

Roll No.

Name:

**Second Semester M Tech,
Model Paper**

**Branch: Electronics & Communication Engineering
Stream: Telecommunication Engineering & Signal Processing**

TSC 2001 ESTIMATION AND DETECTION THEORY

Time: 3 Hours

Max. Marks: 60

Instructions: Answer any **TWO** questions from each Part
All questions carry equal marks

PART - I

- 1 Discuss
 - a) The generalized likelihood ratio test. [2]
 - b) Neyman Pearson Criteria. [2]
 - c) Unbiased Estimate. [2]
 - d) Unbiased Minimum Variance. [2]
 - e) Consistent Estimate. [2]

- 2 a) A random variable X has the distribution $N(0, 1)$. Find the probability that $X > 3$. [3]

b) Consider the random process defined by $X(t) = A \cos(\omega_0 t + \Theta)$, where A and ω_0 are constants, and Θ is a random variable uniformly distributed over the interval $(0, 2\pi)$. Let $Y(t)$ be the random process defined as $Y(t) = X^2(t)$.
 - (a) Find the autocorrelation function of $Y(t)$. [4]
 - (b) Is $Y(t)$ a stationary process? [3]

- 3 a) Define maximum likelihood estimator of the parameter θ . [2]

b) State the invariance property [3]

c) Let Y be a Gaussian random variable with mean zero and variance σ^2 .
 - (i) Obtain the ML estimates of σ and σ^2 .
 - (ii) Are the estimates efficient? [5]

PART - II

4. a) Discuss Bayes Estimation. List out the three cases of costs which are a function of the error. [5]
- b) Show that the minimum mean-square estimate $\hat{\theta}_{ms}$ represents the conditional mean of θ given Y . [5]
5. A binary communication system transmits polar signals of values $-A$ and $+A$ under hypotheses H_0 and H_1 , respectively. The received signal is corrupted by an additive Gaussian noise with zero mean and variance σ^2 .
- (a) Determine the optimum decision rule for minimum probability of error. [5]
- (b) Study the decision rule for $P_1 = P_0 / 3$, $P_0 = P_1$, and $P_1 = 5P_0 / 3$. [5]
6. a) Discuss the minimax criterion. [2]
- b) Derive the minimax equation in terms of cost and probabilities. [3]
- c) Draw a graph of Risk in terms of probability P_1 . [2]
- d) If the cost of the correct decision is Zero and the wrong Decision is 1 then calculate the minimax cost and the average probability of error. [3]

PART – III

7. a) Relationship Between Kalman and Wiener Filters. [2]
- b) State the important properties of the new information *measure* in the observation variable $Y(n)$, (innovation $V(n)$ for the random variables.) [3]
- c) Show that the optimum discrete realizable filter is a cascade of two filters, [5]
8. a) Obtain an expression for the sequential likelihood ratio test. [4]
- b) Determine the thresholds η_0 and η_1 in terms of P_F , the probability of false alarm, and P_M , the probability of a miss. [6]
9. a) Define Non parametric detection. [2]
- b) Discuss Sign test and Rank test in Non parametric detection. [8]