Department: AI&DS **Rev:** Course Structure/00/2023-24

Class: Final Year B. Tech **Semester:** VII

Sr No	Course Code	Course Type	Course	Teaching Scheme				Evaluation Scheme					Credits
				L	T	P	Total Hrs.	CA1	CA 2	MSE	ESE	Total	
1	23AD4701	PCC	Deep Learning	3	-	-	3	10	10	30	50	100	3
2	23AD4702	PEC	Elective-IV	3	-	-	3	10	10	30	50	100	3
3	23AD4703	PEC	Elective-V	3	-	-	3	10	10	30	50	100	3
4	23AD4704	ELC	Research Methodology	3	-	-	3	10	10	30	50	100	3
5	23AD4705	VSEC	Application Development-II	-	-	4	4	25	25	-	-	50	2
6	23AD4706	PCC	Deep Learning Laboratory	-	-	2	2	15	15	-	20	50	1
7	23AD4707	PROJ	Capstone Project Phase-II	-	-	4	4	25	25	-	50	100	2
8	23ADMDXX	MDM	Multidisciplinary Minor	3	-	-	3	10	10	30	50	100	3
9	23AD4708	HSMC	Values and Ethics	2	-	-	2	25	25	-	-	50	Audit
Total				**17**	**-**	**10**	**27**	**140**	**140**	**150**	**320**	**750**	**20**

Elective-IV:
23AD4702A- Introduction to Reinforcement Learning
23AD4702B- Advanced Database Technologies
23AD4702C- Edge Computing

Elective V:
23AD4703A- Internet of Things
23AD4703B- Digital Image Processing
23AD4703C- Pattern Recognition

Multidisciplinary Minor

Basket	Finance & Management	Health Sciences/ Science & Technology/Environment	Management & Entrepreneur Development
Semester VII	Business Analytics and ML Modelling (23ADMDA5)	IOT in healthcare (23ADMDB5)	Management Accounting (23ADMDC5)

Final Year (ARTIFICIAL INTELLIGENCE AND DATA SCIENCE) Semester VII

23AD4701	PCC	Deep Learning	3-0-0	3 Credits

Teaching Scheme	Evaluation Scheme
Lecture:3hrs/week	CA I: 10 Marks CAII: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Machine Learning.

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

CO1	Understand the basics of Deep Learning.
CO2	Evaluate the performance of deep learning models.
CO3	Implement the technique of Convolution Neural Network (CNN).
CO4	Solve the language translation problem using Recurrent Neural Network (RNN).
CO5	Construct new data using deep generative models.
CO6	Apply on-policy reinforcement learning algorithms.

Course Contents:

Unit I: Foundations of Deep learning What is machine learning and deep learning? History of deep learning, Advantage and challenges of deep learning. Understanding how deep learning works in three figures(input, hidden layer, output Architecture Design, Applications of Deep learning. **Hyperparameters:** Learning Rate, Regularization, Momentum, Sparsity, Hidden Units, cost functions, error back propagation, Gradient-Based Learning, Implementing Gradient Descent, vanishing and Exploding gradient descent, Optimization algorithm(SGD, AdaGrad, RMSProp, adam). **Exemplar/Case Studies:** Deep Mind, AlphaGo, Boston Dynamics, Amazon go store	[6]
Unit II: Deep Neural Networks (DNNs) Introduction to Neural Networks: The Biological Neuron, The Perceptron(AND,OR,NOT, XOR), Deep forward network, Multilayer Feed-Forward Networks, Training Neural Networks: Backpropagation and Forward propagation Activation Functions: Linear, Sigmoid, Tannh, Hard Tanh, Softmax, Rectified Linear, Loss Functions: Loss Function Notation, Loss Functions for Regression, Loss	[6]

Functions for Classification, Loss Functions for Reconstruction. **Exemplar/Case Studies:** A Case Study for Music Genre Classification	
Unit III: Convolution Neural Network (CNN) Introduction, CNN architecture overview, The Basic Structure of a Convolutional Network- Padding, Strides, Typical Settings, the ReLU layer, Pooling, Fully Connected Layers, The Interleaving between Layers, Local Response Normalization, Training a Convolutional Network **Exemplar/Case Studies:** AlexNet, VGG	[6]
Unit IV: Recurrent Neural Network (RNN) Recurrent and Recursive Nets: Unfolding Computational Graphs, Recurrent Neural Networks, Bidirectional RNNs, Encoder-Decoder Sequence-to-Sequence Architectures, Deep Recurrent Networks, Recursive Neural Networks, The Challenge of Long-Term Dependencies, Echo State Networks, Leaky Units and Other Strategies for Multiple Time Scales, The Long Short-Term Memory and Other Gated RNNs, Optimization for Long-Term Dependencies, Explicit Memory.	[6]
Unit V: Deep Generative Models Introduction to deep generative model, Boltzmann Machine, Deep Belief Networks, Generative adversarial network (GAN), discriminator network, generator network, types of GAN, Applications of GAN networks **Exemplar/Case Studies**: GAN for detection of real or fake images, ChatGPT	[6]
Unit VI: Reinforcement Learning Introduction of deep reinforcement learning, Markov Decision Process, basic framework of reinforcement learning, challenges of reinforcement learning, Dynamic programming algorithms for reinforcement learning, Q Learning and Deep Q-Networks, Deep Q recurrent networks, Simple reinforcement learning for Tic-Tac-Toe. **Exemplar/Case Studies:** Self-driving cars, Deep learning for chatbots	[6]
Text Books: 1. Goodfellow, I., Bengio, Y., Courville, A, "Deep Learning", MIT Press, 2016 2. Josh Patterson & Adam Gibson, "Deep Learning" Charu Agarwal, "Neural Networks and deep learning"	
Reference Books: 1. Nikhil Buduma, "Fundamentals of Deep Learning", SPD 2. Francois Chollet, "Deep Learning with Python"	

Final Year (ARTIFICIAL INTELLIGENCE AND DATA SCIENCE) Semester VII

Elective-IV

23AD4702A	PEC	Introduction to Reinforcement Learning	3-0-0	3 Credits

Teaching Scheme	Evaluation Scheme
Lecture: 3 hrs/week	CA-I:10 Marks CA-II: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Basic Probability, Linear Algebra, Machine Learning Fundamentals.

