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 Outcome

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 - Polices, Value Functions and Bellman Equations – Solution Methods – Q-learning.

Module:8	Contemporary Issues	1 hour

	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.	Richard S. Sutton and Andrew G. Barto, Reinforcement Learning: An Introduction (Adaptive Computation and Machine Learning series) 2nd edition, A Bradford Book; 2018.
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 : Continuous Assessment Tests, Quizzes, Assignment, Final Assessment Test	

Recommended by Board of Studies	09-05-2022		
Approved by Academic Council	No. 66	Date	16-06-2022