Sub Code: R2321041 **R23** **Set No. 1**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY- GURAJADA VIZIANAGARAM
II B. Tech I Semester Regular Examinations, November – 2024
Random Variables and Stochastic Process
(ECE)

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

Question paper consists of Part A, Part B.
Part A is compulsory, Answer all questions.
In Part B, Answer any one question from each unit.
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PART-A **(20 Marks)**

1	a)	What are the Conditions for a Function to be a Random Variable?	[2]
	b)	What is the application of Exponential Random Variable?	[2]
	c)	Define Skew?	[2]
	d)	What is Transformation Random Variable?	[2]
	e)	Define Marginal Density Function?	[2]
	f)	What is Central Limit Theorem?	[2]
	g)	Define Deterministic Random Processes	[2]
	h)	Define Strict- Sense Stationary.	[2]
	i)	What is Spectrum?	[2]
	j)	What is the System Response of Convolution for Linear Systems?	[2]

PART-B **(50 Marks)**

Unit-1

2	a)	Define conditional probability distribution function and write the properties	[5]
	b)	A production line manufactures 5-gal gasoline cans to a volume tolerance of 5%. The probability of any one can being out of tolerance is 0.03. if four cans are selected at random: i. What is the probability they are all out of tolerance? ii. What is the probability of exactly two being out?	[5]
		(OR)	
3	a)	Define Random variable? List out the properties of Distribution Function	[5]
	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.	[5]

Unit-2

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)=a Tan(X), where a>0. Find the probability density function of	[5]
	b)	State and prove Chebychev's inequality	[5]
		(OR)	
5	a)	Discuss in detail about Functions that gives Moments?	[5]
	b)	Find the mean, variance from moment generation function of uniform distribution?	[5]

Unit-3

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

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

b) Two statistically independent random variable X and Y have mean values $\bar{X}$=E[X]=2 and E[Y]=4. They have second moments $\bar{X}^2$=E[X^2]=8 and E[Y^2]=25. Find i) the mean value ii) the second moment iii) the variance of the random variable W=3X-Y. [5]

(OR)

7 a) Joint Sample Space has three elements (1, 1), (2, 2), and (3, 3) with probabilities 0.4, 0.3, 0.3 respectively then draw the Joint Distribution Function diagram [4]

b) Gaussian random variable X_1 and X_2 for which $\bar{X}_1$=2,σ_{X1}^2=9,$\bar{X}_2$=-1, σ_{X}^2=4 and C_{X1X2}=-3 are transformed to new random variable Y_1 and Y_2 according to Y_1=-X_1+X_2 ,Y_2=-2X_1-3X_2. Find i)σ_{Y1}^2 ii)σ_{Y2}^2 iii) C_{Y1Y2}. [6]

Unit-4

8 a) Write the properties of Cross correlation Function of Random Process [5]

b) Given that the autocorrelation function for a stationary Ergodic process with no period components is [5]

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

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

(OR)

9 a) Write the properties of Autocorrelation Function of Random Process [5]

b) Give the random process by X(t)=A cos(w_0t) + B sin(w_0t) 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 [5]

Unit-5

10 a) The autocorrelation function of a random process X(t) [5]

$$R_{xx}(\tau) = 3 + 2\exp(-4\tau^2)$$

i. Find the power spectrum of X(t)

ii. What is the average power in X(t)?

b) Assume X(t) is a wide sense stationary process with non zero mean value. show that [5]

$$s_{xx}(\omega) = 2\pi\bar{X}^2\delta(\omega) + \int_{-\infty}^{\infty} C_{xx}(\tau)e^{-j\omega\tau}d\tau$$

Where $C_{xx}(\tau)$ is the auto covariance function of X(t).

(OR)

11 a) Derive the relationship between cross-power spectrum and cross-correlation [10]

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