

### **Short Syllabus**

**BCSE209L      Machine Learning                      (3-0-0-3)**

Learning Paradigms - PAC learning ; Classification - Multi-class , Multi-label ; Classifier- KNN, ID3; Regression -Linear, Logistic - Perceptron - Single layer & Multi-layer; Clustering - K-Means clustering – K-Mode clustering – Self organizing maps ; Ensemble Learning - Bagging , boosting ; Class Imbalance – SMOTE ; Reinforcement Learning - RL Framework – Markov Decision Process - Value Functions and Bellman Equation - Q Learning.

Course code	Course Title	L	T	P	C
BCSE209L	Machine Learning	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			
Course Objectives					
1. To teach the theoretical foundations of various learning algorithms.					
2. To train the students better understand the context of supervised and unsupervised learning through real-life examples.					
3. To understand the need for Reinforcement learning in real – time problems.					
4. Apply all learning algorithms over appropriate real-time dataset.					
5. Evaluate the algorithms based on corresponding metrics identified.					
Course Outcomes					
At the end of this course, student will be able to:					
1. Understand, visualize, analyze and preprocess the data from a real-time source.					
2. Apply appropriate algorithm to the data.					
3. Analyze the results of algorithm and convert to appropriate information required for the real – time application.					
4. Evaluate the performance of various algorithms that could be applied to the data and to suggest most relevant algorithm according to the environment.					
Module:1	Introduction to Machine Learning and Pre-requisites	4 hours			
Introduction to Machine Learning – Learning Paradigms – PAC learning – Version Spaces – Role of Machine Learning in Artificial Intelligence applications					
Module:2	Supervised Learning – I	7 hours			
Linear and Non-Linear examples – Multi-Class & Multi-Label classification – Linear Regression – Multiple Linear Regression – Naïve Bayes Classifier – Decision Trees – ID3 – CART – Error bounds.					
Module:3	Supervised Learning – II	8 hours			
K-NN classifier – Logistic regression – Perceptron – Single layer & Multi-layer – Support Vector Machines – Linear & Non-linear – Metrics & Error Correction.					
Module:4	Unsupervised Learning	9 hours			
Clustering basics (Partitioned, Hierarchical and Density based) - K-Means clustering – K-Mode clustering – Self organizing maps – Expectation maximization – Principal Component Analysis – Kernel PCA – tSNE (t-distributed stochastic neighbor embedding) - Metrics & Error Correction.					
Module:5	Ensemble Learning	5 hours			
Bias – Variance Tradeoff – Bagging and Boosting (Random forests, Adaboost, XG boost inclusive) – Metrics & Error Correction.					
Module:6	Machine Learning in Practice	3 hours			
Class Imbalance – SMOTE – One Class SVM – Optimization of hyper parameters.					
Module:7	Reinforcement Learning (RL)	8 hours			
Basics of RL – RL Framework – Markov Decision Process – Exploration Vs Exploitation - Policies, Value Functions and Bellman Equations – Solution Methods – Q-learning.					
Module:8	Contemporary Issues	1 hours			
	Total Lecture hours:				45 Hours
Text Book(s)					
1	Ethem Alpaydin, "Introduction to Machine Learning". MIT Press, Prentice Hall of India,				

	Third Edition 2014.		
2	Reinforcement Learning: An Introduction (Adaptive Computation and Machine Learning series) 2 <sup>nd</sup> edition, Richard S. Sutton and Andrew G. Barto, A Bradford Book; 2018, ISBN 978-0262039246		
Reference Books			
1	Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar "Foundations of Machine Learning", MIT Press, 2012.		
2	Tom Mitchell, "Machine Learning", McGraw Hill, 3rd Edition,1997.		
3	Charu C. Aggarwal, "Data Classification Algorithms and Applications" , CRC Press, 2014.		
Mode of Evaluation: CAT / Written Assignment / Quiz / FAT			
Recommended by Board of Studies		09-05-2022	
Approved by Academic Council		No. 66	Date 16-06-2022