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

CO1	Understand fundamental concepts of Reinforcement Learning.
CO2	Demonstrate Bandit Algorithms and Policy Gradient methods to solve decision-making problems.
CO3	Summarize various algorithms of RL and the role of Bellman Optimality.
CO4	Analyze the role of Dynamic Programming, and TD Methods in RL.
CO5	Develop function approximation techniques and least squares methods for RL.
CO6	Elaborate advanced RL techniques such as DQN, Hierarchical RL, and POMDPs.

Course Contents:

Unit I: Introduction to Reinforcement Learning Definition of RL, comparison with supervised and unsupervised learning Elements of RL: Agent, Environment, State, Actions, Rewards, Policy, Value Function Markov Decision Processes (MDP): States, Actions, Transition Probabilities, Rewards Bellman Equation and Optimality Principle Applications of RL in Robotics, Finance, Healthcare, and Gaming.	[6]
Unit II: Bandit Algorithms – UCB, PAC Multi-Armed Bandit (MAB) problem, Exploration vs. Exploitation trade-off, Upper Confidence Bound (UCB) algorithm, Probably Approximately Correct (PAC) framework, Regret minimization, Median Elimination for MABs, Sample complexity analysis, Introduction to Policy Gradient methods, Monte Carlo Policy Gradient (REINFORCE algorithm), Advantages of Policy Gradient methods	[6]

Unit III: Full RL & MDPs, Bellman Optimality Markov Decision Processes (MDPs), State transition probabilities and reward function, Discount factor and return, Value functions (state-value and action-value functions) Bellman Equations, Bellman Expectation Equations, Bellman Optimality Equations, Policy Evaluation and Policy Improvement, Value Iteration and Policy Iteration Convergence of Bellman Equations	[6]
Unit IV: Dynamic Programming & TD Methods, Eligibility Traces Dynamic Programming (DP) for MDPs, Monte Carlo vs. Temporal Difference (TD) Learning, TD (0) and TD(λ) methods, Off-policy vs On-policy learning Q-learning and SARSA algorithms, Definition of eligibility traces, Forward and backward view of TD(λ), Relationship between TD and Monte Carlo methods Implementing eligibility traces in RL algorithms, Lambda-return estimation.	[6]
Unit V: Function Approximation & Least Squares Methods Need for function approximation in RL, Linear function approximation, Nonlinear function approximation using Neural Networks, Trade-offs: Bias-variance, Stability, Convergence, Stochastic Gradient Descent (SGD) in RL, Least Squares Temporal Difference (LSTD) learning, Least Squares Policy Iteration (LSPI), Least Squares Q learning (LSQ), Importance sampling and function approximation, Stability and convergence properties.	[6]
Unit VI: Hierarchical RL & POMDPs (Partially Observable MDPs) Full RL, Motivation for Hierarchical RL, Options Framework, Semi-Markov Decision Processes (SMDPs), Temporal Abstraction in RL, Hierarchical DQN (h-DQN) Introduction to POMDPs, Belief States and Filtering, Planning in POMDPs, Approximate methods for solving POMDPs, Applications of POMDPs in real-world RL problems.	[6]
Text Books: 1. Reinforcement Learning: An Introduction – Richard S. Sutton & Andrew G. Barto 2. Dynamic Programming and Optimal Control – Dimitri P. Bertsekas 3. Reinforcement Learning and Optimal Control – Dimitri P. Bertsekas.	
Reference Books: 1. Reinforcement Learning: State-of-the-Art – Marco Wiering & Martijn van Otterlo 2. Approximate Dynamic Programming – Warren B. Powell	

Final Year (ARTIFICIAL INTELLIGENCE AND DATA SCIENCE) Semester VII

Elective-IV

23AD4702B	PEC	Advanced Database Technologies	3-0-0	3 Credits

Teaching Scheme	Evaluation Scheme
Lecture: 3 hrs/week	CA-I:10 Marks CA-II: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Database Management System

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

CO1	Demonstrate the architecture and design of advanced database systems.
CO2	Apply optimization methods including normalization, indexing, and query processing strategies.
CO3	Explain object-oriented and object-relational database concepts.
CO4	Interpret the principles of distributed databases and Big Data technologies
CO5	Demonstrate the understanding of SQL, NoSQL, NewSQL and cloud-based database technologies.

Course Contents:

Unit I: Advanced Data Modelling & Architectures Evolution of database systems: From RDBMS to NoSQL and beyond, Overview of modern data challenges, introduction of Advanced data models: Object-Oriented and Object-Relational databases, Distributed database architecture (homogeneous & heterogeneous), Parallel database systems and architectures, Data warehouse architecture and components.	[6]
Unit II: Advanced Relational Design & Optimization Review of normalization and its limitations, Denormalization techniques and performance trade-offs, Query optimization techniques, Indexing methods: B+ Trees, Hash indexing, Bitmap indexing, Query processing and execution plans, Materialized views and query rewriting.	[6]
Unit III: Object and Object Relational Databases Object Database Concepts; Object Database Extensions to SQL; The ODMG Object Model and the Object Definition Language ODL; Object Database Conceptual Design; Object Query Language OQL; Language Binding in the ODMG Standard.	[6]
Unit IV: Distributed databases and Big Data Distributed Database Concepts and Advantages, Data Fragmentation, Replication and	

