**CSE 5401: ADVANCED MACHINE LEARNING [4 0 0 4]**

**Course Outcomes**

After completing the course, the student will be able to:

1. Illustrate principles and overview of learning problems domains and ML algorithms.

2. Utilize learning techniques like random-forest and ensemble method

3. Apply dimensionality reduction techniques for ML algorithm.

4. Make use of different ML algorithm like KNN, Naïve-Bayes and EM

5. Analyse ANN and RNN techniques for ML applications.

**Module 1 4hrs**

Introduction to Machine Learning, Examples of Machine Learning Applications, Different Paradigms Of ML- Supervised learning, Unsupervised Learning, Reinforcement Learning, semi supervised learning, Perspectives and Issues, Hypothesis Evaluation, Version Space, VC-Dimensions and Distributions, Bias-Variance Trade-Off

Textbook 1 (chapter 6- 6.1 to 6.3), Textbook 4 (Chapter 3-3.3), Internet Resources

**Module 2 13hrs**

Feature Selection-Filters and Wrapper Methods, Model Selection and Generalization, Feature Extraction, Dimensionality Reduction, Subset selection, Principal component analysis, linear discriminant analysis, Independent components analysis.

Textbook 3 (Chapter 6- 6.1 to 6.8), Textbook 4 (Chapter 15-15.1)

**Module 3 11hrs**

Classification and Regression Techniques, Linear and Multiple linear regression, Discriminative Methods, Distance Based Methods, Linear Discriminant Functions, Decision Tree, Attribute Selection, Tree-Pruning, Random Decision Forest and Boosting, Support Vector Machines, Optimal Separating Hyper Plane, Soft-margin hyperplane, Linear and Non-Linear Kernel Functions.

Textbook 3 (Chapter 9- 9.1 to 9.4, Chapter 13-13.1 to 13.7)

**Module 4 10hrs**

K- Nearest Neighbours, Bayes Decision Theory, Bayesian Learning, Bayes Optimal Classifier, Naïve Bayes Classifier, Bayesian Belief Networks. Unsupervised Learning, Clustering Methods, Partition based clustering-K-means Gaussian Mixture Modelling, Expectation-Maximization Algorithm, Hierarchical Clustering Methods, Single linkage clustering, Complete Linkage, Average Linkage Clustering.

Textbook 1 (Chapter 19- 19.1 to 19.2), Textbook 3 (Chapter 7- 7.1 to 7.8, Chapter 8- 8.2.3)

**Module 5 10hrs**

Artificial Neural Networks, Single Layer Neural Network, Multilayer Perceptron, Back Propagation Learning, Radial Basis Function Network, Gradient Descent Optimization, Recurrent Neural Networks, Deep Learning basics, Introduction to convolutional neural networks, convolution operation, pooling operation, Case study.

Textbook 1 (Chapter 6- 20.1 to 20.4), internet resources

**References:**

1. Shalev-Shwartz,S., Ben-David,S., (2014), Understanding Machine Learning: From Theory to Algorithms, Cambridge University Press

2. R. O. Duda, P. E. Hart, D. G. Stork (2000), Pattern Classiﬁcation, Wiley-Blackwell, 2nd Edition.

3. Ethem Alpaydin,”Introduction to Machine Learning”, MIT Press, Prentice Hall of India, Third Edition2014.

4. Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar, ”Foundations of Machine Learning”, MIT Press,2012.

5. Mitchell Tom (1997). Machine Learning, Tata McGraw-Hill

6. M. BISHOP (2006), Pattern Recognition and Machine Learning, Springer-Verlag New York, 1st Edition.