

Code No: I8205/R16

M. Tech. I Semester Regular Examinations, January-2017

**DETECTION AND ESTIMATION THEORY**

[Common to Microwave and Communication Engg (82), DECS (38), ECE (70), DECE (37)  
And Communication Systems (47)]

Time: 3 Hours

Max. Marks: 60

*Answer any FIVE Questions*  
*All Questions Carry Equal Marks*

1. a Define an Autoregressive Process. Calculate the values of mean, variance and autocorrelation values of a First order auto regressive model. 6M  
 b Define shot noise. Calculate the values of mean, autocorrelation, and the power spectral density of the shot noise. 6M
2. a Find the digital filter diagram and the state model of an ARMA (3, 1) model. 6M  
 b Define and derive an expression for noise equivalent bandwidth of a filter. 6M
3. a What is Minimum Probability of Error? Explain Baye's decision rule. 6M  
 b Explain the operation of a Correlation receiver for detecting deterministic signals corrupted by additive white Gaussian noise and derive an expression for decision threshold. 6M
4. a Mathematically explain the operation of scalar kalman filter. 6M  
 b Explain the implementation of digital wiener filter. 6M
5. a Let p represent the probability that an integrated circuit is good. Show that the maximum likelihood estimator of p is  $N_G/n$  where  $N_G$  is the number of good circuits in n independent trials 6M  
 b Define the following : 6M
  - i. Empirical Distribution Function
  - ii. Joint Empirical distribution Functions
  - iii. Histograms.
6. a i. If X is uniform (0, 10) and 20 cells are used in a histogram with 200 samples, find the bias, MSE, and normalized RMS error in the histogram. 6M  
 ii. Repeat part (a) if X is normal with a mean of 5 and a standard deviation of 1.5  
 b Discuss about 6M
  - i. Bayesian Estimators
  - ii. Maximum Likelihood estimators.
7. a  $X(n)$  is a stationary zero-mean Gaussian random sequence with an autocorrelation function,  $R_{XX}(k) = \exp(-0.2k^2)$ , Show that  $X(n)$  is ergodic. 6M  
 b Explain the procedure for the Windowed or smoothed estimators of power spectral density functions. Also explain different windows used for this purpose. 6M
8. a If an estimated ARMA model is,  $X(n) = 0.9X(n-1) - 0.2X(n-2) + 0.5e(n-1) + e(n)$ . find the corresponding autocorrelation function, autocorrelation coefficient, and power density spectrum. 6M  
 b Explain the Flowchart in Box-Jenkins method of estimation of random sequence models. 6M

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