Allocation Techniques for Distributed Database Design, Types of Distributed Database Systems, Distributed Database Architectures. Introduction to Big Data and the Hadoop ecosystem, Apache Hadoop ecosystem: HDFS**,** MapReduce, YARN.	[6]
Unit V: NoSQL Databases and NewSQL Databases Introduction to NoSQL Database, CAP theorem and BASE properties, Types of NoSQL database- Key-value stores, Document databases, Column-family stores, Graph databases, Introduction to NewSQL Database, Characteristics of NewSQL, Google Spanner, VoltDB, CockroachDB, comparison between SQL, NoSQL, NewSQL	[6]
Unit VI: Cloud-Based Database Technologies Overview of cloud database services: AWS RDS, Google Cloud Spanner, Database as a Service (DBaaS) models, Scalability, availability, and disaster recovery in cloud databases, Security and compliance challenges in cloud-based database management.	[6]

Text Books:

1. Database System Concepts, 6th Edition, by Abraham Silberschatz, Henry F Korth, S Sudharshan, McGraw-Hill International Edition,2011.
2. NoSQL Distilled-A Brief Guide to the Emerging World of Polyglot Persistence‖, by Pramod J. Sadalage, Martin Fowler, Pearson Education, Inc-2013.

Reference Books:

1. Database Systems: The Complete Book" by Hector Garcia-Molina, Jeffrey D. Ullman, and Jennifer Widom, Pearson Education Inc.
2. Designing Data-Intensive Applications by Martin Kleppmann, Published by O'Reilly Media, Inc.
3. Readings in Database Systems, 5th Edition, Peter Bailis, Joseph M. Hellerstein, Michael Stonebraker, editors, Red Book.

Final Year (ARTIFICIAL INTELLIGENCE AND DATA SCIENCE) Semester VII

Elective-IV

23AD4702C	PEC	Edge Computing	3-0-0	3 Credits

Teaching Scheme	Evaluation Scheme
Lecture: 3 hrs/week	CA-I:10 Marks CA-II: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites:

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

CO1	Understand the relation of AI and Edge Computing.
CO2	Understand the computing tools and technologies of Edge AI.
CO3	Apply segmentation techniques to improve efficiency of AI models and develop secured distributed Edge applications.
CO4	Apply knowledge of AI for optimizing Edge application.
CO5	Understand and apply concepts of Mobile Edge AI.
CO6	Design and Develop edge application.

Course Contents:

Unit I:Introduction to Edge Computing and AI Fundamentals of Edge Computing: Introduction, Need, Key Techniques, Benefits, Systems Paradigms of Edge computing, Edge Computing Frameworks, Value Scenarios for Edge Computing. Edge computing system architectures. Industrial Applications of Edge Computing, Intelligent Edge and Edge Intelligence, Challenges and opportunities in Edge Computing.	[6]
Unit II: Edge AI Computing Tools Role in Edge Computing: A high-level hardware hierarchy of edge computing paradigm, Virtualization: Virtual Machine and Container, Network Virtualization, Introduction to DevOps: Understanding the history and evolution, Overview of the benefits and challenges, Introduction to DevOps tools and practices, CI/CD: tools such as Jenkins, Travis CI, and CircleCI and CircleCI, GitLab CI/CD Setup and Configuration, installing and setting up GitLab CI/CD, Configuring GitLab CI/CD pipelines, Creating a basic CI/CD configuration file.	[6]

Unit III: Inference and Training in Edge AI Artificial Intelligence Inference in Edge: Optimizing AI models in Edge: General method, Edge device, Overview of Tensor Flow Lite (TFLite) format and its benefits, Introduction to Open Neural Network Exchange (ONNX) format and its advantages, Understanding NVIDIA TensorRT format and its optimizations for inference Segmentation of AI Model, Segmentation of AI Model. Artificial Intelligence Training at Edge: Distributed Training at Edge, Federated Learning (FL) at Edge, Communication-Efficient FL, Resource-Optimized FL, Security-Enhanced FL	[6]
Unit IV: Artificial Intelligence for Optimizing Edge AI for Adaptive Edge Caching: use cases DNNs and DRL, Optimizing Edge Task Offloading, Edge Management and Maintenance: Communication, security, joint Edge optimization.	[6]
Unit V: Mobile Edge AI Overview, Edge inference: On-device inference, Computation offloading, Server-based edge inference, Device-edge joint inference, Edge training: Data partition-based, Model partition-based, Coded computing	[6]
Unit VI: Artificial Intelligence Applications on Edge Real-time Video Analytics, Autonomous Internet of Vehicles(IoVs), Intelligent Manufacturing, Smart Home and City, Urban Healthcare, Urban Energy Management, Manufacturing, Transportation, and traffic.	[6]

Text Books:

1. Wang, X., Han, Y., Leung, V. C., Niyato, D., Yan, X., & Chen, X.," Edge AI: Convergence of edge computing and artificial intelligence", Singapore: Springer,2020, ISBN 978-981-15-6185-6.

