Seat No._____

GANPAT UNIVERSITY

M. TECH. SEMESTER I ELECTRONICS& COMMUNICATION ENGINEERING
REGULAR EXAMINATION, JAN-2013

3EC102 SIGNAL DETECTION AND ESTIMATION

Time: 3 H0URS. **TOTAL Marks: 70**

Instructions:

1. Attempt all questions.
2. Answers to the two sections must be written in separate answer books.
3. Figures to the right indicate full marks. Assume suitable data, if necessary.

SECTION-I

1. (A) Explain the Sufficient statistic. Consider the situation where the samples Y_1, Y_2... $Y_K$are independent random variables, each having a Bernoulli distribution with parameter p. Assume that the test statistic is$T(y) = \sum_{k=1}^{k} y_k$, Is $T(Y)$ a sufficient statistic? **5**

(B) Consider the binary hypothesis problem with received conditional probabilities **7**

$$f_{Y|H_0}(y|H_0) = \frac{1}{2(1-e^{-1})} e^{-|y|} for\ |y| \leq 1 \quad \text{and}$$

$$f_{Y|H_1}(y|H_1) = \frac{1}{4}\, rect(\frac{1}{2})$$

The hypotheses $H0$ and $H1$ are equally likely.

(a) Find the decision regions for which the probability of error is minimum.

(b) Calculate the minimum probability of error.

(c) Find the decision rule based on the Neyman-Pearson criterion, such that the probability of false alarm is constrained to be $PF = 0.5$.

OR

1 (A) Explain the detection of Known signals in with the Correction receiver for binary decision problem. **6**

(B) Write a short note on signal detection application in binary symmetric channel. **6**

2 (A) In a digital communication system, consider a source whose output under hypothesis H_1 is a constant voltage of value m, while it's output under H_0 is zero. The received signal is corrupted by N, an AWGN of zero mean, and variance σ^2. **6**

(a) Set up the likelihood ratio test and determine the decision regions.

(b) Calculate the probability of false alarm and probability of detection.

(B) Explain MINIMAX Criterion With example. **5**

OR

2 (A) Explain Optimum detection of M-ary signal in white Gaussian noise. **6**

(B) Explain application of detection for Radar target model. **5**

3 (A) Obtain Optimum Decision Rule In Terms Of Likelihood Ratio And Threshold Using Bayes' Criterion. **6**

(B) In digital communication system consider a source whose output under hypothesis H_1 is constant voltage of value m, while it's output under H_0 is zero. The received is corrupted by N, an AWGN. Suppose that the receiver takes K samples, Y_1, Y_2.....Y_k. The noise samples are independent Gaussian random variables each with zero mean and variance σ^2.obtain the optimum decision rule. **6**

Seat No._____

SECTION-II

4 (A) Explain the Multiple parameter estimation for random parameter. 6

(B) Find $\hat{x}_{ms}$, the minimum mean-square error, and $\hat{x}_{map}$, the maximum a posteriori estimators, of X from the observation $Y = X + N$. X and N are random variables with density functions 6

$$f_X(x) = \frac{1}{2}\delta(x) + \frac{1}{2}\delta(x-1) \quad \text{and} \quad f_N(n) = \frac{1}{2}e^{-|n|} = \begin{cases} \frac{1}{2}e^{n}, & n \le 0 \\ \frac{1}{2}e^{-n}, & n \ge 0 \end{cases}$$

OR

4 (A) Explain MLP Estimation in brief. 6

(B) Consider K observations, such that 6

$Y_k = m + N_k$, $k = 1, 2, \ldots, K$

Where m is unknown and N_ks are statistically independent zero mean Gaussian random variables with unknown variance σ^2.

(a) Find the estimates $\hat{m}$ and $\hat{\sigma}^2$ for $m$and σ^2, respectively.

(b) Is $\hat{m}$ an efficient estimator?

(c) Find the conditional variance of the error var$[(\hat{m} - m) \mid m]$.

5 (A) Explain cramer-rao Inequality for random parameter 6

(B) ML Estimation for nonlinear estimation. 5

OR

5 (A) Explain baye's Estimation for random parameter. 8

(B) Define types of estimation. 3

6 (A) What is Estimation theory? with estimation model 6

(B) MAP Estimation for linear estimation. 6

END OF PAPER