Sub Code: R2021044 **R20** **Set No. 1**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY- GURAJADA VIZIANAGARAM
II B. Tech I Semester Supplementary Examinations, November – 2024
RANDOM VARIABLES AND STOCHASTIC PROCESSES
(ECE)

Time: 3 hours **Max. Marks: 70**

Answer any FIVE Questions
ONE Question from Each unit
All Questions Carry Equal Marks
*****

1 a) Write short notes below [7]
   i. Binomial random variable
   ii. Poisson Random variable

b) A random voltage can have any value defined by the set 'S' = {a≤ s ≤ b}. A quantizer, divides S into 6 equal-sized contiguous subsets and generates random variable X having values {-4, -2, 0, 2, 4, 6}. Each value of X is earned to the midpoint of the subset of 'S' from which it is mapped i) Sketch the sample space and the mapping to the line that defines the values of X ii) Find a and b? [7]

(OR)

2 a) Define Random variable? List out the properties of Distribution Function [7]

b) Suppose height to the bottom of clouds is a Gaussian random variable for which ax=4000m and σx=1000m. A person bets that cloud height tomorrow will fall in the set A={1000m<X≤3000m} while a second person bets that height will be satisfied by B={2000m<X≤4200m}.A third person bets they are both correct. Find the probability that each person will win the bet. [7]

3 a) Discuss in detail about Functions that gives Moments? [7]

b) Find the mean, variance from moment generation function of uniform distribution? [7]

(OR)

4 a) A random variable X is uniformly distributed on the interval $(-\pi,\pi)$. X is transformed to the new random variable Y=T(x)=aTan(X), where a>0. Find the probability density function of [7]

b) State and prove Chebychev's inequality. [7]

5 a) define random variables V and W by [7]

V=X+aY
W=X-aY

Where a is real number and X and Y random variables, Determine a in terms of X and Y such V and W are orthogonal?

b) Two Gaussian random variables X and Y are variances σ_X^2 =9 and σ_Y^2=4 respectively and correlation coefficientρ. It is known that a coordinate rotation by angle -π/8 results in new random variable Y_1 and Y_2 that are uncorrelated. [7]

(OR)

6 a) Random variables X and Y have respective density functions [9]

$$f_X(x)=\frac{1}{a}[u(x)-u(x-a)]$$

$$f_Y(y)=\frac{1}{b}[u(y)-u(y-b)]$$

Where b>a and a>0. Find and sketch the density functions of W= X + Y if X and Y are statistically independent

b) Three statistical independent Random variables X1,X2,X3 are defined by [5]

$$\bar{X}_1 = -1 \qquad \sigma_{X_1}^2 = 2.0$$
$$\bar{X}_2 = 0.6 \qquad \sigma_{X_2}^2 = 1.5$$
$$\bar{X}_3 = 1.8 \qquad \sigma_{X_3}^2 = 0.8$$

Write the equation describing the Gaussian approximation for the density function of the sum X= X1+X2+X3.

7 a) Write the properties of Autocorrelation Function of Random Process [7]

b) Give the random process by X(t)=A cos(w_0t) + B sin(w_0t) [7]

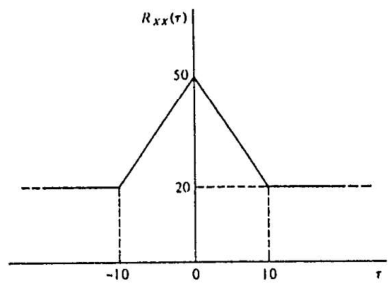
Where w_0 is a constant, and A and B are uncorrelated zero mean random variables having different density functions but the same variance ,show that X(t) is wide sense stationary but not strictly stationary

(OR)

8 a) For stationary ergodic random process having the autocorrelation function shown in below figure then find the [7]

i. Mean

ii. variance



b) Given that the autocorrelation function for a stationary Ergodic process with no period components is [7]

$$R_{xx}(\tau) = 25 + \frac{4}{1 + 6\tau^2}$$

Find the mean and variance of process X(t)?

9 a) Derive the relationship between power spectrum and auto-correlation [7]

b) If X(t) is a stationary process, find the power spectrum of $Y(t) = A_0 + B_0 X(t)$ in term of the power spectrum of X(t) if A_0 and B_0 are real constants [7]

(OR)

10 A Random signal X(t) of PSD of $\frac{N_0}{2}$ is applied on an LTI system having impulse response $h(t)$. If $Y(t)$is output, find (i) $E[Y^2(t)]$ (ii) $R_{XY}(\tau)$ (iii) $R_{YX}(\tau)$ (iv) $R_{YY}(\tau)$ [14]

*****