SARVAJANIK UNIVERSITY
Sarvajanik College of Engineering and Technology
Bachelor of Technology

B. Tech. Semester VII

Subject Name: **Pattern Recognition and Machine Learning** **Subject Code: BTEC14705**
Type of course: PEC
Prerequisite: Probability and Statistics, Linear algebra
Rationale: In today's world, we see various applications of machine learning like face recognition, recommendation on e-commerce portals, weather forecasting, and prediction in various domains like medicine, finance and cyber crimes. This course aims to make machines emulate the human learning process. The course gives a detailed insight into various types of machine learning techniques which will assist in data analysis and analytical model building for various applications.

Teaching and Examination Scheme:

Teaching Scheme				Theory Marks			Practical Marks		Total
L	T	P	C	TEE	CA1	CA2	TEP	CA3	150
3	0	2	4	60	25	15	30	20	

CA1: Continuous Assessment (assignments/projects/open book tests/closed book tests **CA2:** Sincerity in attending classes/class tests/ timely submissions of assignments/self-learning attitude/solving advanced problems **TEE:** Term End Examination **TEP:** Term End Practical Exam (Performance and viva on practical skills learned in course) **CA3:** Regular submission of Lab work/Quality of work submitted/Active participation in lab sessions/viva on practical skills learned in course

Content:

Sr. no.	Topics	Teaching Hrs.	Module % Weightage
1.	**Introduction:** Pattern Recognition Systems, Example, The Design Cycle, Learning and Adaptation.	3	10
2.	**Bayesian Decision Theory:** Probability: independence of events, conditional and joint probability, Bayes' theorem; Random Processes: Stationary and non-stationary processes, Minimum-Error-Rate Classification, Classifiers, Discriminant Functions, and Decision Surfaces, Discriminant Functions for the Normal Density, Bayes Decision Theory, Discrete Features, Bayesian Belief Networks.	6	20
3.	**Maximum Likelihood and Bayesian Parameter Estimation** Maximum-Likelihood Estimation, Bayesian Estimation, Problems of Dimensionality, Component Analysis and Discriminants, Expectation-Maximization (EM).	6	10
4.	**Sequential Pattern Recognition:** Introduction, Hidden Markov Models (HMMs); Discrete HMMs; Continuous HMMs.	6	10

5.	**Nonparametric techniques for density estimation:** Parzen-window method; K-Nearest Neighbour method, The Nearest Neighbour rule, Metrics and Nearest Neighbour Classification.	6	15
6.	**Dimensionality reduction:** Introduction, Fisher discriminant analysis; Principal component analysis; Factor Analysis.	6	10
7.	**Linear Discriminant Functions:** Linear Discriminant Functions and Decision Surfaces, Generalized Linear Discriminant Functions, Minimizing the Perceptron Criterion Function, Support Vector Machines.	4	10
8.	**Multilayer Neural Networks** Feedforward Operation and Classification, Backpropagation Algorithm, Error Surfaces, Backpropagation as Feature Mapping, Backpropagation, Practical Techniques for Improving Backpropagation, Second-Order Methods, Additional Networks and Training Methods, Regularization, Complexity Adjustment and Pruning. Introduction to Associative Memories (AM), self organising feature map (SOFM), Adaptive Resonant Theory (ART)	8	15

Suggested Specification table with Marks (Theory/Practical):

% Distribution of Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
20	40	25	15	0	0

Legends: R: Remembrance, **U:** Understanding; **A:** Application, **N:** Analyze, **E:** Evaluate **C:** Create and above Levels **(Revised Bloom's Taxonomy)**

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Text Books:

Sr. No.	Title of book /article	Author(s)	Publisher and details like ISBN	Year of publication	Publication Edition
1.	Pattern Classification	Richard O. Duda, Peter E. Hart	John Wiley	2001	2nd
2.	The Elements of Statistical Learning	Trevor Hastie, Robert Tibshirani, Jerome H. Friedman	Springer	2009	Latest
3.	Pattern Recognition	S.Theodoridis and K.Koutroumbas	Academic Press	2009	4th

4.	Pattern Recognition and Machine Learning	C.M.Bishop	Springer	2006	2nd

Course Outcome:

Sr. No.	CO Statement After learning this subject students will be able to,	Marks % weightage
CO-1	Demonstrate usage of Baysien theory and parameter estimation	25
CO-2	Apply the concept of various classification techniques	20
CO-3	Apply the concept of neural network for various classification problems	20
CO-4	Demonstrate usage of supervised learning methods for solving real world problems	15
CO-5	Describe important Dimensionality Reduction methods for machine learnings	20

Mapping with POs:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO-1	2	2	1	1	1	2	-	-	-	1	-	-	-	3	2
CO-2	1	2	1	1	2	2	-	-	-	-	1	1	-	3	-
CO-3	1	2	3	3	3	2	-	-	-	-	1	1	-	3	-
CO-4	1	2	1	1	2	2	-	-	-	-	1	1	-	3	3
CO-5	1	2	3	3	3	2	-	-	-	-	1	1	-	1	3

List of practical:

1. Understand concepts of feature extraction and feature reduction.
2. Implement classification applications using Bayesian Decision theory
3. Implement classification applications using HMM
4. Implement classification applications using KNN algorithm
5. Implement classification using SVM
6. Implement classification using BPNN
7. Pattern classification using Associative Memory
8. Mini project (equivalent to two turns)