2. Jie Cao, Quan Zhang, Weisong Shi "Edge Computing: A Primer", Springer International Publishing

Reference Books:

"Mobile Edge Artificial Intelligence Opportunities and Challenges By Yuanming Shi, Kai Yang, Zhanpeng Yang, Yong Zhou 2021, ISBN - 9780128238172, 0128238178, Elsevier Science publication

Final Year (ARTIFICIAL INTELLIGENCE AND DATA SCIENCE) Semester VII

Elective-V

23AD4703A	PEC	Internet of Things	3-0-0	3 Credits

Teaching Scheme	Evaluation Scheme
Lecture: 3 hrs/week	CA-I:10 Marks CA-II: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Data Communication, Computer Programming

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

CO1	Explain how to design and develop Applications in IOT.
CO2	Explain the specifications and functionalities of various protocols/standards of IOT
CO3	Illustrate Working Principals of Different IOT devices
CO4	Develop simple IOT Applications
CO5	Demonstrate Applications of IOT using Arduino &Raspberry Pi
CO6	Elaborate Simple basic Case studies of IOT

Course Contents:

Unit 1: Introduction to the Internet of Things Architectural Overview, Design principles and needed capabilities, IoT Applications, Sensing, Actuation.	[6]
Unit 2: IOT and Communication Protocols Basics of Networking, Communication Protocols, Sensor Networks, Machine-to-Machine Communications and IoT Technology, Fundamentals Devices and gateways, Data management, Business processes in IoT, Everything as a Service(XaaS),Role of Cloud in IoT, Security aspects in IoT	[6]
Unit 3: Interoperability in IoT Hardware Components Computing (Arduino, Raspberry Pi), Communication, Sensing, Actuation, I/O interfaces, Software Components Programming API's (using Python Programming)	[6]
Unit 4: IoT Application Development Solution framework for IoT applications- Implementation of Device integration, Data acquisition and integration.	[6]

Unit 5: IoT Physical Devices and Endpoints Building IoT with Arduino: Arduino–Interfaces-Arduino IDE–Programming, Raspberry Pi: Introduction to Raspberry Pi, About the Raspberry Pi Board: Hardware Layout, Operating Systems on Raspberry Pi, Configuring Raspberry Pi, Programming Raspberry Pi with Python, Wireless Temperature Monitoring System Temperature Sensor.	[6]
Unit 6: IoT Case Studies IoT case studies and mini projects based on Industrial Automation, Transportation, Agriculture, Healthcare, Home Automation, and Smart Cities.	[6]
Text books: - 1. Arashdeep Bahga ,Vijay Madisetti Internet of Things an Hands on Approach,University Press. 2. Dr. SRN Reddy, Rachit Thukral and Manasi Mishra, "Introduction to Internet of Things: A practical Approach", ETI Labs 3. S. Misra, A. Mukherjee, and A. Roy, 2020. Introduction to IoT. Cambridge University Press. 4. . Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press	
Reference books: 1. Jeeva Jose, "Internet of Things", Khanna Publishing House, Delhi 2. Adrian McEwen, "Designing the Internet of Things", Wiley Raj Kamal, "Internet of Things: Architecture and Design", McGraw Hill Cuno Pfister, "Getting Started with the Internet of Things", O Reilly Media.	

Final Year (ARTIFICIAL INTELLIGENCE AND DATA SCIENCE) Semester VII

Elective-V

23AD4703B	PEC	Digital Image Processing	3-0-0	3 Credits

Teaching Scheme	Evaluation Scheme
Lecture: 3 hrs/week	CA-I:10 Marks CA-II: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Basic Linear Algebra, Probability, Python Programming, Intro to AI/ML

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

CO1	Understand the fundamental concepts, components, and models used in digital image processing.
CO2	Apply image enhancement techniques in spatial and frequency domains for visual improvement.
CO3	Analyze and implement restoration methods and geometric transformations on digital images.
CO4	Perform image segmentation and morphological operations for feature isolation and region identification.
CO5	Identify meaningful features from images for object recognition and analysis.
CO6	Identify compression techniques and explore AI-based applications of digital image processing.

Course Contents:

Unit I: Fundamentals of Digital Image Processing Introduction to digital image processing, Components of an image processing system, Image representation: pixel, resolution, bit depth, Color models: RGB, CMY, HSI, Grayscale, Image digitization: sampling and quantization, Applications in AI and Data Science	[6]
Unit II: Image Enhancement in Spatial and Frequency Domain Spatial domain enhancement: contrast stretching, histogram equalization, smoothing and sharpening filters, Frequency domain: Fourier transform, DFT, FFT Frequency filtering: low-pass, high-pass, band-reject filters, Comparison of spatial and frequency domain techniques.	[6]
Unit III: Image Restoration and Geometric Transformations Noise models: Gaussian, Salt & Pepper, Speckle, Restoration techniques: inverse filtering, Wiener filtering, Image transformations: translation, scaling, rotation Affine and perspective transformation, Interpolation techniques	[6]

Unit IV: Image Segmentation and Morphology Edge detection: Sobel, Prewitt, Canny, Thresholding: simple, Otsu's method, Region-based segmentation: region growing, region splitting and merging, Morphological operations: erosion, dilation, opening, closing	[6]
Unit V: Feature Extraction and Representation Texture, shape, and color features, Boundary descriptors and region descriptors Feature detectors: SIFT, SURF, ORB, Feature matching concepts, Introduction to object recognition using extracted features	[6]
Unit VI: Image Compression and Applications in AI Types of redundancy in images, Lossless compression: RLE, Huffman coding Lossy compression: JPEG, MPEG, AI applications: face detection, object classification, medical image analysis, Overview of CNN-based image processing	[6]
Text Books: 1. **Rafael C. Gonzalez and Richard E. Woods**, *Digital Image Processing*, 4th Edition, Pearson Education, 2018. ISBN: 9780133356724	
Reference Books: 1. **Richard Szeliski**, *Computer Vision: Algorithms and Applications*, Springer, 2022. Available free online: http://szeliski.org/Book/ ISBN: 978-3-031-05620-3	

Final Year (ARTIFICIAL INTELLIGENCE AND DATA SCIENCE) Semester VII

Elective-V

23AD4703C	PEC	Pattern Recognition	3-0-0	3 Credits

Teaching Scheme	Evaluation Scheme
Lecture: 3 hrs/week	CA-I: 10 Marks CA-II: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Algebra, Probability & Statistics, Calculus, Python, basics of ML

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

CO1	Define and recall the fundamental concepts, types, and real-life applications of pattern recognition.
CO2	Explain statistical and syntactic approaches in pattern recognition, including their theoretical underpinnings.
CO3	Apply machine learning models such as neural networks, clustering, and classification techniques to real-world data.
CO4	Analyze the performance of pattern recognition models using evaluation metrics and optimization techniques.
CO5	Implement advanced models like SVMs, ensemble methods, and neural networks using modern tools.
CO6	Analyze the working of SVM for different classification problems.

