P23CST06 **MACHINE LEARNING** L T P

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Pre-Requisites : None

Objectives:

- To understand the concepts and mathematical foundations of machine learning and types problems tackled by machine learning.
- To explore the different supervised learning techniques including ensemble methods.
- To learn different aspects of unsupervised learning and reinforcement learning.
- To learn the role of probabilistic methods for machine learning.
- To understand the basic concepts of neural networks and deep learning.

Course Outcomes:

Upon completion of the course, students would be able to

CO1	Understand and outline problems for each type of machine learning.	**K2**
CO2	Design a Decision tree and Random Forest for an application.	**K5**
CO3	Implement Probabilistic Discriminative and Generative algorithms for an application and analyse the results.	**K3**
CO4	Use a tool to implement typical Clustering algorithms for different types of applications.	**K3**
CO5	Design and implement an HMM for a Sequence Model type of application and identify applications suitable for different types of Machine Learning with suitable justification.	**K5**

Course Contents

Unit I **INTRODUCTION, MATHEMATICAL FOUNDATIONS** 9

What is Machine Learning? Need - History - Definitions - Applications - Advantages, Disadvantages & Challenges - Types Of Machine Learning Problems - Mathematical Foundations - Linear Algebra & Analytical Geometry - Probability And Statistics - Bayesian Conditional Probability - Vector Calculus & Optimization - Decision Theory - Information Theory.

Unit II **SUPERVISED LEARNING** 9

Introduction - Discriminative and Generative Models - Linear Regression - Least Squares - Under-fitting / Overfitting - Cross-Validation - Lasso Regression - Classification - Logistic Regression - Gradient Linear Models - Support Vector Machines - Kernel Methods - Instance based Methods - K-Nearest Neighbours - Tree based Methods - Decision Trees - ID3 - CART - Ensemble Methods - Random Forest - Evaluation of Classification Algorithms.

Unit III **UNSUPERVISED LEARNING AND REINFORCEMENT LEARNING** 9

Introduction - Clustering Algorithms - K-Means - Hierarchical Clustering - Cluster Validity Dimensionality Reduction - Principal Component Analysis - Recommendation Systems - EM algorithm.

Unit IV **PROBABILISTIC METHODS FOR LEARNING** 9

Reinforcement Learning - Elements - Model based Learning - Temporal Difference Learning -Introduction - Naïve Bayes Algorithm - Maximum Likelihood - Maximum Apriori - Bayesian Belief Networks - Probabilistic Modelling of Problems - Inference in Bayesian Belief Networks - Probability Density Estimation - Sequence Models - Markov Models - Hidden Markov Models.

Unit V **NEURAL NETWORKS AND DEEP LEARNING** 9

Neural Networks - Biological Motivation - Perceptron - Multi-layer Perceptron - Feed Forward Network - Back Propagation - Activation and Loss Functions - Limitations of Machine Learning - Deep Learning - Convolution Neural Networks - Recurrent Neural Networks - Use cases.