Programme	**Bachelor of Technology in Computer Science and Engineering**	Academic Year of Regulation	**2018-19**
Department	**Computer Science and Engineering**	Semester	**VII**

Course Code	Course Name	Credit Structure				Marks Distribution			
		L	T	P	C	INT	MID	END	Total
CS 413	Pattern Recognition	3	0	0	3	50	50	100	200

Course Objectives	To introduce the fundamentals of pattern recognition and its relevance to classical and modern problems	Course Outcomes	CO1	Able to explain and compare a variety of pattern classification, structural pattern recognition, and pattern classifier combination techniques.
	To introduce the knowledge about state-of-the-art algorithms used in pattern recognition research		CO2	Able to summarize, analyze, and relate research in the pattern recognition area along with various parameter optimization technique.
	To introduce Understand pattern recognition theories, such as Bayes classifier, linear discriminant analysis.		CO3	Apply performance evaluation methods for pattern recognition, and critique comparisons of techniques made in the research literature.
	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.		CO4	Able to apply pattern recognition techniques to real-world problems such as document analysis and recognition.
	To provide knowledge regarding various application of pattern recognition using machine learning model.		CO5	Able to Implement simple pattern classifiers, classifier combinations, and structural pattern recognizers.

No.	COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	CO1	0	1	0	1	0	0	0	0	2	0	0	0	1	2	3
2	CO2	1	1	0	1	0	0	0	0	2	0	0	0	1	3	2
3	CO3	1	0	1	1	2	0	0	0	0	0	0	0	2	3	2
4	CO4	0	0	1	0	2	2	3	0	2	0	0	1	2	1	2
5	CO5	0	0	1	0	2	2	0	0	2	0	0	1	1	1	3
6	CO6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

	SYLLABUS		
No.	Content	Hours	COs
I	**Introduction** Pattern recognition and learning (supervised, unsupervised), training and test sets, feature selection, Clustering vs. Classification; Applications; Linear Algebra, vector spaces, probability theory, estimation techniques.	08	CO1 CO2
II	**Classification** Univariate and multivariate density, discriminant functions for the normal Density different cases, Bayes decision theory – discrete features, compound Bayesian decision theory and context, Minimum-error-rate classification, Classifiers, Discriminant functions, Decision surfaces, Normal density and discriminant functions, discrete features **Parameter Estimation Methods:** Maximum-Likelihood estimation: Gaussian case; Maximum a Posteriori estimation; Bayesian estimation: Gaussian case	08	CO2, CO3, CO4
III	**Clustering** Different distance functions and similarity measures, Criterion for clustering, Methods of clustering - partitional, hierarchical, graph theoretic, density based., Cluster validity	05	CO2 CO3
IV	Un-supervised learning and clustering: Introduction, mixture densities and identifiability, maximum likelihood estimates, application to normal mixtures, K-means clustering. Date description and clustering – similarity measures, criteria function for clustering	05	CO3 CO4
V	Pattern recognition using discrete hidden Markov models: Discrete-time Markov process, Extensions to hidden Markov models, three basic problems of HMMs, types of HMM, continuous observation densities, multiple mixtures per state, speech recognition applications.	10	CO4 CO5
	Total Hours	36	

Essential Readings

1. Pattern Recognition: An Algorithmic Approach, By M. Narasimha Murty and V. Susheela Devi, Springer; 2011 edition
2. Fundamentals of Pattern Recognition and Machine Learning, By Braga-Neto, Springer International Publishing, 2020
3. Pattern Recognition, By S. Theodoridis and K. Koutroumbas, 4th Ed., Academic Press, 2009

Supplementary Readings

1. Pattern Recognition and Machine Learning, By Christopher Bishop, Springer-Verlag New York, 2006
2. Combining Pattern Classifiers: Methods and Algorithms, By Ludmila I. Kuncheva, 2nd Edition, John Wiley, 2014
3. Pattern Classification, By R.O.Duda, P.E.Hart and D.G.Stork, John Wiley, 2001