Course Contents:

Unit I: Introduction to Pattern Recognition Definition and scope of pattern recognition. Applications in various domains (e.g., biometrics, speech, vision). Overview of supervised, unsupervised, and reinforcement learning. Design Cycle of a Pattern Recognition System, Introduction to data preprocessing and feature selection.	[6]
Unit II: Statistical Pattern Recognition Bayes decision theory. Maximum likelihood and Bayesian estimation. Parametric vs. non-parametric methods. Nearest neighbor rule, K-NN Evaluation metrics: accuracy, precision, recall, F1-score.	[6]

Unit III: Structural and Syntactic Pattern Recognition Formal languages and grammars. Pattern recognition using string matching Syntactic pattern recognition techniques. Graph matching and tree classifiers, Applications of Structural Methods.	[6]
Unit IV: Neural Networks and Deep Learning in Pattern Recognition Perceptron, Multi-layer perceptron. Backpropagation algorithm. CNN and RNN for pattern recognition. Transfer learning and real-world applications. Transfer Learning and Pretrained Models.	[6]
Unit V: Unsupervised Learning and Clustering Techniques Clustering algorithms: K-means, Hierarchical, DBSCAN.PCA and Dimensionality reduction. Hidden Markov Models. Evaluation of clustering quality	[6]
Unit VI: Support Vector Machines Support Vector Machines, Kernel Methods, Ensemble Learning: Bagging and Boosting, Decision Trees and Random Forests, Model Evaluation and Cross-Validation	[6]
Text Books: 1. Pattern Classification, Pattern Recognition and Machine Learning, Neural Networks and Learning Machines	
Reference Books: 1. **Pattern Recognition: Concepts, Methods and Applications** by *Shivani Goel* 2. Machine Learning by Tom M. Mitchell	

Final Year (ARTIFICIAL INTELLIGENCE AND DATA SCIENCE) Semester VII

23AD4704	ELC	Research Methodology	3-0-0	3 Credits

Teaching Scheme	Evaluation Scheme
Lecture: 3hrs/week	CA-I:10 Marks CA-II: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites:

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

CO1	Define research, explain research terms, process, and ethics.
CO2	Understanding research process and terminology.
CO3	Explain and interpret different sampling methods, procedures, and criteria used in research design.
CO4	Understanding appropriate scaling techniques in research.
CO5	Explain the concepts of sampling distribution, standard error in statistical analysis.
CO6	Explain the importance of interpretation and the structure of research reports in research communication.

Course Contents:

Unit 1: Introduction to Research Methodology: Meaning and Objectives of Research, Types of Research (Basic & Applied), Importance of Research, Research Process, Criteria of Good Research.	[6]
Unit 2: Introduction to research design: Selecting a Research Problem, Defining the Problem, Meaning and Need of Research Design, Types of Research Design (Exploratory, Descriptive, Experimental), Features of Good Research Design, Important concepts relating to research design.	[6]
Unit 3: Sampling Design: Census vs Sample Survey, Need for Sampling, Steps in sampling design, Criteria of selecting sampling procedure, Types of Sampling (Random, Non-random), Characteristics of Good Sample.	[6]

Unit 4: Measurement and scaling techniques: Measurement in Research, Measurement scales, Types of Measurement Scales (Nominal, Ordinal, Interval, Ratio), Sources of Error in measurement, Basics of Scaling Techniques, Important scaling techniques.	[6]
Unit 5: Sampling fundamentals: Introduction to Sampling Distribution, Need of sampling, Central Limit Theorem (Basic Idea), Concept of Standard Error, Estimation of Mean and Proportion, Basics of Sample Size.	[6]
Unit 6: Interpretation and report writing: Meaning and Importance of Interpretation, Techniques of Interpretation (Basic), Research Report Writing: Structure of Report, Steps in Writing, Types of Reports, Significance of report writing, Layout of research report.	[6]

Text Books:

1. C.R.Kothari, Research Methodology: Methods and Techniques, New Age International,2013.
2. Deepak Chawla Neena Sondhi, Research Methodology concepts and cases Vikas, New Delhi,2011.

Reference Books:

1. Panneerselvam R, "Research Methodology", PHI, New Delhi,2013.
2. Taylor, Bill, "Research Methodology", PHI, New Delhi,2006.

Final Year (ARTIFICIAL INTELLIGENCE AND DATA SCIENCE) Semester VII

23AD4705	VSEC	Application Development -II	0-0-4	2 Credits

Teaching Scheme	Evaluation Scheme
Lecture: 4hrs/week	CA1: 25 Marks CA2: 25Marks End Semester Exam: 50 Marks

Pre-Requisites: Database Management Systems, Computer Networks and Security

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

CO1	Understand the fundamentals of web technologies, internet architecture, and web ecosystem.
CO2	Design responsive web pages using HTML5, CSS3, and Bootstrap.
CO3	Develop interactive features using JavaScript and manage dynamic content.
CO4	Build backend logic using PHP or Node.js and integrate with databases.
CO5	Perform database operations and implement user authentication systems.
CO6	Deploy a functional website using version control and hosting platforms. .

