SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institution)

S.R.M. Nagar, Kattankulathur - 603203

DEPARTMENT OF MATHEMATICS

QUESTION BANK

II YEAR / IV SEMESTER

B.E Electronics and Communication Engineering

MA3424 -APPLIED MATHEMATICS FOR ELECTRONICS AND COMMUNICATION ENGINEERING

Regulation – 2023

Academic Year – 2025 - 26

Prepared by

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SUBJECT: MA3424- APPLIED MATHEMATICS FOR ELECTRONICS AND COMMUNICATION ENGINEERING

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<table>
<tr><th>Q.No</th><th>QUESTIONS</th><th>BT Level</th><th>Competence</th><th>COS</th></tr>
<tr><td colspan="4">UNIT I RANDOM VARIABLES AND PROBABILITY DISTRIBUTIONS 6L
Discrete and Continuous random variables – Two dimensional random variables-Joint distributions – Marginal and conditional distributions.</td><td></td></tr>
<tr><td colspan="4">Part - A (2 MARK QUESTIONS)</td><td></td></tr>
<tr><td>1.</td><td>Define random variable.</td><td>BTL-1</td><td>Remembering</td><td>CO1</td></tr>
<tr><td>2.</td><td>Define Discrete random variable.</td><td>BTL-1</td><td>Remembering</td><td>CO1</td></tr>
<tr><td>3.</td><td>Define Continuous random variable.</td><td>BTL-1</td><td>Remembering</td><td>CO1</td></tr>
<tr><td>4.</td><td>Define Probability mass function of a discrete random variable.</td><td>BTL-1</td><td>Remembering</td><td>CO1</td></tr>
<tr><td>5.</td><td>Define Probability density function of a continuous random variable.</td><td>BTL-1</td><td>Remembering</td><td>CO1</td></tr>
<tr><td>6.</td><td>Define Cumulative distribution function of a discrete random variable.</td><td>BTL-1</td><td>Remembering</td><td>CO1</td></tr>
<tr><td>7.</td><td>Define Cumulative distribution function of a continuous random variable.</td><td>BTL-1</td><td>Remembering</td><td>CO1</td></tr>
<tr><td>8.</td><td>Write any two properties of Cumulative distribution function.</td><td>BTL-2</td><td>Understanding</td><td>CO1</td></tr>
<tr><td>9.</td><td>Define expectation of a discrete and continuous random variables.</td><td>BTL-1</td><td>Remembering</td><td>CO1</td></tr>
<tr><td>10.</td><td>A random variable X has the following probability function. Find k
<table>
<tr><td>x</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td></tr>
<tr><td>P(x)</td><td>k</td><td>2k</td><td>5k</td><td>7k</td><td>9k</td></tr>
</table></td><td>BTL-2</td><td>Understanding</td><td>CO1</td></tr>
<tr><td>11.</td><td>The number of hardware failures of a computer system in a week of operations has the following p.d.f, Find the mean of the number of failures in a week.
<table>
<tr><td>No.of failures</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td></tr>
<tr><td>Probability</td><td>.18</td><td>.28</td><td>.25</td><td>.18</td><td>.06</td><td>.04</td><td>.01</td></tr>
</table></td><td>BTL-2</td><td>Understanding</td><td>CO1</td></tr>
<tr><td>12.</td><td>The number of hardware failures of a computer system in a week of operations has the following p.d.f, Calculate the value of K.
<table>
<tr><td>No.of failures</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td></tr>
<tr><td>Probability</td><td>K</td><td>2 K</td><td>2 K</td><td>K</td><td>3 K</td><td>K</td><td>4 K</td></tr>
</table></td><td>BTL-2</td><td>Understanding</td><td>CO1</td></tr>
<tr><td>13.</td><td>Check whether the function given by $f(x)=\frac{x+2}{25}$ for x=1, 2,3,4,5 can serve as the probability distribution of a discrete random variable.</td><td>BTL-2</td><td>Understanding</td><td>CO1</td></tr>
<tr><td>14.</td><td>A continuous random variable X has the probability density function given by $f(x)=3x^2, 0<x<1$, Find K such that P(X > K)= 0.5</td><td>BTL-2</td><td>Understanding</td><td>CO1</td></tr>
<tr><td>15.</td><td>The no. of monthly breakdowns of a computer is a RV having Poisson distribution with mean 1.8. Find the probability that this computer will function for a month with only one breakdown.</td><td>BTL-2</td><td>Understanding</td><td>CO1</td></tr>
<tr><td>16.</td><td>If X is a Poisson variate such that $2P(X=0)+P(X=2)=2P(X=1)$, find find the probability distribution of X</td><td>BTL-2</td><td>Understanding</td><td>CO1</td></tr>
</table>

