Code: **17ECMC1T1**

PVP 17

I M.Tech - I Semester – Regular / Supplementary Examinations
December 2018

DETECTION AND ESTIMATION THEORY
(MICROWAVE & COMMUNICATION ENGINEERING)

Duration: 3 hours Max. Marks: 60

Answer the following questions.

1.a) Describe the applications of estimation in signal processing and define the mathematical estimation problem. 7 M

b) Derive the lower bound for variance of any unbiased phase estimator for sinusoid embedded in WGN (given below)

$x[n] = Acos(2\pi f_0 n + \phi) + w[n], n = 0, 1, \ldots . N - 1$

where A and f_0 are assumed known. 8 M

(OR)

2.a) Define the Scalar parameter - Cramer Rao Lower Bound theorem and explain its significance. 7 M

b) Consider the observations

$x[n] = A + w[n], n = 0,1, \ldots . N - 1$, where A is the parameter to be estimated and w[n] is WGN. Verify whether the below estimator is unbiased or not

$$\check{A} = \frac{1}{2N} \sum_{n=0}^{N-1} x[n]$$

8 M

3.a) Explain in detail the Best Linear Unbiased Estimation along with its advantages. 7 M

b) Distinguish between minimum mean square estimation and least squares estimation. 8 M

(OR)

4.a) Describe the criteria for the selection of prior PDF in the Bayesian random parameter estimation with an example. 7 M

b) Describe the Bayesian philosophy for random parameter estimation with an example. 8 M

5.a) Define and distinguish Maximum Aposteriori Probability detection and Maximum likelihood detection. 7 M

b) Derive the Neyman-Pearson detector for the signal detection problem 8 M

$$H_0: x[n] = w_0[n], n = 0,1,2, \ldots\ldots N-1$$
$$H_1: x[n] = w_1[n], n = 0,1,2, \ldots\ldots N-1$$

where $w_0[n]$ is WGN with variance σ_0^2 and where $w_1[n]$ is WGN with variance σ_1^2

(OR)

6.a) Explain the minimum probability of error criterion for designing detectors. 7 M

b) Derive the detector based on minimizing the probability of error criterion for the below hypothesis testing problem

$$H_0: x[n] = w[n], n = 0,1,2, \ldots . . N-1$$
$$H_1: x[n] = A + w[n], n = 0,1,2, \ldots . . N-1$$

where $A > 0$ and w[n] is WGN with variance σ^2

8 M

7.a) What is a matched filter? Compute the matched filter coefficients for detecting the signal s[n] = {1, 2, 3, 4 5} in white Gaussian noise. 7 M

b) Derive the SNR at the output of the optimum detector for known signal in white noise and show that a matched filter maximizes it. 8 M

(OR)

8.a) Describe the detection of known binary signals in white Gaussian noise. 7 M

b) Write short notes on detection of signals with random parameters. 8 M