INDIAN INSTITUTE OF INFORMATION TECHNOLOGY
DESIGN AND MANUFACTURING (IIITDM) KANCHEEPURAM

Course Title	**Pattern Recognition**	**Course Code**	**COM511**			
Dept./ Specialization	**CSE**	**Structure (LTPC)**	**3**	**0**	**2**	**4**
To be offered for	**PG/PhD**	**Status**	**Core** ☐		**Elective** ▬	
Faculty Proposing the course	**Dr. UmaraniJayaraman**	**Type**	**New** ☐		**Modification** ▬	
Recommendation from the DAC		**Date of DAC**	**10-12-2021**			
External Expert(s)	**Dr. Surya Prakash, Associate Professor, IIT Indore**					
Pre-requisite	**Probability, Statistics and Linear Algebra**	**Submitted for approval**			**46th Senate**	
Learning Objectives	This course covers the techniques and gain proficiency of pattern recognition that are fundamental to a wide variety of application areas such as digital image processing, medical image processing , biometrics, computer vision, etc.					
Learning Outcomes	● A good knowledge of Bayesian decision theory and Bayesian learning. ● Fundamental understanding of classifiers such as linear discriminant function, quadratic discriminant function, nearest neighbor rule, neural network and SVM. ● A good understanding of feature selection algorithms. ● Ability to evaluate the performance of various classifiers on real-world datasets.					
Contents of the course ***(With approximate break-up of hours for L/T/P)***	1) Basics of Probability, Random Processes and Linear Algebra (recap). Probability: independence of events, conditional and joint probability, Bayes theorem Random Processes: Stationary and non-stationary processes, Expectation, Autocorrelation, Cross-Correlation, spectra. **(L6)** 2) Bayes Decision Theory: Minimum-error-rate classification. Classifiers, Discriminant functions, Decision surfaces. Normal density and discriminant functions. Discrete features.**(L4/P2)** 3) Parameter Estimation Methods: Maximum-Likelihood estimation: Gaussian case. Maximum Posteriori estimation. Bayesian estimation: Gaussian case. Unsupervised learning and clustering - Criterion functions for clustering. Algorithms for clustering: K-Means, Hierarchical and other methods. Cluster validation. Gaussian mixture models, Expectation-Maximization method for parameter estimation. Maximum entropy estimation. Sequential Pattern Recognition. Hidden Markov Models (HMMs): Discrete HMMs, Continuous HMMs. Nonparametric techniques for density estimation. Parzen-window method. K-Nearest Neighbour method**.(L11/P2)** 4) Dimensionality reduction: Principal component analysis - itsrelationship to Eigen analysis. Fisher discriminant analysis - Generalized Eigen analysis. Eigen vectors/Singular vectors as dictionaries. Factor Analysis, Total variability space - a dictionary learning method.Non-negative matrix factorization - a dictionary learning method**.(L8/P2)** 5) Linear discriminant functions: Gradient descent procedures, Perceptron, Support vector machine.**(L4/P2)**					

	6) Artificial neural networks: A brief introduction, Multilayer perceptron – feed forward neural network**(L2/P1)** 7) Non-metric methods for pattern classification: Non-numeric data or nominal data. Decision trees: Classification and Regression Trees (CART). **(L3/P1)** **8)** Practical Application(s): Face recognition - preprocessing, face detection algorithms, selection of representative patterns, classification algorithms, results and discussion. **(P4)**
Text Books	1. O.Duda, P.E.Hart and D.G.Stork, *Pattern Classification*, John Wiley, 2001 2. S.Theodoridis and K.Koutroumbas, *Pattern Recognition*, 4th Ed., Academic Press, 2009
Reference Books	1 C.M.Bishop, *Pattern Recognition and Machine Learning*, Springer, 2006 2 P.A Devijver and J. Kittler, *Pattern Recognition: A Statistical Approach*, Prentice-Hall International, Englewood Cliffs, NJ, 1980. 3 K. Fukunaga, *Introduction to Statistical Pattern Recognition, 2nd Ed.* Academic Press, New York, 1990.