Code No.: **MDS 552**
Course Title: **Applied Machine Learning**   Full Marks: 75
Nature: Theory+Practical **(Compulsory)**   Credit: 3

Course Description:
This course covers the concept of machine learning and it application in real world task. It includes Supervised, Unsupervised and reinforcement learning algorithms and evaluation metrics to choose the best algorithm for a particular task.

Course Objectives:
This course is designed to familiarize students to the concept of machine learning and their application.

Course Contents:

Unit 1: Introduction to Machine Learning   [6Hrs.]

The Motivation & Applications of Machine Learning, The Definition of Machine Learning, Supervised Learning, Unsupervised Learning and Reinforcement Learning, Overview of Learning theory and Evaluation Metrics.

Unit 2: Supervised Learning   [10Hrs.]

Supervised Learning, Linear Regression, Gradient Descent, Batch Gradient Descent, Stochastic Gradient Descent (Incremental Descent), The Concept of Under fitting and Over fitting, Locally Weighted Regression, Logistic Regression, Supervised learning Setup, Least Mean squares, Perceptron Learning Algorithm.

Classification, Linear Classifiers: Support Vector Machines, K-Nearest Neighbors, Multi-Class Classification, Kernelized Support Vector Machines, Naïve Bayes Classifiers, Decision Trees and Random Forest, Cross-Validation, Ensemble Learning, ensemble Size, Bagging, Boosting, Stacking.

Unit 3: Unsupervised Learning   [10 Hrs.]

Clustering: Cluster Analysis, Partitioning Method: K-Means, Agglomerative and Divisive Clustering, Density Based Clustering: DBSCAN, Mixture Models and EM Algorithm,.

High Dimensional Data: Principal Component Analysis, Variants of PCA, Low Rank Approximations, Canonical Correlation Analysis, Latent Semantic Analysis.

Outlier Detection: Outlier Analysis, Outlier Detection Method, Clustering based approaches, Classification based Approach.

Unit 4: Model Evaluation and Selections   [6 Hrs.]

Model Evaluation & Selection, Confusion Matrices & Basic Evaluation Metrics, Classifier, Decision Functions, Precision-recall and ROC curves, Multi-Class Evaluation, Regression Evaluation, Model Selection: Optimizing Classifiers for Different Evaluation Metrics.

Unit 5: Reinforcement Learning   [6Hrs.]

Applications of Reinforcement Learning, Markov Decision Process (MDP), Defining Value &Policy Functions, Value Function, Optimal Value Function, Value Iteration, Policy Iteration,Generalization to Continuous States, Discretization & Curse of Dimensionality.

Unit 6: Neural Network and Deep Learning   [10Hrs.]

Neural Network, Activation functions, learning rules, Back-propagation, Multi-layer Neural Networks, Feed Forward Neural Network, Recurrent Neural Network

Deep Neural Network: Convolution Neural Network, Image classification with CNN, Text Processing with RNN, Vanishing gradient and Dropout.

Laboratory Works:

Student are advised to implement supervised, unsupervised machine learning algorithm using any high level programing language (Python and Scikit-Learn preferred). The deep learning algorithms such as CNN and RNN should be implemented from scratch (Using library are not preferred).

References:

1. Forsyth, D.A. (2019) .*Applied Machine Learning*, 1st Edition, SpingerVerlag.

2. Sattari ,H. (2017).*Applied Machine Learning with Python*, Packt Publishing.

***