DR. BABASAHEB AMBEDKAR TECHNOLOGICAL UNIVERSITY, LONERE – RAIGAD -402 103

Semester Examination – OCT - 2022

Branch: Electronics and Telecommunication Engineering **Sem.:- II**

Subject with Subject Code:- Estimation and Detection Theory (MTDCC201, MTETC201)

Marks: 60

Date:- **Time:- 3 Hr.**

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Instructions to the Students

1. Each question carries 12 marks.
2. Attempt **any five** questions of the following.
3. Illustrate your answers with neat sketches, diagram etc., wherever necessary.
4. If some part or parameter is noticed to be missing, you may appropriately assume it and should mention it clearly

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(Marks)

Q.1 A) State and prove Cauchy Schwartz inequality. (06)

B) Explain Least Square Estimator method. (06)

Q.2 Consider the binary decision problem with (12)

$$P(R/H_0) = \begin{cases} 0.5(R+2) & -2 \le R \le 1 \\ 0 & otherwise \end{cases}$$

$$P(R/H_1) = \begin{cases} 0.5(2-R) & -1 \le R \le 2 \\ 0 & otherwise \end{cases}$$

1) Determine minimum probability of error decision rule if $P_0 = 1/3$

2) Determine Neyman-Perason decision rule for $P(d_1/H_0) = 0.1$

3) Determine min-max decision rule for $C_{00} = C_{11} = 0 \quad and \quad C_{01} = 2C_{10}$

Q.3 A) a) For Non-random parameter case by assuming estimator is unbiased, show the following. (06)

$$\text{var}(a_e(R)) = E\{(\hat{a}(R) - A)^2\} \ge \frac{[E(\partial \ell n(p_{r/a}(R/A)))^2]^{-1}}{\partial A}$$

B) The random variable $\Lambda(R)$ is defined as $\frac{P(R|H_1)}{P(R|H_0)}$ and has a different probability density on H_1 and H_0. Prove the following: (06)

i) $E\{\Lambda^n|H_1)\} = E\{\Lambda^{n+1}|H_0\}$ ii) $E\{\Lambda|H_0\} = 1$

iii) $E\{\Lambda|H_1\} - E\{\Lambda|H_0) = Var\{\Lambda|H_0\}$

Q.4 Let $y = \sum_{i=1}^{n} x_i$ where x_i's are iid zero mean $N(0,\sigma^2)$ & N is non-random parameter. (12)

Find (a) ML estimate of N

(b) Is $\hat{N}_{ML}$ unbiased ?

(c) Variance of $\hat{N}_{ML}$.

(d) Is $\hat{N}_{ML}$ efficient ?

Q.5 A) What is an abelian group? What are the properties of an abelian group? (06)

B) Explain the following terms (06)

1. Vector Space
2. Linear Independence

Q.6 Write a short note on the following (12)

i) Sign test

ii) Wilcoxon test

iii) Min-Max criteria.