List of Experiment:

1	Create a Static Website Using HTML and CSS Design a basic multi-page website (e.g., a personal portfolio or travel site) using only HTML and CSS.
2	Build a Responsive Web Page Using Bootstrap Develop a single-page responsive layout using Bootstrap Grid and Components.
3	Create an Interactive Form with JavaScript Validation Build a registration form and implement real-time form validation using JavaScript.
4	DOM Manipulation: Build a To-Do List App Using JavaScript Use JavaScript to dynamically add, remove, and update tasks in a to-do list.
5	Fetch and Display API Data Using JavaScript (Fetch API + JSON) Use JavaScript to fetch user data from a public API and display it in a styled table.
6	Set Up a Local Server and Process Forms Using PHP/Node.js Create a simple contact form that sends and processes data using GET/POST methods.
7	User Login and Registration System with Database Integration Develop a basic login and registration module using PHP/Node.js and MySQL.

8	Perform CRUD Operations (Create, Read, Update, Delete) in a Web App Design a student record system with full CRUD functionality connected to MySQL
9	Host a Static Website on GitHub Pages or Netlify Publish a portfolio or project website using GitHub Pages or Netlify.
10	Develop and Deploy a Complete Web Application Plan, design, and build a mini application (e.g., online book store or blog) and deploy it online

Final Year (ARTIFICIAL INTELLIGENCE AND DATA SCIENCE) Semester

23AD4706	PCC	Deep Learning Laboratory	0-0-2	1 Credit

Teaching Scheme	Evaluation Scheme
Practical:2hrs/week	CA1: 15 Marks CA2: 15Marks Practical and Oral Exam: 20 Marks

Pre-Requisites: Machine Learning

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

CO1	Understand the basics of Deep Learning and apply the tools to implement deep learning applications
CO2	Evaluate the performance of deep learning models
CO3	Implement the technique of Convolution neural network (CNN)
CO4	Solve the language translation problem by Recurrent neural network (RNN
CO5	Construct new data by deep generative models
CO6	Apply on-policy reinforcement learning algorithms

List of Experiment:

1	Installing of Anaconda or Miniconda and working with Tensorflow and Keras
2	Developing a simple perceptron (Single layer neural network)
3	Develop simple multilayer neural network for different tasks.
4	Design and Develop basic CNN for different tasks.
5	Use transfer learning in CNN
6	Develop simple RNN for Different tasks
7	Implement RNN for handwriting digit recognition
8	Implement Bidirectional LSTM for sentiment analysis
9	Implement Variational Auto encoders for image denoising
10	Implement Generative Adversarial Networks to generate realistic photographs.

23AD4707	PROJ	Capstone Project Phase-II	0-0-4	2 Credits

Practical Scheme:	**Evaluation Scheme:**
Practical:4 hr./week	CA I :25 Marks CA II:25 Marks End Semester Exam: 50 Marks

Pre-Requisites:

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

CO1	Identify real life problem and feasibility of solution to the problem
CO2	Analyze and optimize solutions to real life problems with individual and team work through modern tool usage
CO3	Improve professional ethics and communication skill and engage with environment sustainability to build lifelong learning attitude

Team Work

1. At the end of semester student have to submit project phase-2 report for POE.

Multidisciplinary Minor

23ADMDA5	**MDM**	**Business Analytical and Machine Learning Modelling**	**3-0-0**	**3Credits**

Teaching Scheme	**Evaluation Scheme**
Lecture:3hrs/week	CA 1:10 Marks CA 2: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites: Python, Statistics and Probability, Basic Linear Algebra and Mathematics.

Course Outcomes:

CO1	Understand the core concepts and types of business analytics and data preprocessing techniques.
CO2	Apply statistical and machine learning models to solve business-related problems.
CO3	Build, evaluate, and tune supervised learning models for prediction and classification.
CO4	Implement unsupervised learning techniques like clustering and association analysis for business insights.
CO5	Analyze time-series data and apply forecasting techniques in business scenarios.
CO6	Understand the ethical considerations, and advanced ML concepts like NLP and deep learning in business.

Course Contents:

Unit I: Foundations of Business Analytics Introduction to Business Analytics. Business Data and Sources. Data Preparation and Preprocessing. Tools and Technologies in Business Analytics.	[6]
Unit II: Introduction to Machine Learning and Statistical Foundations Machine Learning-Supervised, Unsupervised, Reinforcement Learning. Statistical Concepts for ML. Model Evaluation Metrics. Train-Test Split and Cross Validation. Introduction to Python for ML.	[6]
Unit III: Supervised Learning Techniques Linear Regression. Logistic Regression-Logistic function, odds, log-odds. Decision Trees-Tree construction, splitting criteria. Random Forests. K-Nearest Neighbors (KNN).Model Evaluation and Tuning.	[6]

Unit IV: Unsupervised Learning and Clustering Introduction to Unsupervised Learning. K-Means Clustering. Hierarchical Clustering. Principal Component Analysis (PCA). Market Basket Analysis and Association Rules. Business Applications.	[6]
Unit V: **Time Series Analysis and Forecasting.** Time Series Data Concepts. Smoothing Techniques. Stationarity and Differencing. ARIMA Model-AutoRegressive (AR), Integrated (I), Moving Average (MA) components. Forecast Accuracy Metrics-MAPE, RMSE, MAE in forecasting evaluation.	[6]
Unit VI: Advanced Topics, Ethics and Applications in Business Analytics. Introduction to Neural Networks and Deep Learning. Natural Language Processing (NLP) in Business. Model Deployment and Cloud Analytics. Data Ethics and Privacy. Emerging Trends in Business Analytics-AI-driven automation, chatbots, explainable AI.	[6]

