Code No: **19ECT401** **R19**

II B. TECH II SEMESTER SUPPLEMENTARY EXAMINATIONS JULY - 2022
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 random variable X has a density function $f_X(x) = C(1-x^4)$ in $-1 \le x \le 1$. Find the value of 'C' and $P[\,|x| < 0.5]$. [6M]

   b) State the properties of density and distribution functions. [6M]

(OR)

2. a) If X is Gaussian random variable, show that [6M]

   $\int_{\infty}^{\infty} x f_X(x) = m_x.$

   b) Write the properties of Conditional density and distribution function of a random variable. [6M]

UNIT – II

3. a) A random variable X can have values -4, -1, 2, 3, and 4, each with probability 0.2. Find (i) the density function (ii) the mean (iii) the variance of the random variable $Y = X^2$. [6M]

   b) Find the expected value of the function $g(X) = X^3$ where X is a random variable defined by the density. [6M]

   $$f_X(x) = \left(\frac{1}{2}\right) u(x) \exp(-x/2).$$

(OR)

4. a) Find the characteristic function and the first two moments for $f_X(x) = ae^{-bx}$, $x \ge 0$. [6M]

   b) Explain the transformations of a random variable X. [6M]

UNIT – III

5. a) Define Marginal density function? Find the Marginal density functions of with joint density function. [6M]

   $$f_{XY} = \frac{1}{12} u(x) u(y) e^{-x/3} e^{-y/4}$$

   b) Gaussian random variables X and Y have first and second order moments $m_{10} = -1.1$, $m_{20} = 1.16$, $m_{01} = 1.5$, $m_{02} = 2.89$, $R_{XY} = -1.724$ Find C_{XY}, ρ [6M]
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(OR)

6. a) Defined the random variables V and W by (i) V=X+aY (ii) W= X-aY Where 'a' is real number and X and Y random variables, Determine 'a' in terms of X and Y such that V and W are orthogonal? [6M]

b) Given the joint distribution function [6M]

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

Find the conditional density functions $f_X(x / y)$ and $f_Y(y / x)$.

Are the random variables X and Y statistically independent.

UNIT –IV

7. a) Explain the classification of Random processes. [6M]

b) Explain the properties of cross correlation functions [6M]

(OR)

8. a) Consider a random processes $X(t) = A\cos(\omega_1 t + \theta)$ and $Y(t) = B\cos(\omega_2 t + \phi)$ where A, B, ω_1 and ω_2 are constants while θ and ϕ are statistically independent random variables uniformly distributed on $(0, 2\pi)$. Show that X(t) and Y(t) are jointly WSS processes. [8M]

b) If $\theta = \phi$, show that the two processes are not jointly WSS unless $\omega_1 = \omega_2$. [4M]

UNIT –V

9. a) A random noise X(t), having a power spectrum $S_{XX}(\omega) = 9 / (49 + \omega^2)$ is applied to a differentiator that has a transfer function $H_1(w) = jw$, the differentiator's output is applied to a network for which $h_2(t) = u(t).t^2 \exp(-7t)$ and the network's response is a noise denoted by Y(t).Find the average power in X(t) [6M]

b) Find the power spectrum of Y(t). [6M]

(OR)

10. a) Define the following terms. (i)Noise equivalent temperature (ii) Noise figure (iii) Available power gain. [6M]

b) The noise present at the input to a two port network is 1μW. the noise figure F is 0.5dB, the receiver gain $g_a = 10^{10}$, calculate: [6M]

(i) The available noise power contributed by two port network

(ii) The output available power.

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