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MLR INSTITUTE OF TECHNOLOGY

(An Autonomous Institution)

II B.Tech I Semester Regular Examinations- December-2016

RANDOM VARIABLES AND STOCHASTIC PROCESSES

(ECE)

Time: 3 hours Max. Marks: 75

Note: 1. This question paper contains two parts A and B
2. Part A is compulsory which carries 25 marks .Answer all Questions in part A.
3. Part B consists of 5 units. Answer any one full question from each unit. Each question carriers 10 Marks and may have a, b,c sub questions.

PART-A

1 a) what are the conditions for a function to be random variable? [2M]
b) Define Rayleigh density and distribution function. [2M]
c) State Central Limit theorem. [2M]
d) Distinguish between stationary and non-stationary random processes. [2M]
e) Define Power density Spectrum. [2M]

2 a) what is Poisson random variable .Explain in brief? [3M]
b) Explain the concept of Transformations of random variable . [3M]
c) State and prove the properties of joint characteristics function. [3M]
d) Explain briefly about time average and ergodicity. [3M]
e) Write a short notes on the cross Power spectral density? [3M]

PART-B

3 (a) Distinguish between distribution function and density function .Explain their properties.[5M]

(b) A random variable has a pdf $f_X(x) = \frac{C}{\sqrt{25-x^2}} - 5 < x < 5.$ Find [5M]
(i) The value of C (ii)$P(X > 2)$ (iii)$P(X < 3)$ (iv)$P(X < 3/X > 2)$.

OR

4 (a) Define Exponential density and distribution function. Explain with their plots. [5M]

(b) The Probabilities of a random variable X are given as when $x_1 = \frac{1}{2}$, $P(x_1) = \frac{1}{2}$ [5M]
and $x_2 = \frac{-1}{2}$, $P(x_2) = \frac{1}{2}$. Find the Moment Generationg Function and the first four Movents.

5 (a) state and prove the properties of variance of a random variable. [5M]

(b) Find the density function of the random variable X if the characteristic function [5M]
is $\emptyset_X(\omega) = \begin{cases} 1 - |\omega|, & |\omega| \le 1 \\ 0 \quad , & elsewhere \end{cases}$

OR

6 (a) Explain in detail about the central Moments. [5M]

(b) A random variable X has $\bar{X} = -3, \overline{X^2}=11$, and$\sigma_X^2 = 2$. For a new random variable $Y = 2X - 3$, Find (a) $\bar{Y}$ (b) $\overline{Y^2}$ (c)σ_Y^2 [5M]

7 (a) Define and explain the conditional distribution and density function of two variables X and Y. [5M]

(b) The joint CDF of a random variable X and Y is given by [5M]

$$F_{X,Y}(x,y) = \begin{cases} (1-e^{-ax})(1-e^{-bx}), x \geq 0, y \geq 0, a, b > 0 \\ 0, \quad elsewhere \end{cases}$$

(i) Find the marginal CDFs of X and Y

(ii) Show that X and Y are independent

(iii) Find $P(X \leq 1, Y \leq 1), P(X \leq 1), P(Y \geq 1), and\ P(X > x, Y > y)$

OR

8 (a) Explain the Gaussian density function for N random variables. [5M]

(b) the joint density function of X and Y is

$$f_{X,Y}(x,y) = \begin{cases} \frac{1}{100}, \ 0 < x < 5,\ 0 < y < 20 \\ 0, \quad elsewhere \end{cases}$$

Find the expected value of the function.

i) XY ii) X^2Y iii) $(XY)^2$

9 (a) Explain how random processes are classified with neat sketches. [5M]

(b) A stationary process has an autocorrelation function given by

$$R_{XX}(\tau) = \frac{25\tau^2+36}{6.25\tau^2+4}$$

Find the mean value, mean square value and variance of the process. [5M]

OR

10 (a) Write short notes on Gaussian random processes. [5M]

(b) A random process $Y(t)$ is given by $Y(t) = X(t)\cos(\omega t + \theta)$,where $X(t)$ is a Wide sense stationary random process,ω is a constant and θ is a random phase independent of $X(t)$,uniformly distributed on $(-\pi, \pi)$ .Find (i)$E[Y(t)]$(ii)$R_{YY}(\tau)$. [5M]

11 (a) State and prove Wiener –Khintchin relations. [5M]

(b) The spectral density of a wide sense stationary random process $X(t)$ is given by

$S_{XX}(\omega) = \frac{\omega^2}{\omega^4+13\omega^2+36}$ .Find the autocorrelation and average power of the process. [5M]

OR

12 (a) write short notes on cross power density spectrum? [5M]

(b) A random process $X(t)$ has the autocorrelation function $R_{XX}(\tau) = \frac{A_0^2}{2}\sin(\omega_o\tau)$

Find the power spectral density $S_{XX}(\omega)$. [5M]