<table>
<tr><td>17.</td><td>If the random variable X takes the values 1,2,3 and 4 such that
$2P(X=1)=3P(X=2)=P(X=3)=5P(X=4)$,
Find the probability distribution of X.</td><td>BTL-2</td><td>Understanding</td><td>CO1</td></tr>
<tr><td>18.</td><td>The RV X has the following probability distribution:
<table><tr><td>x</td><td>-2</td><td>-1</td><td>0</td><td>1</td></tr><tr><td>P(x)</td><td>0.4</td><td>k</td><td>0.2</td><td>0.3</td></tr></table>Find k and the mean value of X.</td><td>BTL-2</td><td>Understanding</td><td>CO1</td></tr>
<tr><td>19.</td><td>If $f(x) = K(x + x^2)$ in $1 < x < 5$ is a pdf of a continuous random variables. Find the value of K.</td><td>BTL-2</td><td>Understanding</td><td>CO1</td></tr>
<tr><td>20.</td><td>The pdf of a continuous random variable X is $f(x) = k(1+x)$,
$2 < x < 5$ Find k.</td><td>BTL-2</td><td>Understanding</td><td>CO1</td></tr>
<tr><td>21.</td><td>For a continuous distribution $f(x) = k(x - x^2), 0 \leq x \leq 1$, Find k.</td><td>BTL-2</td><td>Understanding</td><td>CO1</td></tr>
<tr><td>22.</td><td>The probability function of a random variable is P(X=x) = $\frac{1}{2^x}$,
x =1,2,3,….,find P(X is even).</td><td>BTL-2</td><td>Understanding</td><td>CO1</td></tr>
<tr><td>23.</td><td>The probability function of a random variable is P(X=x) = $\frac{1}{2^x}$,
x =1,2,3,….,find P(X ≥ 4).</td><td>BTL-2</td><td>Understanding</td><td>CO1</td></tr>
<tr><td>24.</td><td>If $f(x) = kx^2, 0 < x < 3$, is to be a density function, find the value of k.</td><td>BTL-2</td><td>Understanding</td><td>CO1</td></tr>
<tr><td>25.</td><td>If $F(x) = 1 - e^{-\frac{x}{5}}$, $x \geq 0$,then find the probability density function of x.</td><td>BTL-2</td><td>Understanding</td><td>CO1</td></tr>
<tr><td colspan="4">PART – B (16 MARK QUESTIONS)</td><td></td></tr>
<tr><td>1.</td><td>A random variable X has the following probability distribution:
<table><tr><td>X</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td></tr><tr><td>P(X)</td><td>0</td><td>k</td><td>2 k</td><td>2 k</td><td>3 k</td><td>k^2</td><td>$2k^2$</td><td>$7k^2$+k</td></tr></table>Find (i) the value of k (ii) $P(1.5 < X < 4.5 / X > 2)$
(iii) $P(X < 4)$ (iv) $P(X \geq 4)$ (v) $P(X \geq 6)$
(vi) $P(X < 6)$ (vii) If $P(X \leq k) > 1/2$ then find the least value of k and (viii) CDF of x.</td><td>BTL-3</td><td>Applying</td><td>CO1</td></tr>
<tr><td>2</td><td>The probability mass function of a discrete R. V X is given in the following table:
<table><tr><td>X</td><td>-2</td><td>-1</td><td>0</td><td>1</td><td>2</td><td>3</td></tr><tr><td>P(X=x)</td><td>0.1</td><td>K</td><td>0.2</td><td>$2k$</td><td>0.3</td><td>k</td></tr></table>Find (1) Find the value of k, (2) P(X<1),(3) P(-1< X ≤ 2) (4) CDF of x.</td><td>BTL-4</td><td>Analyzing</td><td>CO1</td></tr>
<tr><td>3.</td><td>The probability mass function of a discrete r.v X is given in the table.
<table><tr><td>X</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td></tr><tr><td>P(X)</td><td>a</td><td>3a</td><td>5a</td><td>7a</td><td>9a</td><td>11a</td><td>13a</td><td>15a</td><td>17a</td></tr></table>Find (i) the value of a , (ii) $P(X < 3)$, (iii) Mean of X,
(iv) Variance of X.</td><td>BTL-3</td><td>Applying</td><td>CO1</td></tr>
<tr><td>4.</td><td>If the discrete random variable X has the probability function given by the table.
<table><tr><td>x</td><td>1</td><td>2</td><td>3</td><td>4</td></tr><tr><td>$P(x)$</td><td>$k/3$</td><td>$k/6$</td><td>$k/3$</td><td>$k/6$</td></tr></table>Find the value of k and Cumulative distribution of X.</td><td>BTL-3</td><td>Applying</td><td>CO1</td></tr>
<tr><td>5.</td><td>The probability mass function of a RV X is given by
$P(X = r) = kr^3, r = 1,2,3,4$. Find (1) the value of k,
(2)$P(\frac{1}{2} < X < \frac{5}{2} / X > 1)$.</td><td>BTL-4</td><td>Analyzing</td><td>CO1</td></tr>
<tr><td>6.</td><td>The probability distribution of an infinite discrete distribution is</td><td></td><td></td><td></td></tr>
</table>

