Course code: Course Title	Course Structure			Pre-Requisite
SE411: Pattern Recognition	L	T	P	Linear Algebra, Probability Theory
	3	1	0	

Course Objective: To equip with basic mathematical and statistical techniques commonly used in pattern recognition. Also provide with an adequate background on probability theory, statistics, and optimization theory to tackle a wide spectrum of engineering problems.

S. NO	Course Outcomes (CO)
CO1	Understand fundamental principles, and methodologies of pattern recognition, including real-world applications and models.
CO2	Implement bayesian classifier, discriminant functions, to address issues like missing and noisy features using Bayesian networks.
CO3	Utilize Maximum Likelihood and Bayesian parameter estimation methods, including PCA, Fisher Discriminant Analysis, and Expectation-Maximization for dimensionality reduction.
CO4	Develop models using hidden markov models, dynamic bayesian networks, perceptron, and other non-parametric density estimation techniques.
CO5	Apply clustering techniques like K-means, Mixture Modeling, Hidden Markov Models, and Kalman Filtering for pattern recognition tasks.

S. NO	Contents	Contact Hours
UNIT 1	**Pattern recognition fundamentals:** Basic concepts of pattern recognition, fundamental problems in pattern recognition system, design concepts and methodologies, example of automatic pattern recognition systems, a simple automatic pattern recognition model.	7
UNIT 2	**Bayesian decision theory:** Minimum-error-rate classification, Classifiers, Discriminant functions, Decision surfaces, Normal density and Discriminant functions, Discrete features, Missing and noisy features.	7
UNIT 3	**Maximum-likelihood and Bayesian parameter estimation:** Maximum-Likelihood estimation: Gaussian case, Maximum a Posteriori estimation, Bayesian estimation: Gaussian case, Problems of dimensionality, Dimensionality reduction: Principle component analysis.	6
UNIT 4	**Non-parametric techniques for density estimation:** Parzen-window method, K-Nearest Neighbour method, Fuzzy classifications. **Unsupervised learning and Clustering:** k-mean clustering, fuzzy k-mean clustering, similarity measures, criterion functions for clustering, hierarchical clustering.	8
UNIT 5	**Neural Network Classifiers:** Single and Multilayer Perceptron, Feed forward operations and classifications, network learning, training protocols, Back Propagation Learning, Bayes discriminants and neural networks.	6
UNIT 6	**Stochastic Methods:** Stochastic search, Boltzmann factor, simulated annealing algorithm, deterministic simulated annealing, Boltzmann learning. **Evolutionary Methods:** Genetic algorithms, genetic programming, particle swarm optimization.	8

	TOTAL	42

REFERENCES

S.No.	Name of Books/Authors/Publishers	Year of Publication / Reprint
1	Richard Duda, Peter Hart, David Stork, “Pattern Classification”, Wiley, 2nd Edition.	2007
2	Christopher M. Bishop, “Pattern Recognition and Machine Learning”, Springer, 1st Edition.	2009
3	Sergios Theodoridis, Konstantinos Koutroumbas, “Pattern Recognition”, Academic Press, 4th Edition.	2008
4	Christopher M. Bishop, “Neural Networks for Pattern Recognition”, Clarendon Press, 1995.	1995
5	Trevor Hastie, Robert Tibshirani, Jerome Friedman, “The Elements of Statistical Learning: Data Mining, Inference, and Prediction, Second Edition (Springer Series in Statistics)”, Springer, 2nd Edition.	2009