Dr Ghanshyam

JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT

TEST-3 EXAMINATION- JUNE -2016

M. Tech 4th Semester

(Electronics and Communication Engineering)

COURSE CODE: 13M1WEC431 MAX. MARKS: 35

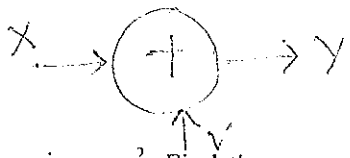
COURSE NAME: STATISTICAL SIGNAL PROCESSING

COURSE CREDITS: 03 MAX. TIME: 2 HRS

Note: *All questions are compulsory. Carrying of mobile phone during examinations will be treated as case of unfair means.*

Q. 1(a) In a binary communication problem as shown in Figure below, X is a binary random variable defined as:

$$X = \begin{cases} 1 & \textit{with probability } 1/2 \\ -1 & \textit{with probability } 1/2 \end{cases}$$



V is the Gaussian noise with mean zero and variance σ^2. Find the mean square error for X form the observed data Y. **[4]**

(b) Derive the Wiener-Hopf Equations. [3]

Q. 2(a) Explain the linear minimum mean square error estimator (LMMSE). What is the problem of determining the estimator parameters by the LMMSE criterion? Discuss the sub-classes of the problem which are identified. **[4]**

(b) Write the statement of the Cramer-Rao theorem and prove it. **[3]**

Q. 3(a) Consider the case of a carrier signal in presence of white Gaussian noise: $x[n] = A\cos[w_0 n + \phi]$, $w_0 = \pi/4$ and $y[n] = x[n] = v[n]$, where ϕ is uniformly distributed in (1, 2π). v[n] is the white Gaussian noise sequence of variance 1 and is independent of x[n]. Find the parameters for the FIR Wiener filter with $M = 3$. **[4]**

(b) What is the consistent estimator? Explain with suitable example. **[3]**

Q. 4(a) Explain the Neyman-Pearson approach to signal detection with suitable example. How do you evaluate the Neyman-Pearson detection performance? **[4]**

(b) What is the Lagrangian optimization? Explain it with suitable example. **[3]**

Q. 5(a) Discuss the optimal detection approach by considering the problem of detecting a known deterministic signal in the white Gaussian noise. How is it different with the Neyman-Pearson detection approach? **[4]**

(b) Explain the energy detection performance in terms of the signal-to-noise ratio. **[3]**