Seat No.: ________ Enrolment No.______________

GUJARAT TECHNOLOGICAL UNIVERSITY

M. E. - SEMESTER – I • EXAMINATION – WINTER 2012

Subject code: 710401N **Date: 08-01-2013**

Subject Name: Statistical Signal Analysis

Time: 02.30 pm – 05.00 pm **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1 **(a)** What is moment of random variable? Define central and initial moment with example. State its significance. **07**

(b) A binary source generates digits 1 and 0 randomly with probabilities 0.6 and 0.4 respectively. **07**

(a) What is the probability that two 1s and three 0s will occurs in a five digit sequence?

(b) What is the probability that at least three 1s will occur in a five digit sequence?

Q.2 **(a)** Suppose that a voltage X is zero mean Gaussian random variable with unit variance. Find the output Probability Density function (PDF) if voltage X is applied to half wave rectifier. **07**

(b) What is characteristics function? State its uses. How it differ from moment generating function? **07**

OR

(b) What is conditional probability? What is conditional expectation? Give practical example of both. **07**

Q.3 **(a)** The PDF of a random variable X is given by **07**

$$f_X(x) = \begin{cases} k & a \le x \le b \\ 0 & otherwise \end{cases}$$

Where k is constant

a. Determine the value of k.

b. Let a = -1 and b = 2. Calculate P(|X| $\le$ c) for c = 1/2

(b) If X_1, X_2,…, X_n. are jointly Gaussian vectored random variable. If All X_i for i=1 to n are statistically independent, zero mean and uncorrelated random variables. Find the characteristic function of Vectored random variable $\bar{X}$. **07**

OR

Q.3 **(a)** Let Y=2X+3. If a random variable X is uniformly distributed over [-1, **07**

2] find $f_Y(y)$. Sketch $f_x(x)$ and $f_Y(y)$.

(b) If X and Y both are independent then show that **07**
E[XY] = E[X] E[Y]

Q.4 **(a)** Let Y=aX+b. where X and Y both are random variables and a, b are constants. Show that if X is Gaussian with mean μ and variance σ^2 then random variable Y will have mean of $a\mu+b$ and variance of $a^2\sigma^2$. **07**

(b) Define random variables Z and W by **07**
Z = X + **a**Y and W = X – **a**Y
Where **a** is a real number. Determine **a** such that Z and W are orthogonal.

OR

Q.4 **(a)** For random process define cross correlation function and cross power spectral density. Give useful property of cross power spectral density. **07**

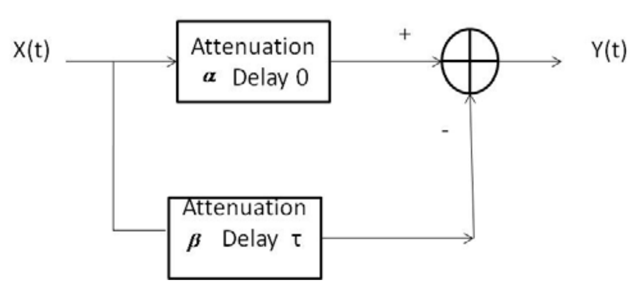
Q.4 **(b)** What is Ergodic random process? With an example explain it in detail. **07**

Q.5 **(a)** Consider a random process X(t) given by **07**
X(t) = A cos (wt + θ) where w and θ are constant and A is a random variable. Determine whether X(t) is Wide sense random process or not.

(b) Explain Mean square convergence and convergence in probability with an example. **07**

OR

Q.5 **(a)** Two ray multipath channel model is given as below **07**



X(t) and Y(t) are input and output random process. h(t) is a channel model. In this situation find the output power spectral density of output random process Y(t).

(b) What is convergence of Random variable? Explain sure convergence, Almost sure convergence. **07**

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