Course Title	Course Structure			Pre-Requisite
Machine Learning	L	T	P	Basic Programming
	3	0	2	

Course Objective:
The objective of the machine learning course is to understand the basic theory underlying machine learning. It will help students will be able to understand a range of machine learning algorithms along with their strengths, and weaknesses. Students will be able to apply machine learning algorithms to solve real-world problems to design optimized solutions and report on the expected accuracy that can be achieved by applying the models

Course Outcome (CO):
1. Understand the basic concepts of machine learning, supervised, unsupervised, regression analysis, and machine learning algorithms.
2. Apply the learned concepts of machine learning to interpret various problems.
3. Analyze the different mathematical machine learning models for various systems.
4. Evaluate the performance of the machine learning model using various performance measures.
5. Develop an efficient machine learning system to solve various real-time problems.

S.No.	Content	Contact Hours
Unit 1	**Introduction to Machine Learning:** Need, Objective, History of Machine Learning, Introduction of Machine Learning Approaches (Artificial Neural Network, Clustering, Reinforcement Learning, Classification, Regression), Types of Machine Learning Algorithms, Applications of Machine Learning, Data Science vs Machine Learning, Understanding the data-scale of measurement, Research Variables and Data analysis methods, Issues in Machine Learning Techniques, Steps in Model Prediction, Validation and performance evaluation, Confusion Matrix	8
Unit 2	**Supervised Learning - I:** Classification vs Regression. Decision Tree: Basic Methodology, ID3 Algorithm: Information Gain, Entropy, Inductive Bias, Occam's Razor, Issues in Decision Tree, Problem with IDE3 Algorithm, Problem with Information Gain Approach, C4.5 algorithm: Gain ratio and Decision Trees using Gain Ratio, CART algorithm: Gini Index and Decision trees using Gini Index, Implementing Decision trees, K-Nearest Neighbor- Introduction, Nearest Neighbor Algorithm, Feature Weighting in KNN, Random Forest, Ensemble Learning-Standard Ensemble Learning Strategies, Bagging, AdaBoost, Stacking.	8
Unit 3	**Supervised Learning - II:** Artificial Neural Network(ANN): Introduction, advantages and disadvantages Introduction, Characteristics of ANN, Topologies, Neuron and its terminologies, ANN: Transfer Functions (Purelin, Sign, Step, Log Sigmoid, Tan Sigmoid, Unipolar and Bipolar), Perceptron, Perceptron Convergence Theorem.	10

	Single Layer ANN, Multilayer Perceptron: Back Propagation Learning Algorithm, Implementing Back propagation algorithm, ANN: Learning and Generalization, Bias and Variance, Bias/Variance Trade-off, Preventing Over-fitting and Under-fitting, Applications of Neural Networks. Support Vector Machine (SVM): Baic, Maximal Margin Hyperplane, Linear SVM, Non-Linear SVM, Attribute Transformation, Kernel Trick, Applications of SVM. Bayesian Learning: Probability Theory, Bayes theorem, Naïve Bayes Learning Algorithm, Nearest Neighbor Classifiers	
Unit 4	**Unsupervised Learning:** Introduction, Clustering Introduction and its applications, Partitional Clustering vs Hierarchical Clustering, Partial vs Complete Clustering, Hard Clustering vs Soft Clustering, K-means Clustering. Need and Classification of Dimensionality Reduction Methods**,** Univariate Analysis, Correlation-Based Feature Selection (CFS), Feature Extraction, and Principal Component Analysis-Variance, Covariance, Covariance Matrix, Eigenvectors, Eigen values, PCA	8
Unit 5	**Recent Applications & Research Topics:** Case Studies based on various Supervised Learning Approaches. Cross Validation Methods, Bias Variance trade-off, Techniques to deal with Imbalanced dataset, Resampling, Measuring, and Comparing two classification algorithms using statistical tests.	8
	Total	42

Books:-

S.No.	Name of Books/Authors/Publisher
1	Introduction to Machine Learning, Alpaydin, E., MIT Press, 2004
2	Machine Learning, Tom Mitchell, McGraw Hill, 1997.
3	Elements of Machine Learning, Pat Langley Morgan Kaufmann Publishers, Inc. 1995. ISBN 1-55860-301-8
4	The elements of statistical learning, Friedman, Jerome, Trevor Hastie, and Robert Tibshirani. Vol. 1. Springer, Berlin: Springer series in statistics, 2001.
5	Machine Learning: A probabilistic approach, by David Barber, 2006.