Semester-II Credit-30			
Sr. No	**Course Code**	**Course**	**L-T-P-C**
1.		Wireless communications	3-0-0-6
2.	EE 694	Detection and Estimation Theory	3-0-0-6
3.	EE 624	Optimization Theory and Algorithms	3-0-0-6
4.	EE 606	Pattern Recognition and Machine Learning (PRML) Laboratory	3-0-0-6
5.	EE 612	PRML Lab	0-0-3-3
6.	EE 699	Next generation wireless networks	3-0-0-6

1	**Title of the course** (L-T-P-C)	**Detection and Estimation Theory** (3-0-0-6)
2	**Pre-requisite courses(s)**	EE629: Probability Models and Applications
3	**Course content**	• Structure of statistical reasoning, Introduction to Estimation theory • Quick Pointers to Random variables, vectors, processes, and theirrelevant statistical description • Estimation: Minimum Variance Unbiased Estimator, Cramer Rao Lower Bound (CRLB) for scalar and vector parameters • Estimation : Maximum Likelihood Estimation (MLE), Maximum A Posteriori Estimation (MAP), Linear Least Squares (LLSE) with examples of Gaussian mixture modeling (GMM) etc. • Detection : Introduction, Neyman Pearson theorem, Binary and Multiple hypothesis testing, Examples • Demonstration of applying above contents to relevant engineering problems
4	**Texts/References**	**1.** H.V. Poor, "An Introduction to Signal Detection and Estimation,"Second Edition, Springer, 1998. **2.** H.L. Van Trees, "Detection, Estimation and Modulation Theory Part I," Second Edition, John Wiley,1968. **3.** S.M. Kay, "Fundamentals of Statistical Signal Processing: Detection Theory," First Edition, Prentice Hall, 1998. **4.** S.M. Kay, "Fundamentals of Statistical Signal Processing: Estimation Theory," First Edition, Prentice Hall, 1998. **5.** Moulin and Veeravalli, "Statistical Inference for Engineers and Data Scientists", Cambridge university Press, 2019.

1	**Title of the course** (L-T-P-C)	**Optimization Theory and Algorithms** **(3-0-0-6)**
2	**Pre-requisite courses(s)**	Exposure to Calculus or equivalent
3	**Course content**	The following topics will be covered: Quick Review of Linear Algebra and basic calculus. Introduction to convex sets and functions, and its properties. Duality theory, Lagrangian dual and KKT conditions. Algorithms for unconstrained and constrained minimization. Subgradient methods for non-differentiable functions. Important standard classes such as linear and quadratic programming, semidefinite programming etc. Applications of convex programming in electrical engineering. Recognizing and formulating convex optimization problems in practice. Beyond convex optimization. Introduction to functional optimization theory.
4	**Texts/References**	**1**. Stephen Boyd and Lieven Vandenberghe, "Convex Optimization," Cambridge university press. **2**. David G. Luenberger, "Optimization by Vector Space Methods," Wiley publications.

1	**Title of the course** (L-T-P-C)	**Pattern Recognition and Machine Learning (PRML) (3-0-0-6)**
2	**Pre-requisite courses(s)**	Exposure to basic concepts in calculus and probability
3	**Course content**	**Overview of** Probability Theory, Linear Algebra, Convex Optimization. **Introduction:** History of pattern recognition & machine learning, distinction in focus of pattern recognition and machine learning. **Regression**: Linear Regression, Multivariate Regression, Logistic Regression. **Clustering:** Partitional Clustering, Hierarchical Clustering, BirchAlgorithm CURE Algorithm, Density-based Clustering **PCA and LDA:** Principal Component Analysis, Linear Discriminant Analysis. **Kernel methods:** Support vector machine **Graphical Models**: Gaussian mixture models and hidden Markov models **Introduction to Bayesian Approach:** Bayesian classification, Bayesian Learning, Bayes Optimal Classifier, Naive Bayes Classifier and BayesianNetwork..
4	**Texts/References**	**1.** C. Bishop, "Pattern Recognition and Machine Learning," Springer, 2006. **2.** S. Theodoridis and K. Koutroumbas, "Pattern Recognition" Second Edn, Elsivier, 2003 **3.** B. Yegnanarayana, "Artificial Neural Networks", PHI, 1999. **4.** Simon Hayking, "Neural Networks and Learning Machines", Pearson, 1999.

1	**Title of the course** (L-T-P-C)	**Pattern Recognition and Machine Learning (PRML) Laboratory (0-0-3-3)**
2	**Pre-requisite courses(s)**	Currently taking or already taken PRML theory course
3	**Course content**	The lab will closely follow the theory course. The idea is to have the students implement the basic algorithms on different topics studied in the PRML theory course.
4	**Texts/References**	**1.** C. Bishop, "Pattern Recognition and Machine Learning," Springer, 2006. **2.** S. Theodoridis and K. Koutroumbas, "Pattern Recognition" Second Edn, Elsivier, 2003 **3.** B. Yegnanarayana, "Artificial Neural Networks", PHI, 1999. **4.** Simon Hayking, "Neural Networks and Learning Machines", Pearson, 1999.