Semester	7
Program	B.Sc. Computer Science (Hons.)
Course	MACHINE LEARNING
Paper Code	C4CS230712T
No. of Credits	6
Hours / week	Theory: 3, Practical: 2
Category: Core/MDC/SEC/VAC	Core
Theory/ Practical / Composite	Composite
Number of Modules	One

Course Overview: This course provides a comprehensive introduction to Machine Learning, covering fundamental concepts, mathematical foundations and data preprocessing techniques along with core learning algorithms. Students will explore both the supervised and unsupervised learning methods, model evaluation strategies and neural networks, with an emphasis on both theoretical understanding and practical applications.

Course Outcomes	**CO1.** Explain the core concepts of machine learning, including types of learning, hypothesis space and inductive bias **CO2.** Apply fundamental concepts of probability, statistics and linear algebra to solve machine learning problems **CO3.** Analyze and preprocess data using techniques such as data cleaning, integration, reduction and feature selection **CO4.** Identify and generate frequent itemsets and association rules using algorithms like Apriori and hash-based techniques **CO5.** Develop and evaluate regression models (linear, logistic, and polynomial) and interpret their goodness of fit for real-world applications **CO6.** Implement classification algorithms (SVM, Decision Tree, Random Forest, Naive Bayes, rule-based) and evaluate their performance using metrics such as accuracy, precision, recall, F1-score, ROC, and AUC **CO7.** Apply clustering algorithms to discover patterns in unlabeled data **CO8.** Explain and implement basic neural network models including perceptron, backpropagation and multilayer networks

Syllabus

Unit/Module	Content	Hours	CO Mapping	Cognitive Level
1	**Introduction to Machine Learning:**	2	CO1	K2 (Understand)

	Definitions, types of learning, hypothesis space and inductive bias.			
2	**Mathematical Prerequisites:** Review of probability and statistics concepts, Linear algebra basics.	4	CO2	K3 (Apply)
3	**Data Preprocessing:** Overview; Data cleaning; Data Integration; Data Reduction; Dimension reduction and Feature selection.	5	CO3	K4 (Analyze)
4	**Mining Frequent Patterns and Associations:** Frequent itemsets, Closed itemsets, Association rules; Apriori algorithm, Hash based technique.	5	CO4	K3 (Analyze)
5	**Regression:** Linear regression; Logistic regression; Polynomial regression, Goodness of fit; Applications.	5	CO5	K5 (Evaluate)
6	**Classification:** Supervised learning; Support Vector Machine, Decision Tree, Random Forest, Naive Bayes classifier; Rule	7	CO6	K3 (Apply)

	based classification, Model evaluation and selection, Confusion matrix, Accuracy, Recall, Precision, F1 score, ROC, AUC.			
7	**Clustering:** Unsupervised learning, Partitioning methods; Hierarchical methods; Density based methods, Greed based methods	7	CO7	K4 (Analyze)
8	**Neural Network:** Introduction and Features, Perceptron, Backpropagation, Multilayer network.	4	CO8	K3 (Apply)

Text Books		
1. Machine Learning by Tom M. Mitchell, McGraw-Hill Science/Engineering/Math		
2. Introduction to Machine Learning by Ethem Alpaydin, MIT Press		
3. Data Mining Concepts and Techniques by J. Han, M. Kamber, J. Pei, Morgan Kaufmann Series		
Suggested Readings		
1. The Hundred Page Machine Learning Book by A. Burkov		
Web Resources		
1. Machine Learning by Balaraman Ravindran, IIT Madras; course link: https://www.youtube.com/@machinelearning-balaramanr9557		
Evaluation	Theory CIA: 12 Attendance: 3 Semester Exam: 45	Practical CA: 38 Attendance: 2
Paper Structure for Theory Semester Exam Module: Answer 3 out of 5 of 15 marks each		

Course outcomes (COs) and Cognitive Level Mapping

COs	CO Description	Cognitive Levels
CO1	Machine Learning concepts and learning types	K2 (Understand)
CO2	Mathematical Foundations	K3 (Apply)
CO3	Data preprocessing	K4 (Analyze)
CO4	Association Rule Mining	K3 (Apply)
CO5	Regression modeling and evaluation	K5 (Evaluate)
CO6	Classification algorithms	K3 (Apply)
CO7	Clustering algorithms	K4 (Analyze)
CO8	Neural Networks	K3 (Apply)