Course Code	ECE 452/552
Course Name	Statistical Signal Processing
Credits	4
Course Offered to	UG/PG
Course Description	This post graduate course is designed to cover techniques for statistical signal processing, detection and parameter estimation. It will briefly review the preliminaries on linear algebra and statistics. The rest of the course is broadly divided into three parts. The first part will deal with the design, implementation and performance evaluation of detectors; this would cover composite and M-ary hypothesis testing. The second part of the course deals with estimation techniques like Maximum Likelihood, MAP and MMSE estimation. The third part introduces adaptive filtering approaches; this will cover stochastic and data-driven approach with emphasis on least squares based techniques. Homework will be a mix of theory and programming assignments.

Pre-requisites

Pre-requisite (Mandatory)	Pre-requisite (Desirable)	Pre-requisite(other)
Signals & Systems	Matlab Programming	
Probability and Statistics	Probability and Random Processes	
Linear Algebra		

Post Conditions*(For suggestions on verbs please refer the second sheet)

CO1	CO2	CO3	CO4
Apply hypothesis testing to signal and event detection problems.	Evaluate detector performance using ROC curves, sensitivity/specificity etc.	Choose among MLE, MAP and MMSE estimators given a parameter estimation tasks.	Apply and design least squares based adaptive filters for stochastic signals.

Weekly Lecture Plan

Week Number	Lecture Topic	COs Met	Assignment/Labs/Tutorial
1	Linear Algebra & Prob Review		
2	Sufficient Statistics & Significance Testing		HW 1 (Sufficient Statistics, Prob, Stats, MC Sampling)
3	MMSE, CRLB, MVUE	CO3	
4	General MVUE, BLUE	CO3	
5	MLE, MAP Estimation	CO3	HW 2 (Estimation - MLE, MAP, BLUE)
6	NP Detector, LRT, ROC Curves	CO1, CO2	
7	Generalized Matched Filters, Estimator-Correlator	CO1, CO2	
8	Estimator-Correlator & GLRT	CO1, CO2	HW 3 (Detection - NP, LRT, GLRT)
9	Wiener Filtering, Steepest Descent	CO4	
10	LMS Adaptive Filters, Variants of Least Squares	CO4	HW 4 (Adaptive Filtering)
11	RLS, Kalman Filtering	CO4	
12	Robust Least Squares	CO4	HW 5 (Kalman Filtering/ RLS)
13	Overflow		

Assessment Plan

Type of Evaluation	% Contribution in Grade
Assignment	30
Quiz	30
Mid-sem	20
End-sem	20

*Please insert more row for other type of Evaluation

Resource Material

Type	Title
Textbook	Fundamentals of Statistical Signal Processing (Vol. 1 & 2) – Steven Kay
Textbook	Adaptive Filter Theory – Simon Haykin, 4th Ed.