Engineering: Introduction, Feature Transformation, Feature Subset Selection

**UNIT III Bayesian Concept Learning & Supervised Learning: Classification**

Introduction, Why Bayesian Methods are Important? Bayes' Theorem, Bayes' Theorem and Concept Learning, Bayesian Belief Network

Supervised Learning: Classification: Introduction**,** Example of Supervised Learning**,** Classification Model**,** Classification Learning Steps**,** Common Classification Algorithms-*k*-Nearest Neighbour(*k*NN), Decision tree, Random forest model, Support vector machines

**UNIT IV Supervised Learning: Regression**

Introduction, Example of Regression, Common Regression Algorithms-Simple linear regression, Multiple linear regression, Assumptions in Regression Analysis, Main Problems in Regression Analysis, Improving Accuracy of the Linear Regression Model, Polynomial Regression Model, Logistic Regression, Maximum Likelihood Estimation.

**UNIT V Unsupervised Learning**

Introduction, Unsupervised vs Supervised Learning, Application of Unsupervised Learning, Clustering – Clustering as a machine learning task, Different types of clustering techniques, Partitioning methods, *K*-Medoids: a representative object-based technique, Hierarchical clustering, Density-based methods-DBSCAN Finding Pattern using Association Rule- Definition of common terms, Association rule, Theapriori algorithm for association rule learning, Build the aprioriprinciplerules

**Textbooks:**

1.Machine Learning, SaikatDutt, Subramanian Chandramouli, Amit Kumar Das, Pearson, 2019.

**Reference Books:**

1. EthernAlpaydin, “Introduction to Machine Learning”, MIT Press, 2004.
2. Stephen Marsland, “Machine Learning -An Algorithmic Perspective”, Second Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series,2014.

1.Andreas C. Müller and Sarah Guido “Introduction to Machine Learning with Python: A Guide for Data Scientists”, Oreilly.

**Online Learning Resources:**

- Andrew Ng, “Machine Learning B.Techning”
- https://www.deeplearning.ai/machine-learning- B.Techning/
- Shai Shalev-Shwartz , Shai Ben-David, “Understanding Machine Learning: From Theory to Algorithms” , Cambridge University Press
- https://www.cse.huji.ac.il/~shais/UnderstandingMachineLearning/index.html

| | Database Management System (Open Elective-III) | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**Course Objectives:**

- To introduce the fundamental concepts of database systems and data modeling.
- To provide knowledge on relational databases and SQL for data retrieval and manipulation.
- To understand database design principles using normalization and ER modeling.
- To study transaction management, concurrency control, and database recovery.
- To explore emerging database technologies and architectures including NoSQL.

**Course Outcomes (COs):**

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

1. Understand the basic concepts of database systems and their architecture.
2. Apply ER modeling and relational algebra for database design.
3. Analyze and implement normalization techniques for schema refinement.
4. Evaluate transaction management techniques, concurrency control, and recovery.
5. Explore non-relational databases and recent trends in database systems.

**UNIT I: Introduction to Databases**

Database System Applications and Purpose, View of Data: Data Abstraction and Data Independence, Database Users and Administrators, DBMS Architecture and Data Models, ER Model: Entities, Attributes, Relationships, ER Diagrams, Reduction of ER Model to Tables

**UNIT II: Relational Model and Algebra**

Structure of Relational Databases, Relational Model Concepts and Integrity Constraints, Relational Algebra: Selection, Projection, Set Operations, Joins, Tuple Relational Calculus, Introduction to SQL: DDL, DML, DCL, Advanced SQL: Subqueries, Joins, Views, Indexes

**UNIT III: Database Design and Normalization**

Schema Design and Logical Database Design, Functional Dependencies, Normal Forms: 1NF, 2NF, 3NF, BCNF, Decomposition and Lossless Join, Dependency Preservation, Multi-Valued and Join Dependencies.

**UNIT IV: Transaction Management and Concurrency Control**

Concept of a Transaction, ACID Properties, Serializability and Schedules, Concurrency Control: Lock-Based, Timestamp-Based Protocols, Deadlock Handling, Recovery Techniques: Log-Based, Shadow Paging

**UNIT V: Advanced Topics and NoSQL Databases**

Distributed Databases and Parallel Databases, Introduction to NoSQL: Types – Document, Columnar, Key-Value, Graph, CAP Theorem, MongoDB: Basics and CRUD Operations, Big Data and NewSQL Overview, Case Studies on Real-World Databases

Textbooks:

1. Abraham Silberschatz, Henry F. Korth, S. Sudarshan – *Database System Concepts*, 7th Edition, McGraw Hill
2. Ramez Elmasri, Shamkant B. Navathe – *Fundamentals of Database Systems*, 7th Edition, Pearson Education

Reference Books:

1. C.J. Date – *An Introduction to Database Systems*, 8th Edition, Addison-Wesley
2. Raghu Ramakrishnan, Johannes Gehrke – *Database Management Systems*, 3rd Edition, McGraw Hill
3. Pramod J. Sadalage & Martin Fowler – *NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence*, Pearson

Online Resources & Courses:

1. NPTEL – Database Management Systems by IIT Madras
2. Coursera – Databases by Stanford University
3. Khan Academy – Intro to SQL
4. MongoDB University – Free Courses on NoSQL Databases
5. W3Schools SQL Tutorial
6. GeeksforGeeks – DBMS Concepts and Practice Problems

| | CYBER SECURITY<br>(Open Elective-III) | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**Course Objectives:**

The course is designed to provide awareness on different cyber crimes, cyber offenses, tools and methods used in cybercrime.

