

II B. TECH I SEMESTER REGULAR EXAMINATIONS, MARCH - 2022
RANDOM VARIABLES AND STOCHASTIC PROCESSES
(ELECTRONICS AND COMMUNICATION ENGINEERING)

Time: 3 Hours

Max. Marks: 70

Note: Answer ONE question from each unit (5 × 14 = 70 Marks)

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UNIT-I

1. a) A combined experiment is performed by flipping a coin three times. The elements of the product space are HHH, HHT, HTH, etc. i) Write all the elements of the cartesian product space. ii) Find the probability of obtaining exactly one head. iii) Find the probability of obtaining at least two tails. [9M]
  - b) Describe with examples the classification of Random Variables. [5M]
- (OR)
2. a) State the properties of distribution of a Random Variable and also describe uniform and exponential distribution functions with examples. [10M]
  - b) A pair of dice are tossed 10 times. Find the probability that a 6 will occur exactly 4 times. [4M]

UNIT-II

3. a) A random variable X has a probability density [8M]
 
$$f_X(x) = \begin{cases} \frac{\pi}{16} \cos\left(\frac{\pi x}{8}\right) & -4 \leq x \leq 4 \\ 0 & \text{elsewhere} \end{cases}$$
 Find its mean value  $\bar{X}$ , its second moment  $\bar{X}^2$  and its variance.
- b) Explain the concept of nonmonotonic transformations of a continuous random variables. [6M]

(OR)

4. a) a). The characteristics function for a gaussian random variable X, having a mean value of 0, is  $\Phi_X(w) = e^{(-\sigma_X^2 w^2 / 2)}$  Find all the moments of X using  $\Phi_X(w)$ . [8M]
- b) Find  $f_Y(y)$  for the square law transformation.  $Y = T(X) = cX^2$  [6M]

UNIT-III

5. a) A joint sample space for two random variables X and Y has four elements (1,1), (2,2), (3,3), and (4,4). Probabilities of these elements are 0.1, 0.35, 0.05, and 0.5 respectively. Determine through logic and sketch the distribution function  $F_{X,Y}(x, y)$ . Also write an equation and sketch the joint density function  $f_{X,Y}(x, y)$  [8M]
- b) List and explain the properties of N jointly Gaussian random variables. Also explain the significance of the multiple random variable's functions. [6M]

(OR)

6. a) List jointly Gaussian random variable properties for two random variable and N random variable cases. [6M]

- b) The joint distribution function for two random variables X and Y is [8M]

$$F_{X,Y}(x,y) = u(x)u(y)[1 - e^{-ax} - e^{-ay} + e^{-a(x+y)}]$$

Where  $u(\cdot)$  is the unit step function and  $a > 0$ . Sketch  $F_{X,Y}(x,y)$ , find and sketch marginal distribution functions for above given function.

UNIT-IV

7. a) Give a brief about the random process and write the details of processes classification. [8M]

- b) Discuss first-Order Stationary Processes, Second-order and Strict-Sense Stationarity. [6M]

(OR)

8. a) Derive the expression for power density spectrum of a Radom Process. [8M]

- b) State and prove any two properties of auto-correlation function. [6M]

UNIT-V

9. a) Including an equivalent circuit, describe modeling of noise sources. [7M]

- b) A Random Process  $X(t)$  whose mean value is 2 and ACF is  $R_{xx}(\tau) = 4.e^{-2|\tau|}$  is applied to a system whose transfer function is  $1/(2+jw)$ . Find out mean value, and PDS of output  $y(t)$ . [7M]

(OR)

10. a) List and write briefly: the fundamentals of a linear system with random inputs. [9M]

- b) Find the equivalent temperature? When the noise figure of given an amplifier is 0.3dB. [5M]

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