

II B. TECH II SEMESTER REGULAR EXAMINATIONS, AUGUST 2021 RANDOM VARIABLES AND STOCHASTIC PROCESSES

(Electronics and Communication Engineering)

Time: 3 hours

Max. Marks: 60

Note: Answer **ONE** question from each Unit (**5 × 12 = 60 Marks**)

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### UNIT - I

1. a) A Gaussian random voltage  $X$  for which  $\mu_X = 0$  and  $\sigma_X = 4.2$  V appears across a 100- $\Omega$  resistor with a power rating of 0.25 W. What is the expected probability that the voltage will cause an instantaneous power that exceeds the resistor rating? [6M]
- b) Explain various types of random variable with suitable examples. [6M]

(OR)

2. a) The given function is a valid probability density function. Calculate the value for constant A. [6M]

$$f_X(x) = \begin{cases} 0 & : x < -1 \\ A(1 - x^2)\cos\left(\frac{\pi x}{2}\right) & : -1 \leq x \leq 1 \\ 0 & : x > 1 \end{cases}$$

- b) Find  $P(X > 1)$  and  $P(X \leq -1)$  for a given Gaussian random variable  $X$  has  $\mu_X = 4$  and  $\sigma_X = 4$ . [6M]

### UNIT – II

3. a) Explain these concepts: Monotonic Transformations for a Continuous Random Variable and Non-monotonic Transformations for a Continuous Random Variable. [6M]
- b) A random variable  $X$  can have values -4, -1, 2, 3 and 4, each with probability  $1/5$ . Find the density function, mean, and the variance of the random variable  $Y = 3X^2$ . [6M]

(OR)

4. a) Describe the expected value and expected value of function of a random variable. [6M]
- b) Find the characteristic function of a Gaussian random variable which has zero mean and unit variance. [6M]

### UNIT – III

5. a) Find and sketch density function of  $Y = X_1 + X_2 + X_3$ . Three statistical independent random variables  $X_1, X_2,$  and  $X_3$  all have the same density function  $f_X(x) = \frac{1}{a}[u(x_i) - u(x_i - a)]$  where  $i = 1, 2, 3$  and  $a > 0$  is constant. [6M]
- b) State the joint distribution and list out its properties. [6M]

(OR)

6. a) State jointly Gaussian random variable and list out properties of Gaussian random variables. [6M]  
 b) Sketch  $F_{X,Y}(x,y)$ . The joint distribution function for two random variables X and Y is  $F_{X,Y}(x,y) = u(x)u(y)[1 - e^{-ax} - e^{-ay} + e^{-a(x+y)}]$  Here  $u(\cdot)$  is the unit step function and  $a > 0$ . [6M]

UNIT –IV

7. a) Find the autocorrelation and auto covariance of the process of  $X(t) = X_0 + Vt$  where  $X_0$  and  $V$  are statistically random variables uniformly distributed on intervals  $[X_{01}, X_{02}]$  and  $[V_1, V_2]$ , respectively. [6M]  
 b) Write about band limited random processes and list their properties. [6M]

(OR)

8. a) Explain about Poisson random process. [6M]  
 b) Assume a random process has a power spectrum, [6M]

$$\varphi_{XX}(w) = \begin{cases} 4 - \left(\frac{w^2}{9}\right) & : |w| \leq 6 \\ 0 & : \text{elsewhere} \end{cases}$$

Find the average power and autocorrelation function of the process.

UNIT –V

9. a) Derive the convolution of the random response of linear system. [6M]  
 b) Define the average noise figure and derive the expression for the system output noise power. [6M]

(OR)

10. a) Derive cross-correlation functions of input  $X(t)$  and output  $Y(t)$ . [6M]  
 b) Explain linear system fundamentals. [6M]

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