Text Books:

1. Business Analytics: Data Analysis & Decision-Making **Author:** S. Christian Albright, Wayne L. Winston. **Publisher:** Cengage Learning.
2. Data Mining: Concepts and Techniques. **Author:** Jiawei Han, Micheline Kamber, Jian Pei **Publisher:** Morgan Kaufmann

Reference Books:

1. Pattern Recognition: Business Intelligence: A Managerial Perspective on Analytics. Author: Ramesh Sharda, Dursun Delen, Efraim Turban
2. Ethics of Data and Analytics. Author: Kirsten Martin Forecasting: Principles and Practice. Authors: Rob J Hyndman & George Athanasopoulos

Final Year (ARTIFICIAL INTELLIGENCE AND DATA SCIENCE) Semester VII

Multidisciplinary Minor

23ADMDB5	**MDM**	**IOT in Healthcare**	**3-0-0**	**3 Credits**

Teaching Scheme	Evaluation Scheme
Lecture:3hrs/week	CA 1:10 Marks CA 2: 10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites:

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

CO1	Understand the basic concepts, architecture, and components of IoT systems applied to healthcare.
CO2	Explain the role of sensors, wearable devices, and communication technologies in medical monitoring.
CO3	Illustrate IoT architectures for healthcare applications.
CO4	Explain communication protocols, networking options, and data management in healthcare IoT systems.
CO5	Describe security, privacy, and ethical concerns in healthcare IoT environments and propose mitigation strategies.
CO6	Explain recent trends, case studies, and integration of AI/ML in smart healthcare systems.

Course Contents:

Unit I: Introduction to IoT and Healthcare IoT overview, IoT architecture, Physical design of IoT – Logical design of IoT – IoT enabling technologies, Components of IoT: Sensors, Actuators, Embedded Systems, Overview of healthcare domain and challenges, Impact of IoT on healthcare delivery	[6]
Unit II: IoT Architecture for Healthcare Applications Functional architecture specific to healthcare IoT, IoT levels and deployment templates, Wearable medical devices and body area networks, Patient monitoring systems and smart diagnostics, Cloud and edge integration in healthcare.	[6]

Unit III: Communication and Networking in Healthcare IoT Communication technologies: Bluetooth, ZigBee, LoRa, Wi-Fi, NB-IoT, Wireless Body Area Networks (WBAN) Protocols: MQTT, CoAP, HTTP/HTTPS, Routing Protocols Data transmission and storage frameworks, Medium access control	[6]
Unit IV: Applications of IoT in Healthcare Chronic disease monitoring (Diabetes, Cardiac), Smart hospitals and ICU management, Elderly care and fall detection, Medication adherence and emergency alerts, Wearable sensor network for remote health monitoring,	[6]
Unit V: Security, Privacy and Regulatory Aspects Security threats in healthcare IoT, Data privacy issues in healthcare applications Data encryption, authentication, and access control, Regulatory standards (HIPAA, GDPR basics), Blockchain and privacy-preserving models.	[6]
Unit VI: Emerging Trends Computer Vision in IoT, Advanced Connectivity & Networking- Satellite IoT, Digital Twins Technique, integration of AI/ML in smart healthcare- Predictive Analysis and Operations, Generative AI in Drugs Discovery, Edge AI & TinyML, Quantum-Safe IoT Security, Anomaly Detection in Health Data	[6]
Text Books: 1. Valentina Emilia Balas and Souvik Pal, Healthcare Paradigms in the Internet of Things Ecosystem, Academic Press, 2021. 2. Arshdeep Bahga, Vijay Madisetti, Internet of Things: A Hands-On Approach, Universities Press, 2015. 3. Rajkumar Buyya, Amir Vahid Dastjerdi, Internet of Things: Principles and Paradigms, Morgan Kaufmann, 2016.	
Reference Books: 1. B. Venkatesh, A. Ranjith, Internet of Things and Applications, CRC Press, 2021. 2. Academic journals and IEEE/Springer/Elsevier publications on IoT in healthcare systems.	

Final Year (ARTIFICIAL INTELLIGENCE AND DATA SCIENCE) Semester VII

Multidisciplinary Minor

23ADMDC5	MDM	Management Accounting	3-0-0	3 Credits

Teaching Scheme	Evaluation Scheme
Lecture:3hrs/week	CA I: 10 Marks CA II:10 Marks Mid Semester Exam: 30 Marks End Semester Exam: 50 Marks

Pre-Requisites:

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

CO1	Understand the concepts and objectives of management accounting and distinguish it from financial accounting and cost accounting.
CO2	Analyze and interpret financial statements using tools like ratio analysis, fund flow, and cash flow analysis.
CO3	Prepare budgets and apply standard costing techniques for cost control and performance evaluation.
CO4	Apply marginal costing and break-even analysis for managerial decision-making.
CO5	Evaluate the role of management accounting in business strategy and control systems.
CO6	Use management accounting information for strategic planning and operational control.

