



Sardar Patel Institute of Technology

Bhavan's Campus, Munshi Nagar, Andheri (West), Mumbai-400058-India

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
ET921	Statistical Signal Processing	4	--	--	4	--	--	4
		Examination Scheme						
		Theory Marks						
		ISE		MSE		ESE		
10		30		100 (60% Weightage)				

Pre-requisite Course Codes		--
Course Outcomes	CO1	Generalize the properties of statistical models in the analysis of signals using Stochastic processes
	CO2	Outline various estimation methods to accomplish the signal modeling
	CO3	Principle of various estimators and choose right one for an application
	CO4	Design and development of filters using classical and adaptive algorithms.
	CO5	Differentiate the importance of various spectral estimation techniques

Module No.	Unit No.	Topics	Ref.	Hrs.
1		Review of random variables: Distribution and density functions, moments, independent, uncorrelated and orthogonal random variables; Vector-space representation of Random variables, Schwarz Inequality Orthogonalit principle in estimation, Central Limit theorem, Random processes, wide-sense stationary processes, autocorrelation and autocovariance functions, Spectral representation of random signals, Wiener Khinchin theorem Properties of power spectral density, Gaussian Process and White noise process, Linear System with random input, Spectral factorization theorem and its importance, innovation process and whitening filter, .Random signal modelling: MA(q), AR(p) , ARMA(p,q) models.		8
2		Classical Detection and Estimation Theory: Introduction, simple binary hypothesis tests, M Hypotheses, estimation theory, composite hypotheses, general Gaussian problem, performance bounds and approximations.		10
3		Detection of Signals – Estimation of Signal Parameters: Introduction, detection and estimation in white Gaussian noise, detection and estimation in nonwhite Gaussian noise, signals with unwanted parameters, multiple channels and multiple parameter estimation		10
4		Estimation of Continuous Waveforms: Introduction, derivation of estimator equations, a lower bound on the mean-square		10



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		estimation error, multidimensional waveform estimation, nonrandom waveform estimation.		
5		Linear Estimation: MA, AR, ARMA processes and their properties, MMSE linear estimate. Weiner Filter. Kalman Filter. Lattice filter structure, Levinson Durbin and innovation algorithms.		10
6		Spectral analysis: Estimated autocorrelation function, periodogram, Averaging the periodogram (Bartlett Method), Welch modification, Blackman and Tukey method of smoothing periodogram, Parametric method, AR spectral estimation and detection of Harmonic signals, MUSIC algorithm		10
Total				48

References:

- [1] H. L. Van Trees. (1968). Detection, Estimation, and Modulation Theory, vol. I, John Wiley & Sons.
- [2] Steven Kay. (1993). Fundamentals of Statistical Signal Processing Volume II: Detection Theory. Prentice Hall.
- [3] M. Hays: Statistical Digital Signal Processing and Modelling, John Willey and Sons, 1996.
- [4] S. M. Kay: Modern Spectral Estimation, Prentice Hall, 1987.
- [5] Steven Kay. (1993). Fundamentals of Statistical Signal Processing Volume I: Estimation Theory. Prentice Hall.
- [6] M.D. Srinath, P.K. Rajasekaran and R. Viswanathan, "Introduction to Statistical Signal Processing with Applications," Pearson Education (Asia) Pte. Ltd. /Prentice Hall of India, 2003.