

**UNIT- I : REVIEW :**

IIR and FIR filters design, Filtering problems, Advanced signal processing techniques and transforms, Multirate Signal processing – Down sampling/up sampling, Introduction to discrete Hilbert transform, wavelet transform, Haar transform.

**State Estimation Filter-** Concept of Estimation of linear and nonlinear signals, estimation Wiener Filter Non linear Estimation-Concept of sufficient statistics and statistical estimation of parameters .

**UNIT- II : ADAPTIVE FILTERING :**

Introduction to Adaptive filtering, Types of adaptive filters, Introduction to Statistical signal Detection, Four classes of application in interference (noise, echo) cancellation, Identification, Inverse modeling, prediction. Least mean square filter (LMS), Recursive least square filter (RLS), Simulation and design of LMS and RLS filters ,its Applications. Binary decisions with multiple observations, Vector observations, Waveform Observation, Detection of signals in additive Gaussian Noise, random noise and color noise.

**UNIT- III : KALMAN FILTERS :**

Introduction to Kalman Filters (KF) . Adaptive beam forming. Kalman filtering.state measurement and estimation for scalar random variables , prediction and estimation of Linear signals, design techniques, Extended Kalman filter ( EKF), prediction and estimation of nonlinear signals, applications of KF,EKF in audio and speech signals detection.

**UNIT- IV :**

Filtering of Random Processes, Spectral factorization, Special types of Random Processes, The Levinson-Durbin Recursion, The Inverse Levinson-Durbin Recursion, The Cholesky Decomposition, Inverting a Toeplitz matrix.

**UNIT – V :**

Wiener filtering, The FIR Wiener filter, Linear prediction, Noise Cancellation, The IIR Wiener filter, Causal and noncausal IIR Wiener filter, Causal Wiener filtering, Causal linear Prediction, Wiener deconvolution.

**References :**

1. “Statistical Signal Processing Vol. 1 : Estimation Theory, vol. 2 : Detection Theory “ by Steven. M. Kay, Prentice Hall Inc, 1995.
2. “Adaptive Filter theory” by S. Haykin, Pearson Education publication.
3. “Detection, Estimation and Modulation Theory Part 1” by Harry L. Van Trees, John Wiley & Sons Inc, 1968.
4. “Statistical Digital Signal Processing and Modeling” by Monson H. Hayes, John Wiley and Sons, Inc.