STATISTICAL SIGNAL PROCESSING
(ELECTIVE-II)

Course Code: 13EC2114

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Course Outcomes:

CO1: Generalize the properties of statistical models in the analysis of signals using Stochastic processes.

CO2: Differentiate the prominence of various spectral estimation techniques for Achieving higher resolution in the estimation of power spectral density.

CO3: Outline various parametric estimation methods to accomplish the signal modeling even at higher order statistics.

CO4: Design and development of optimum filters using classical and adaptive algorithms.

CO5: Extrapolate the importance of least squares techniques and decomposition methods in analyzing the signal estimations.

UNIT-I

SIGNAL MODELS AND CHARACTERIZATION:

Types and properties of statistical models for signals and how they relate to signal processing, common second-order methods of characterizing signals.

STOCHASTIC PROCESSES:

Wide sense stationary processes, orthogonal increment processes, Wiener process, and the Poisson process, Doob decomposition, KL expansion. Ergodicity, Mean square continuity, mean square derivative and mean square integral of stochastic processes.

UNIT-II

SPECTRAL ESTIMATION:

Moving average (MA), autoregressive (AR), autoregressive moving average (ARMA), various non-parametric approaches, non-parametric methods for estimation of power spectral density, autocorrelation, cross-correlation, transfer functions, and coherence from finite signal samples.

UNIT-III

PARAMETRIC SIGNAL MODELING AND ESTIMATION:

A review on random processes, A review on filtering random processes, Examples, Maximum likelihood estimation, maximum a aposterior estimation, Cramer-Rao bound Pisarenko, MUSIC, ESPRIT, Higher order statistics.

UNIT-IV

OPTIMUM LINEAR FILTERS:

Linear Mean square error estimation, optimum IIR filters, optimum IIR filters , Inverse filtering and deconvolution, order recursive algorithms for optimum FIR filters, Algorithms of Levinsion, Levinsion-Durbin and Schiir, Triangularization and inversion of Toeplitz matrices, Wiener filtering and Kalman filtering.

UNIT-V

LEAST SQUARES ESTIMATION:

Least –squares error estimation, Least –squares Signal estimation, LS computation using the Normal equations, least-squares computation using orthogonalization Techniques and singular value decomposition.

TEXT BOOKS:

[1] D.G. Manolakis, V.K. Ingle, S.M. Kogon, "*Statistical and Adaptive Signal Processing*", 2000.

[2] Monsoon H.Hayes, "*Statistical Digital Signal Processing and Modeling*", New York, USA: Wiley, 1996.

REFERENCE BOOKS:

[1] Papoulis, probability, "*Random variables and Stochastic Processes"*, 2nd Ed., McGraw Hill, 1983.Steven M. Kay, "*Fundamentals of Statistical Signal Processing: Estimation theory*", Upper Saddle River, New Jersey, USA: Prentice-Hall, 1993.ISSBN-0-13-345711-7.

[2] J.G. Proakis, C.M. Rader, F. Ling, C.L. Nikias, M.Moonen, I.K. Proudler, "*Algorithms for Statistical Signal Processing*", 2002.