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Reg. No. : ....

Name : ....

Second Semester M.Tech. Degree Examination, December 2016
(2013 Scheme)
ELECTRONICS AND COMMUNICATION ENGINEERING
TSC 2001 : Estimation and Detection Theory

Time: 3 Hours Max. Marks : 60

Instruction: *Answer* ***any two*** *questions from* ***each*** *Module.* ***Each*** *question carries* ***10*** *marks.*

MODULE – 1

1. Consider the binary hypothesis problem with received conditional probabilities.

   $$p(y.|H_0) = \frac{1}{2(1-e^{-1})} e^{-|y|} \text{ for } |y| \leq 1 \text{ and } p(y|H_1) = \frac{1}{2}\,\text{rect}\left(\frac{y}{2}\right)$$

   The hypothesis H_0 and H_1 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 criteria such that the probability of false alarm is constrained to 0.5.

2. What is composite hypothesis testing ? Derive the decision region using GLRT for the following binary hypothesis problem.

   H_0 : x[n]= W[n] ; n0, ... N – 1

   H_1 : x[n] = A + W[n]; n = O_1 .... N – 1 W[n] is Gaussian.

   With zero mean and variance 2, A is unknown. Explain the detection technique.

P.T.O.

3. Assume we have 3 hypothesis.
   $H_0 : x[n] = -A + W[n] \quad n = 0,1 \ldots N-1$
   $H_1 : x[n] = W[n] \quad n = 0\ 1,1 \ldots N-1$
   $H_2 : x[n] = A + W[n] \quad n = 0, 1 \ldots N-1$ where $A > 0$ W[n] is WGN with variance σ^2. Set up the decision regions and obtain the expression for minimum probability of error and probability of correct decision.

MODULE – 2

4. Let Y_1 and Y_2 be two statistically independent. Gaussian random variables, such that $E[Y_1] = m$ and $E[Y_2] = 3m$ and var $[Y_1]$ = var $[Y_2] = 1$; m is unknown.
   a) Obtain the ML estimate of m.
   b) If the estimator of m is of the form $a_1 y_1 + b_1 y_1$, determine a_1 and a_2 so that estimator is unbiased.

5. Derive the least square estimate of θ. The relationship between parameter θ and the observed data is given by the linear model.
   $Y = H\theta + N$. H is a known $(K \times M)$ matrix and N is an unknown $(K \times 1)$ error vector that occurs in measurement.

6. Consider the case of DC embedded in white noise.
   $x[n] = A + W[n]$ $n = 0 \ldots N-1$. W[n] is WGN with variance σ^2 and amplitude A unknown. Obtain the fisher information matrix, $\hat{A}$, $\hat{\sigma}^2$, reestimator of amplitude and variance.

MODULE – 3

7. Discuss any one application of estimation in the field of speech processing.
8. Explain the Lattice filter structure.
9. Obtain a Kalman filter for the following :
   Signal model is $S[n] = \frac{1}{2} S[n-1] + u[n]$ $n \geq 0$. Where $S[-1] \sim N(0, 1)$ and $\sigma^2_u = 2$. Assume that the signal is observed in noise (WGN). So that the data are $x[n] = S[n] + W[n]$ W[n] is zero Gaussian noise with independent samples, a variance of $\sigma^2_n = \left(\frac{1}{2}\right)^n$ and independent of $s[-1]$ and $u[n]$ for $n \geq 0$.