National Institute of Technology Meghalaya

An Institute of National Importance

CURRICULUM

Programme	**Master of Computer Applications**	Academic Year of Regulation	**2024-25**
Department	**Computer Science and Engineering**	Semester	**V**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CA679	**Pattern Recognition and Applications**		**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

		CO's	**Statement**	**Bloom's Taxonomy**
Course Objectives	To introduce the fundamentals of pattern recognition and its relevance to classical and modern problems	CA679.1	Able to explain and compare a variety of pattern classification, structural pattern recognition, and pattern classifier combination techniques.	Understand
	To introduce the knowledge about state-of-the-art algorithms used in pattern recognition research	CA679.2	Able to summarize, analyze, and relate research in the pattern recognition area	Analyze
	To introduce Understand pattern recognition theories, such as Bayes classifier, linear discriminant analysis.	CA679.3	Able to apply performance evaluation methods for pattern recognition, and critique comparisons of techniques made in the research literature.	Apply
	To provide an understanding of pattern recognition techniques in practical problems and a main objective is to be able to identify where, when and how pattern recognition can be applied.	CA679.4	Able to apply pattern recognition techniques to real world problems	Apply
	To provide knowledge regarding various application of pattern recognition using machine learning model.	CA679.5	Able to Implement simple pattern classifiers, classifier combinations, and structural pattern recognizers.	Apply

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CA679.1		1	2	2	3	2			1					**1**	
CA679.2	**2**	**1**		**3**		**1**							**2**	**1**	
CA679.3	**1**	**2**	**3**	**1**	**2**								**1**		**1**
CA679.4	**1**		**1**	**2**	**2**	**3**	**1**						**1**	**1**	
CA679.5	**1**	**1**	**1**	**3**	**3**	**1**							**1**	**1**	
CA679	1.25	1.25	1.75	2.20	2.50	1.75	1.00		1.00				1.25	1.00	1.00

SYLLABUS

No.	Content	Hours	COs
I	Overview of Pattern classification and regression: Introduction to Statistical Pattern Recognition Overview of Pattern Classifiers: Bayesian decision making and Bayes Classifier, The Bayes Classifier for minimizing Risk, Estimating Bayes Error; Minimax and Neymann-Pearson classifiers	**6**	**CA679.1**
II	**Parametric Estimation of Densities**: Implementing Bayes Classifier; Estimation of Class Conditional, Maximum Likelihood estimation of different densities, Bayesian estimation of parameters of density functions, MAP estimates, Bayesian Estimation examples, the exponential family of densities and ML estimates, Sufficient Statistics; Recursive formulation of ML and Bayesian estimates **Mixture Densities and EM Algorithm**: Mixture Densities, MLestimation and EM algorithm, Convergence of EM algorithm; overview of Nonparametric density estimation **Nonparametric density estimation**: Convergence of EM algorithm; overview of Nonparametric density estimation, Nonparametric estimation,Parzen Windows, nearest neighbour methods	**8**	**CA679.2**
III	**Linear models for classification and regression**: Linear Discriminant Functions;Perceptron -- Learning Algorithm and convergence proof, Linear Least Squares Regression; LMS algorithm, AdaLinE and LMS algorithm; General nonliner least-squares regression, Logistic Regression;Statistics of least squares method; Regularized Least Squares, Fisher Linear Discriminant, Linear Discriminant functions for multi-class case; multi-class logistic regression **Overview of statistical learning theory, Empirical Risk Minimization and VC-Dimension**: Learning and Generalization;PAC learning framework, Overview of Statistical Learning Theory;Empirical Risk Minimization, Consistency of Empirical Risk Minimization, Consistency of Empirical Risk Minimization; VCDimension, Complexity of Learning problems and VC Dimension, VC-Dimension Examples; VC-Dimension of hyperplanes	**10**	**CA679.3, CA679.4**
IV	**Artificial Neural Networks for Classification and regression**: Overview of Artificial Neural, Multilayer Feedforward Neural networks with Sigmoidal activation functions; Backpropagation Algorithm; Representational abilities of feedforward networks; Feedforward networks for Classification and Regression; Backpropagation in Practice; Radial Basis Function Networks; Gaussian RBF networks; Learning Weights in RBF networks; K-means clustering algorithm **Support Vector Machines and Kernel based methods**: Support Vector Machines -- Introduction, obtaining the optimal hyperplane; SVM formulation with slack variables; nonlinear SVM classifiers; Kernel Functions for nonlinear SVMs; Mercer and positive definite Kernels; Support Vector Regression and ε-insensitive Loss function, examples of SVM learning; Overview of SMO and other algorithms for SVM; v -SVM and v-SVR;SVM as a risk minimizer; Positive Definite Kernels; RKHS; Representer Theorem	**10**	**CA679.3, CA679.4, CA679.5**

V	**Feature Selection, Model assessment and cross-validation**: Feature Selection and Dimensionality Reduction; Principal ComponentAnalysis; No Free Lunch Theorem; Model selection and model estimation;Bias-variance trade-off; Assessing Learnt classifiers; Cross Validation; **Boosting and Classifier ensembles** Bootstrap,Bagging and Boosting; Classifier Ensembles;AdaBoost, Risk minimization view ofAdaBoost	**8**	**CA679.3, CA679.4, CA679.5**
Total Hours		**42**	

Essential Readings

1. R.O.Duda,P.E.Hart and D.G.Stork, “Pattern Classification”, John Wiley, 2002.
2. C.M.Bishop, “Neural Networks and Pattern Recognition”, Oxford University Press (Indian Edition), 2003.

Supplementary Readings

1. C.M.Bishop,"Pattern Recognition and Machine Learning",Springer, 2006.