<table>
<tr><td></td><td>given by $P[X = j] = \frac{1}{2^j}$ (j = 1,2,3…) Find (1)Mean of X,
(2)P [X is even], (3) P(X is odd) (4) P(X is divisible by 3).</td><td>BTL-3</td><td>Applying</td><td>CO1</td></tr>
<tr><td>7.</td><td>Find the mean and variance of the following probability distribution<table><tr><td>X_i</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td></tr><tr><td>P_i</td><td>0.08</td><td>0.12</td><td>0.19</td><td>0.24</td><td>0.16</td><td>0.10</td><td>0.07</td><td>0.04</td></tr></table></td><td>BTL-3</td><td>Applying</td><td>CO1</td></tr>
<tr><td>9.</td><td>If a random variable X has p.d.f $f(x) = \begin{cases} \frac{1}{4}, & \lvert X \rvert < 2 \\ 0, & Otherwise \end{cases}$
Find (a) $P(X < 1)$ (b) $P(\lvert X\rvert > 1)$ (c) $P(2X + 3 > 5)$.</td><td>BTL-4</td><td>Analyzing</td><td>CO1</td></tr>
<tr><td>10.</td><td>Find the MGF of the random variable X having the probability density function f(x) = $\begin{cases} \frac{x}{4}e^{-\frac{x}{2}}, & x > 0 \\ 0 & \text{,otherwise} \end{cases}$. Also find the mean and variance.</td><td>BTL-3</td><td>Applying</td><td>CO1</td></tr>
<tr><td>11.</td><td>A random variable X has c.d.f $F(x) = \begin{cases} 0, if x < -1 \\ a(1+x), if -1 < x < 1 \\ 1, if x \geq 1 \end{cases}$.
Find the value of a. Also P(X>1/4) and $P(-0.5 \leq X \leq 0)$.</td><td>BTL-4</td><td>Analyzing</td><td>CO1</td></tr>
<tr><td>12.</td><td>If f(x) = $\begin{cases} ax, & 0 \leq x \leq 1 \\ a, & 1 \leq x \leq 2 \\ 3a - ax, & 2 \leq x \leq 3 \\ 0, & elsewhere \end{cases}$ is the p.d.f of X. Calculate
(i) The value of a.
(ii) The cumulative distribution function of X.
(iii) If X_1, X_2 and X_3 are 3 independent observations of X. Find the probability that exactly one of these 3 is greater than 1.5?</td><td>BTL-4</td><td>Analyzing</td><td>CO1</td></tr>
<tr><td>13.</td><td>The Probability distribution function of a R.V. X is given by
$f(x) = \frac{4x(9 - x^2)}{81}$, $0 \leq x \leq 3$. Find the mean, variance.</td><td>BTL-4</td><td>Analyzing</td><td>CO1</td></tr>
<tr><td>14.</td><td>If the CDF of a R.V.X is F(x) = $\begin{cases} 1 - \frac{4}{x^2}, & if\ x > 2 \\ 0 & if\ x \leq 2 \end{cases}$
Find (1) $P(X < 3)$, (2) $P(X \geq 3)$, (iii) $P(4 < X < 5)$</td><td>BTL-3</td><td>Applying</td><td>CO1</td></tr>
<tr><td>15.</td><td>A continuous random variable X has the pdf f(x) = kx^4,
-1< x < 0. Find the value of k and P [X >-1/2 / X < -1/4].</td><td>BTL-3</td><td>Applying</td><td>CO1</td></tr>
<tr><td>16.</td><td>A continuous random variable X has a pdf f(x) = 6x(1-x),
$0 \leq x \leq 1$. Determine b if P(X < b) = P (X > b).</td><td>BTL--3</td><td>Applying</td><td>CO1</td></tr>
<tr><td>17.</td><td>A random variable X has a pdf f(x) = kx (2-x),0 < x < 2.
Find the cdf.</td><td>BTL-4</td><td>Analyzing</td><td>CO1</td></tr>
<tr><td>18.</td><td>Two cards are drawn successively with replacement from a well shuffled deck of 52 cards. Find the probability distribution of number of kings.</td><td>BTL-4</td><td>Analyzing</td><td>CO1</td></tr>
<tr><td colspan="4">UNIT II TWO – DIMENSIONAL RANDOM VARIABLES 6L
Two dimensional random variables-Joint distributions – Marginal and conditional distributions – Correlation – regression.</td><td>COS</td></tr>
<tr><td colspan="4">PART-A(2 MARK QUESTIONS)</td><td></td></tr>
<tr><td>1.</td><td>The joint probability distribution of X and Y is given by
$p(x, y) = \frac{x + y}{21}$, $x = 1,2,3; y = 1, 2$. Find the marginal probability</td><td>BTL-2</td><td>Understanding</td><td>CO2</td></tr>
</table>

