Student Exam No.________

GANPAT UNIVERSITY
M. TECH. SEMESTER I ELECTRONICS& COMMUNICATION ENGINEERING
REGULAR EXAMINATION, DEC-2013
3EC102 SIGNAL DETECTION AND ESTIMATION

Time: 3 HOURS. **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

QUE. 1 (A) Explain alternative implementation of Correlation receiver for binary problem. **6**

(B) In communication system the information source is binary, and produces zeros and ones with equal probability, uses amplitude shift keying (ASK) so that the received signals under hypotheses $H1$ and $H0$ are **6**

$$H_1 : Y(t)=As(t)+W(t), \quad 0 \le t \le T$$
$$H_0 : Y(t)= \quad W(t), \quad 0 \le t \le T$$

The attenuation A produced by the communication channel is a Gaussian random variable with mean zero and variance σ_a^2. The signal s(t) is deterministic with energy E, and W(t) is an additive white Gaussian noise with mean zero and power spectral density N0/2. Determine the optimum receiver assuming minimum probability of error criterion.

OR

QUE. 1 (A) Consider the problem where conditional density functions under each hypothesis are **6**

$$f_{Y|H_0}(y|H_0)=\frac{1}{\sqrt{2\pi}\sigma}\exp\left(-\frac{y^2}{2\sigma_0^2}\right) \text{ and } f_{Y|H_1}(y|H_1)=\frac{1}{\sqrt{2\pi}\sigma}\exp\left(-\frac{y^2}{2\sigma_1^2}\right)$$

where $\sigma_1^2 > \sigma_0^2$.

(a) Determine the decision rule in terms of sufficient statistics.

(b) Assuming K independent observations, what would the decision rule be in terms of sufficient statistics?

(B) How Composite hypothesis testing different with Binary hypothesis testing? Explain Composite hypothesis testing for random variable and nonrandom variable. **6**

QUE. 2 (A) Write down and Explain ROC properties. **5**

(B) Explain application of detection radar target model. **6**

OR

QUE. 2 (A) Obtain the Matched filter Receiver for M-Ary detection and how Maximization of Output Signal-to-Noise Ratio in this receiver? **6**

(B) Write a short note on signal detection application in binary symmetric channel. **5**

QUE. 3 (A) Explain MINIMAX Criterion With example. **6**

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(B) Consider the binary hypothesis problem with received conditional probabilities **6**

$f_{Y|H_0}(y|H_0) = \frac{1}{2(1-e^{-1})} e^{-|y|} for\ |y| \leq 1$ 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 $PF = 0.5$.

SECTION-II

QUE. 4 (A) Explain baye's Estimation for random parameter and Consider the all cost function. **8**

(B) Explain wiener filter and give the Relation between the Kalman and Wiener Filters. **4**

OR

QUE. 4 (A) MAP Estimation for nonlinear estimation. **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 $var[(\hat{m}-m) \mid m]$.

QUE. 5 (A) What is Estimation theory? With estimation model. **6**

(B) Explain cramer-rao Inequality for nonrandom parameter **5**

OR

QUE. 5 (A) Explain application of Parameter estimation in Radar System. **5**

(B) Briefly explain the Kalman Filter. **6**

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

(B) Consider the problem where the observed samples are **6**

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

M and N_k are statistically independent Gaussian random variables with zero mean and variance σ^2. Find $\hat{m}_{ms}$, $\hat{m}_{map}$, $\hat{m}_{mave}$

END OF PAPER