Course Contents:

Unit I: Introduction to Management Accounting Meaning, Nature, Scope, Objectives of Management Accounting. Difference between Management Accounting, Financial Accounting & Cost Accounting. Importance and Limitations of Management Accounting. Role of Management Accountant	[6]
Unit II: Financial Statement Analysis Types of Financial Statements. Comparative and Common Size Statements. Trend Analysis. Ratio Analysis – Classification, Calculation, and Interpretation	[6]
Unit III: Fund Flow and Cash Flow Analysis Concept of Fund and Flow of Fund. Preparation of Fund Flow Statement. Cash Flow Statement as per AS-3. Applications and Limitations	[6]
Unit IV: Budgetary Control and Standard Costing Concept of Budget and Budgetary Control. Types of Budgets: Fixed and Flexible Budgets. Standard Costing and Variance Analysis (Material, Labour, Overhead)	[6]

Unit V: Marginal Costing and Break-even Analysis Concept and Importance of Marginal Costing. Cost-Volume-Profit Analysis. Break-even Point: Meaning, Assumptions, Limitations. Applications in Decision Making.	[6]
Unit VI: Management Accounting in Strategic Decision Making Role in Planning and Control. Responsibility Accounting. Transfer Pricing. Balanced Scorecard Approach	[6]
Text Books: 1. R.S.N. Pillai and Bagavathi – Management Accounting, S. Chand 2. M.Y. Khan & P.K. Jain – Management Accounting, Tata McGraw Hill Dr. S.N. Maheshwari – Principles of Management Accounting, Sultan Chand	
Reference Books: 1. Horngren, Sundem, Stratton – Introduction to Management Accounting, Pearson Sharma & Gupta – Management Accounting, Kalyani Publishers	

Final Year (ARTIFICIAL INTELLIGENCE AND DATA SCIENCE) Semester VII

23AD4708	HSMC	Values & Ethics	2-0-0	Audit

Teaching Scheme	Evaluation Scheme
Lecture: 2 hrs/week	CA-I: 25 Marks CA-II: 25 Marks

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

CO1	Interpret the principles of ethics and human values by examining their influence on personal behavior, public conduct, and value formation through family, society, and education.
CO2	Demonstrate improved attitude, morals, aptitude, and integrity in contributing positively to society
CO3	Distinguish between values and skills, happiness and accumulation of physical facilities, the Self and the Body, Intention and Competence of an individual, etc.
CO4	Explain the significance of value inputs in a classroom and start applying them in their life and profession.
CO5	Analyze publication ethics and misconduct to ensure adherence to ethical standards, authorship guidelines, and responsible research dissemination.
CO6	Evaluate the role of ethics, professional values, and gender sensitization in promoting responsible and equitable conduct in engineering and public life.

Course Contents:

Unit I: Ethics and Human Interface Ethics and Human Interface, Essence, determinants and consequences of Ethics in human actions; Dimensions of ethics; ethics in private and public relationships, Human Values – lessons from the lives and teachings of great leaders, reformers and administrators, Role of family, society in inculcating values, role of educational institutions in inculcating values.	[4]
Unit II: Attitude, Morals, Aptitude, Integrity towards Society Attitude: content, structure, function, Attitude and its influence and relation with thought and behavior, Aptitude and foundational values towards society, integrity, impartiality and non-partisanship, objectivity, dedication towards society, empathy, tolerance and compassion intelligence-concepts, and their utilities and application.	[4]
Unit III: Understanding Harmony in the Human Being - Harmony in Myself Understanding human being as a co-existence of the sentient 'I' and the material 'Body', Understanding the needs of Self ('I') and 'Body', Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer), Understanding the characteristics and activities of 'I' and harmony in 'I', Understanding the harmony of I with the Body; correct appraisal of Physical needs, meaning of Prosperity in detail, Programs to ensure Sanyam and Swasthya, Understanding harmony in the Family.	[4]

Unit IV: Value Education Need, Guidelines, content and process for Value Education, Self-Exploration–; Natural Acceptance and Experiential Validation, Continuous Happiness and Prosperity, Right understanding, Relationship and Physical Facilities, Understanding Happiness and Prosperity correctly, Method to fulfill the above human aspirations: understanding and living in harmony at various levels.	[4]
Unit V: Publication Ethics Publication Ethics: Introduction, Scope & importance, Best practices/standards initiatives & Guidelines: COPE, WAME, etc., Conflict of Interest, Publication Misconduct: definition, concept, problems that lead to unethical behavior & Vice versa, Violation of Publication Ethics, Authorship & Contributor ship, Identification of Publication misconduct, complaints & appeals, Predatory publishers & Journals.	[4]
Unit VI: Ethics and Gender Sensitization Ethics - Meaning, Importance, & Types of Ethics, Values and Attitudes of Professional Engineers, Seven Principles of Public Life. Gender Sensitization: Introduction, Sex vs. Gender, Social construction of Gender, Gender Roles, Gender Stereotypes, Ending violence against girls/ women: Advancing safety and rights, Gender Equality.	[4]
Text Books: 1. R R Gaur, R Sangal, G P Bagaria, 2009, A Foundation Course in Human Values and Professional Ethics. 2. M Govindrajran, S Natrajan& V.S. Senthil Kumar, Engineering Ethics (including Human Values), Eastern Economy Edition, Prentice Hall of India Ltd. 3. Neeraj Kumar, "Lexicon for Ethics, Integrity & Aptitude", Chronicle Publication, 2016. 4. Santosh Ajmera, Nand Kishor Reddi, "Ethics - Integrity and Aptitude", Tata McGraw-Hill Publication, 2014. 5. M. Karthikeyan, "Ethics, Integrity and Aptitude", Tata McGraw-Hill Publication, 2015. 6. Dr. Vara Lakshmi G, Dr. R V Anuradha, "Gender Sensitization", Neelkamal Publications.	
Reference Books: 1. Ivan Illich, 1974, Energy & Equity, The Trinity Press, Worcester, and Harper Collins, USA. 2. A N Tripathy, 2003, Human Values, New Age International Publishers. 3. E G Seebauer& Robert L. Berry, 2000, Fundamentals of Ethics for Scientists & Engineers, Oxford University Press. 4. B P Banerjee, 2005, Foundations of Ethics and Management, Excel Books. 5. B L Bajpai, 2004, Indian Ethos and Modern Management, New Royal Book Co., Lucknow. Reprinted 2008. P L Dhar, RR Gaur, 1990, Science and Humanism, Commonwealth Publishers.	