<table>
<tr><td></td><td>distributions of X.</td><td></td><td></td><td></td></tr>
<tr><td>2.</td><td>The joint probability function (X,Y) is given by $P(x,y) = k(2x+3y), x = 0,1,2 \ \ y = 1,2,3,$ Find the value of K.</td><td>BTL-2</td><td>Understanding</td><td>CO2</td></tr>
<tr><td>3.</td><td>Find the probability distribution of X + Y from the bivariate distribution of (X,Y) given below:
<table><tr><td>X \ Y</td><td>1</td><td>2</td></tr><tr><td>1</td><td>0.4</td><td>0.2</td></tr><tr><td>2</td><td>0.3</td><td>0.1</td></tr></table></td><td>BTL-1</td><td>Remembering</td><td>CO2</td></tr>
<tr><td>4.</td><td>Let X and Y have the joint p.m.f
<table><tr><td>Y \ X</td><td>0</td><td>1</td><td>2</td></tr><tr><td>0</td><td>0.1</td><td>0.4</td><td>0.1</td></tr><tr><td>1</td><td>0.2</td><td>0.2</td><td>0</td></tr></table>Find P(X+Y > 1).</td><td>BTL-2</td><td>Understanding</td><td>CO2</td></tr>
<tr><td>5.</td><td>Find the marginal distributions of X and Y from the bivariate distribution of (X,Y) given below:
<table><tr><td>X \ Y</td><td>1</td><td>2</td></tr><tr><td>1</td><td>0.1</td><td>0.2</td></tr><tr><td>2</td><td>0.3</td><td>0.4</td></tr></table></td><td>BTL-1</td><td>Remembering</td><td>CO2</td></tr>
<tr><td>6.</td><td>The joint probability distribution function of the random variable (X,Y) is given by $f(x,y) = k(x^3y - xy^3), 0 \le x \le 2, 0 \le y \le 2.$ Derive the value of k.</td><td>BTL-2</td><td>Understanding</td><td>CO2</td></tr>
<tr><td>7.</td><td>If the joint probability density function of a random variable X and Y is given by $f(x,y) = \begin{cases} \frac{x^3y^3}{16}, & 0 < x < 2, 0 < y < 2 \\ 0, & otherwise \end{cases}$.
Obtain the marginal density function of X.</td><td>BTL-2</td><td>Understanding</td><td>CO2</td></tr>
<tr><td>8.</td><td>The joint probability density of a two dimensional random variable (X,Y) is given by $f(x,y) = \begin{cases} kxe^{-y}; & 0 \le x < 2, y > 0 \\ 0, & otherwise \end{cases}$. Evaluate k.</td><td>BTL-2</td><td>Understanding</td><td>CO2</td></tr>
<tr><td>9.</td><td>The joint probability density function of a random variable (X,Y) is $f(x,y) = k\,e^{-(2x+3y)}, x \ge 0, \ y \ge 0$. Point out the value of k.</td><td>BTL-2</td><td>Understanding</td><td>CO2</td></tr>
<tr><td>10.</td><td>If the joint pdf of (X, Y) is $f(x,y) = \begin{cases} \frac{1}{4}, & 0 < x, y < 2 \\ 0, & otherwise \end{cases}$.
Find $P(X+Y \le 1)$.</td><td>BTL-2</td><td>Understanding</td><td>CO2</td></tr>
<tr><td>11.</td><td>Let X and Y be random variables with joint density function
f(x,y) = $\begin{cases} 4xy, & 0 < x < 1, \ 0 < y < 1 \\ 0, & otherwise \end{cases}$ formulate the value of E(XY).</td><td>BTL-2</td><td>Understanding</td><td>CO2</td></tr>
<tr><td>12.</td><td>The joint density function of a random variable X and Y is $f(x,y) = 8xy, \ 0 < y \le x \le 1$.Calculate the marginal probability function of X.</td><td>BTL-2</td><td>Understanding</td><td>CO2</td></tr>
<tr><td>13.</td><td>Write the condition for two independent random variables .</td><td>BTL-1</td><td>Remembering</td><td>CO2</td></tr>
<tr><td>14.</td><td>If the joint probability density function of X and Y is $f(x,y) = e^{-(x+y)}, x, y \ge 0$.Are X and Y independent ?</td><td>BTL-2</td><td>Understanding</td><td>CO2</td></tr>
<tr><td>15.</td><td>State any two properties of correlation coefficient.</td><td>BTL-1</td><td>Remembering</td><td>CO2</td></tr>
<tr><td>16.</td><td>Write the angle between the regression lines.</td><td>BTL-1</td><td>Remembering</td><td>CO2</td></tr>
<tr><td>17.</td><td>The regression equations are x + 6y = 14 and 2x + 3y = 1. Evaluate the correlation coefficient between X & Y.</td><td>BTL-2</td><td>Understanding</td><td>CO2</td></tr>
<tr><td>18.</td><td>If $\bar{X} = 970, \bar{Y} = 18, \sigma_x = 38, \sigma_y = 2$ and r = 0.6 , Derive the line of regression of X on Y.</td><td>BTL-2</td><td>Understanding</td><td>CO2</td></tr>
<tr><td>19.</td><td>In a partially destroyed laboratory, record of an analysis of</td><td></td><td></td><td></td></tr>
</table>

