**Introduction to Machine Learning**

**B.Sc. 4th Semester**

**Part-1**

**CO1: Understand the history, definition, types and applications of machine learning in Natural Language Processing and Computer Vision 3 Hours**

Objective: Overview of Machine Learning - History of Machine Learning, Supervised, Unsupervised, and Reinforcement Learning Algorithms, definitions, and types of machine learning, Applications - Natural Language Processing: Sentiment Analysis, Machine Translation; Computer Vision: Object Recognition, Object Detection, and Object Generation.

**CO2: Perform categorical encoding, scaling, feature engineering, train test split after handling null values, duplicates and outliers 6 Hours**

Objective: Data preprocessing—handling missing data, scaling and normalization, dealing with outliers, encoding categorical variables. Terminology: feature, sample, training set, validation set, test set, feature engineering.

**CO3: Determine the relationship between dependent and independent variables encountered in specific domains using simple linear regression and its error metrics (MSE, MAE, RMSE) 6 Hours**

Objective: simple linear regression, loss functions, gradient descent, mean squared error, mean absolute error, root mean squared error.

**CO4: Perform model evaluation using cross-validation, confusion matrix and classification report for K-Nearest Neighbour in specific domains 6 Hours**

Objective: KNN, model evaluation metrics (confusion matrix, accuracy, precision, recall, F1-Score), cross-validation.

**CO5: Identify patterns in a provided dataset using k-means clustering with elbow method and dendrograms 3 Hours**

Objective: K-means clustering, elbow method and dendrograms

**CO6: Understand perceptron, logistic regression (sigmoid activation function, binary classification), error backpropagation, feed-forward neural network 9 Hours**

Objective: Perceptron-Logistic regression, sigmoid activation function, binary classification, error back propagation algorithm, feed-forward neural network, Universal Approximation Theorem

**CO7: Solve a real-world problem belonging to health/finance by applying machine learning skills 12 Hours**

Project selection, project status review-1. Final project submission: source code and report, presentation, and Viva.

**Part-2**

**CO1: Determine the relationship between dependent and independent variables encountered in specific domains using multiple linear regression and its error metrics (MSE, MAE, RMSE) 6 Hours**

Multiple-linear regression, mean squared error, mean absolute error, root mean squared error.

**CO2: Improve model performance of multiple linear regression using grid search hyperparameter tuning technique 3 Hours**

Hyperparameters, common hyperparameters with examples, and hyperparameter tuning techniques: grid search, random search

**CO3: Perform model evaluation using cross-validation, confusion matrix, classification report and area under curve for Decision Tree in specific domains 6 Hours**

Decision tree, Random forest, model evaluation metrics: confusion matrix, accuracy, precision, recall, F1-Score, cross validation, Area under curve, Gradient Boosting.

**CO4: Apply Principal Component Analysis (PCA) to reduce dimensionality on real-world datasets belonging to health/finance 6 Hours**

Dimensionality reduction techniques - Principal Component Analysis (PCA)

**CO5: Apply convolutional neural networks for classification 9 Hours**

Introduction to CNN: Difference between CNN and MLP; Layers in CNN: Convolution, Pooling, BatchNorm, Dropout, Activation, Dense Layers, Loss Functions, Standard CNN models.

**CO6: Building blocks of a classic CNN model (ResNet, VGG-18) 3 Hours**

ResNet : Residual connections,  ResNet model: variants, VGG-18.

**CO7: Solve a real-world problem belonging to health/finance by applying machine learning skills 12 Hours**

Project selection, project status review-1. Final project submission: source code and report, presentation, and Viva.