

Time: 3 hours

Max Marks: 70

PART-A
(Compulsory Questions)

(10 x 2 = 20 M)

1)	Answer the following	UNIT	Marks
✓ a)	List the axioms of probability.	I	[2M]
✓ b)	Define Random variable. If $X=\{1,2,3,4,5\}$ is which type of random variable?	I	[2M]
✓ c)	If $E[x]=5$ then find the expected value of $E[2X+5]$.	II	[2M]
✓ d)	What is second central moment? Write expression.	II	[2M]
✓ e)	Write the expressions for second order joint central moment. What is its significance?	III	[2M]
✓ f)	Define joint characteristic function of two Random variables X and Y.	III	[2M]
✓ g)	Differentiate deterministic and nondeterministic random processes.	IV	[2M]
✓ h)	Define Ergodic Random Process.	IV	[2M]
✓ i)	Define Bandlimited Processes.	V	[2M]
✓ j)	Draw PSD and ACF of White noise.	V	[2M]

PART-B

(5 x 10=50 M)

(ANSWER One FULL Question from each unit; All questions carry EQUAL marks)

UNIT-I

- 2) a) A pair of dice is thrown in a gambling problem. Person A wins if the sum of numbers showing up is six or less and one of the dice shows four. Person B wins if the sum is five or more and one of the dice shows four. [5M]
- Find: (i) the probability that A wins (ii) the probability of B winning, and (iii) the probability that both A and B win.
- b) Two cards are drawn from a 52-card deck (the first is not replaced). [5M]
- i) Give the first card is queen, what is the probability that second is also a queen?
- ii) Repeat part (a) for the first card a queen and the second card a 7.
- iii) What is the probability that both cards will be a queen?

(OR)

- 3) a) Define CDF and list the properties [5M]
- b) The distribution function for a random variable X is, [5M]

$$F(x) = \begin{cases} 1 - e^{-2x} & x \geq 0 \\ 0 & x < 0 \end{cases}$$

Find: (i) Density function (iii) $P(-3 < X \leq 4)$, and

(ii) $P(X > 2)$ (iv) Plot the density function

UNIT-II

- 4) ✓ a) A random variable X has a probability density [5M]

$$f_x(x) = \begin{cases} (1/2) \cos(x) & -\pi/2 < x < \pi/2 \\ 0 & \text{elsewhere in } x. \end{cases}$$

Find the mean value of the function on $g(X)=4X^2$

- b) State and prove Chebychev's inequality [5M]

(OR)

- 5) ✓ a) Define characteristic function. Find the characteristic function of the exponential distributed random variable. [5M]
- b) If two random variables X and Y are independent then show that the density of their sum is convolution of individual density functions [5M]

UNIT-III

- 6) ✓ a) Random variables X and Y have the joint density [5M]

$$f(x, y) = \begin{cases} \frac{1}{24} & 0 < x < 6 \text{ and } 0 < y < 4 \\ 0 & \text{elsewhere} \end{cases}$$

Find the expected value of the function $g(X, Y) = (XY)^2$.

- b) Two statistically independent random variables X and Y have mean values $E[X]=2$, $E[Y]=4$. They have second moments $E[X^2]=8$ $E[Y^2]=25$. [5M]

Find: (i) mean value (ii) second moment (ii) variance of random variable $W=3X-Y$

(OR)

- 7) a) Explain about the linear transformations of Gaussian random variables. [5M]
- b) Two random variables X and Y have zero means and variances 4 and 9 respectively. Their covariance is 3. These are transformed into new random variables as $V = x + 27$, $W = X - 3Y$. Find Means, variances and covariance of new random variables. [5M]

UNIT-IV

- 8) ✓ a) Define random process. Explain the classification of random processes. [5M]
- b) Auto correlation of a Random process $X(t)$ is $R_x(\tau) = 9 + 4/(1 + \tau^2)$, $X(t)$ is ergodic with no Periodic components, Find $E[x]$, $E[x^2]$, σ^2 . [5M]

(OR)

- 9) a) Define Power spectrum and list the properties. [5M]
- b) Find the auto correlation of Random Process when PSD is given $4/(4 + w^2)$. [5M]

UNIT-V

- 10) ✓ a) Derive mean and mean squared value of system response. [5M]
- ✓ b) Find the system response when signal $x(t) = u(t) e^{-3t}$ is applied to a network having an impulse response $h(t) = 4 u(t) e^{-4t}$. [5M]

(OR)

- 11) White noise of zero mean and of two sided power spectral density $\eta / 2$ watts/Hz is passed through an RC Low pass filter. Find the power spectral density and auto correlation function of the output. [10M]