**Course Outcomes:**

After completion of the course, students will be able to

- Classify the cybercrimes and understand the Indian ITA 2000
- Analyse the vulnerabilities in any computing system and find the solutions
- Predict the security threats of the future
- Investigate the protection mechanisms
- Design security solutions for organizations

**UNIT I Introduction to Cybercrime**

Introduction, Cybercrime, and Information Security, Who are Cybercriminals, Classifications of Cybercrimes, And Cybercrime: The legal Perspectives and Indian Perspective, Cybercrime and the Indian ITA 2000, A Global Perspective on Cybercrimes.

**UNIT II Cyber Offenses: How Criminals Plan Them**

Introduction, How Criminals plan the Attacks, Social Engineering, Cyber stalking, Cyber cafe and Cybercrimes, Botnets: The Fuel for Cybercrime, Attack Vector, Cloud Computing

**UNIT III Cybercrime: Mobile and Wireless Devices**

Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication service Security, Attacks on Mobile/Cell Phones,

Mobile Devices:

Security Implications for Organizations, Organizational Measures for Handling Mobile, Organizational Security Policies an Measures in Mobile Computing Era, Laptops.

**UNIT IV Tools and Methods Used in Cybercrime**

Introduction, Proxy Servers and Anonymizers, Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Trojan Horse and Backdoors, Steganography, DoS and DDoS attacks, SQL Injection,Buffer Overflow.

**UNIT VCyber Security:Organizational Implications**

Introduction, Cost of Cybercrimes and IPR issues, Web threats for Organizations, Security and Privacy Implications, Social media marketing: Security Risks and Perils for Organizations, Social Computing and the associated challenges for Organizations.

**Textbooks:**

1. Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Nina Godbole and Sunil Belapure, Wiley INDIA.

**Reference Books:**

1. Cyber Security Essentials, James Graham, Richard Howard and Ryan Otson, CRC Press.

2. Introduction to Cyber Security, Chwan-Hwa(john) Wu,J.DavidIrwin.CRC Press T&F Group

**Online Learning Resources:**

*http://nptel.ac.in/courses/106105031/40*

*http://nptel.ac.in/courses/106105031/39*

*http://nptel.ac.in/courses/106105031/38*

| | COMPUTER NETWORKS<br>(Open Elective-IV) | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**Course Objectives:**
The course is designed to

1. To introduce the fundamentals of the Internet, networking concepts, reference models, and transmission media.
2. To understand the data link layer design, error handling mechanisms, LAN technologies, and access networks.
3. To study the routing algorithms, internetworking concepts, and network layer functionalities.
4. To explore transport layer protocols such as UDP and TCP, and understand their mechanisms, including congestion control.
5. To introduce the principles behind network applications and protocols, and explore widely used application-layer services such as the Web, Email, DNS, peer-to-peer systems, and content distribution networks.

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

1. Describe the architecture of the Internet, reference models, and explain different types of transmission media used in networking.
2. Apply error detection and correction techniques and analyze data link layer protocols and LAN technologies.
3. Explain routing algorithms and the structure of the network layer, including internetworking.
4. Analyze the working of transport layer protocols like TCP and UDP, including concepts of connection management and congestion control.

Explain the principles of network applications and describe the functionality of protocols such as HTTP, SMTP, DNS, and peer-to-peer systems, including multimedia streaming and content delivery networks.

**UNIT I Computer Networks and the Internet**
What Is the Internet? The Network Edge, The Network Core, Delay, Loss, and Throughput in PacketSwitched Networks(Textbook 2), Reference Models, Example Networks, Guided Transmission Media, Wireless Transmission(Textbook 1)

**UNIT II The Data Link Layer, Access Networks, and LANs**
Data Link Layer Design Issues, Error Detection and Correction, Elementary Data Link Protocols, Sliding Window Protocols (Textbook 1) Introduction to the Link Layer, Error-Detection and -Correction Techniques, Multiple Access Links and Protocols, Switched Local Area Networks

Link Virtualization: A Network as a Link Layer, Data Center Networking, Retrospective: A Day in the Life of a Web Page Request (Textbook 2)

**UNIT III The Network Layer**
Routing Algorithms, Internetworking, The Network Layer in The Internet (Textbook 1)

**UNIT IV The Transport Layer**
Connectionless Transport: UDP (Textbook 2), The Internet Transport Protocols: TCP, Congestion Control (Textbook 1)

**UNIT V Principles of Network Applications**

Principles of Network Applications, The Web and HTTP, Electronic Mail in the Internet, DNS—The Internet's Directory Service, Peer-to-Peer Applications Video Streaming and Content Distribution Networks (Textbook 2)

**Textbooks:**

1. Andrew S.Tanenbaum, David j.wetherall, Computer Networks, 5th Edition, PEARSON.
2. James F. Kurose, Keith W. Ross, "Computer Networking: A Top-Down Approach", 6th edition, Pearson, 2019.

**Reference Books:**

1. Forouzan, Datacommunications and Networking, 5th Edition, McGraw Hill Publication.
2. Youlu Zheng, Shakil Akthar, "Networks for Computer Scientists and Engineers", Oxford Publishers, 2016.

**Online Learning Resources:**

https://nptel.ac.in/courses/106105183/25

http://www.nptelvideos.in/2012/11/computer-networks.html

https://nptel.ac.in/courses/106105183/3

| | INTERNET OF THINGS (Open Elective-IV) | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**Course Objectives:**

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

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

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

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

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

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

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

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

**Textbooks:**

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

**Reference Books:**

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

**Online Learning Resources:**

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