Register No.: …… Name: ……

SAINTGITS COLLEGE OF ENGINEERING (AUTONOMOUS)

(AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANANTHAPURAM)

SECOND SEMESTER M.TECH DEGREE EXAMINATION (Regular), JULY 2022

TELECOMMUNICATION ENGINEERING

(2021 Scheme)

Course Code: **21TE201**

Course Name: **Detection and Estimation Theory**

Max. Marks: **60** **Duration: 3 Hours**

Special instructions: Use Q-function table to solve problems if necessary

PART A

(Answer all questions. Each question carries 3 marks)

1. Determine the NP test for distinguishing between the hypotheses H_0 : μ=0 and H_1 : μ=1 based on the observed sample x [0]~N(μ,1).
2. Illustrate the development of matched filter from replica correlator.
3. State CRLB for scalar parameters.
4. Describe nonlinear least square estimators.
5. Differentiate Wiener filter and Kalman filter.
6. Explain dynamical signal model.
7. Describe the application of detection theory in communication.
8. Briefly explain the fields of applications of estimation theory.

PART B

(Answer one full question from each module, each question carries 6 marks)

MODULE I

9. a) Explain Bayes risk in hypothesis testing. (3)
   b) Explain probability of false alarm and probability of detection in hypothesis testing. (3)

OR

10. Design a minimum P_e detector to decide among the hypotheses having the following PDFs. Also determine it's P_e. (6)

$$p(x[0]/\mathrm{H}_0) = \frac{1}{2}\exp(-|x[0]+1|)$$

$$p(x[0]/H_1) = \frac{1}{2}\exp(-|x[0]|)$$

$$p(x[0]/H_2) = \frac{1}{2}\exp(-|x[0]-1|)$$

MODULE II

11. Describe composite hypothesis testing? Explain GLRT approach for composite hypothesis testing in detail. (6)

OR

12. In a signal detection problem which detect a damped exponential, $s[n] = Ar^n$, where A is unknown and r is known ($0 < r < 1$), in WGN with known variance σ^2. Based on x[n] for n = 0,1,…, N−1, show that the GLRT decides H_1 if $\hat{A}^2 > \gamma'$ where $\hat{A}$ is the MLE of A . (6)

MODULE III

13. Obtain CRLB for the estimation of DC Level in white Gaussian noise for a given signal $x[n] = A + w[n]$, n = 0, 1, 2, …, (N-1) with $w[n] \sim N(0, \sigma^2)$. (6)

OR

14. Explain BLUE in detail. Describe the procedure for finding BLUE for scalar parameters. (6)

MODULE IV

15. a) Explain maximum likelihood estimators in detail. (3)
    b) Briefly explain the properties of MLE. (3)

OR

16. Describe MMSE and MAP estimators in detail. (6)

MODULE V

17. Explain Wiener filter for
    (i) Smoothing problem
    (ii) Filtering problem
    (iii) Prediction problem (6)

OR

18. Explain scalar state – scalar observation Kalman filter in detail. (6)

MODULE VI

19. Explain the application of detection theory in pattern recognition. (6)

OR

20. Obtain the application of linear models in estimation theory with system identification as an example. (6)

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