INTRODUCTION OF AI AND MACHINE LEARNING

Code: CS31113CS	Course Type: Core	Semester: I
Evolution Scheme (TA-MSE-ESE): 20-30-100	Total Marks: 150	L-T-P (Credits): 3-0-0 (3)

Pre-Requisites: Linear Algebra, Probability & Statistics, Python Programming, Data Structures & Algorithms.

Course Objective: To develop understanding of advanced artificial intelligence and machine learning techniques for designing scalable, interpretable, and ethical intelligent systems addressing complex real-world problems across diverse application domains.

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

CO-1	Analyze and apply advanced machine learning algorithms and frameworks to solve complex real-world problems
CO-2	Design and optimize AI models using appropriate feature engineering, evaluation strategies, and hyperparameter tuning techniques
CO-3	Develop deep learning-based intelligent systems and interpret model behavior using explainable AI techniques
CO-4	Implement scalable and ethical AI solutions considering deployment constraints, fairness, privacy, and societal impact

Course Articulation Matrix:

PO	PEO-1	PEO-2	PEO-3	PEO-4	PEO-5
CO-1	3	2	1	-	-
CO-2	3	2	1	-	1
CO-3	3	2	-	-	3
CO-4	3	2	1	1	-

1 - Slightly; 2 - Moderately; 3 – Substantially

Syllabus:

Unit-1: Foundations of Applied AI

Review of supervised and unsupervised learning paradigms, bias-variance tradeoff, overfitting and regularization techniques, feature engineering feature selection strategies, model validation techniques including cross-validation and bootstrapping and, evaluation metrics for classification, regression, and imbalanced datasets, introduction to probabilistic learning frameworks.

Unit-2: Advanced Machine Learning Models

Ensemble learning techniques (bagging, boosting, stacking), gradient boosting frameworks (XGBoost, LightGBM, CatBoost), kernel methods and support vector machines, probabilistic graphical models, Bayesian learning and inference, introduction to reinforcement learning and decision-making under uncertainty.

Unit-3: Deep Learning and Representation Learning

Artificial neural networks, convolutional neural networks for image understanding, recurrent neural networks and LSTM for sequence modeling, attention mechanisms and transformer architectures, transfer learning and fine-tuning, representation learning, model compression techniques, introduction to explainable AI (SHAP, LIME) and interpretability methods.

Unit-4: AI System Design and Deployment

MLOps lifecycle, model deployment pipelines, containerization and cloud-based AI deployment, federated learning and distributed AI systems, AI applications in healthcare, finance, and smart systems, ethical AI, bias detection and mitigation, privacy-preserving machine learning techniques.

Learning Resources:

Text Books:

1. Bengio, Yoshua, Ian Goodfellow, and Aaron Courville. Deep learning. Vol. 1. Cambridge, MA, USA: MIT press, 2017.
2. Murphy, Kevin P. Machine learning: a probabilistic perspective. MIT press, 2012.
3. Géron, Aurélien. Hands-on machine learning with Scikit-Learn, Keras, and TensorFlow. " O'Reilly Media, Inc.", 2022.