	correlation data, the following results only are legible; Variance of X = 9; Regression equations are 8X - 10Y + 66 = 0 and 40X-18Y = 214. Find the mean values of X and Y?	BTL-2	Understanding	CO2
20.	The regression equations are 3x + 2y = 26 and 6x + y = 31. Find the correlation coefficient**.**	BTL-2	Understanding	CO2
21.	Define Covariance.	BTL-1	Remembering	CO2
22.	Prove that $-1 \leq r_{xy} \leq 1$.	BTL-2	Understanding	CO2
23.	The equations of two regression lines are 3x+2y=19 and 3y+9x=46. Obtain the mean of X and Y.	BTL-2	Understanding	CO2
24.	The equations of two regression lines are 3x+2y=19 and 3y+9x=46. Derive the correlation coefficient between X and Y.	BTL-1	Remembering	CO2
25.	Show that $[Cov(X,Y)]^2 \leq Var(X)Var(Y)$.	BTL-2	Understanding	CO2

PART B (16 Mark Questions)

1.	From the following table for bivariate distribution of (X, Y). Find (i) $P(X \leq 1)$ (ii)$P(Y \leq 3)$ (iii) $P(X \leq 1, Y \leq 3)$ (iv)$P(X \leq 1/ Y \leq 3)$ (v) $P(Y \leq 3/ X \leq 1)$ (vi)$P(X + Y \leq 4)$	BTL-3	Applying	CO2

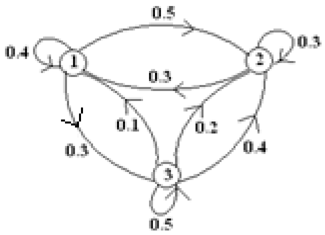
X \ Y	1	2	3	4	5	6
0	0	0	$\frac{1}{32}$	$\frac{2}{32}$	$\frac{2}{32}$	$\frac{3}{32}$
1	$\frac{1}{16}$	$\frac{1}{16}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{8}$
2	$\frac{1}{32}$	$\frac{1}{32}$	$\frac{1}{64}$	$\frac{1}{64}$	0	$\frac{2}{64}$

2.(a)	The two dimensional random variable (X, Y) has the joint probability mass function $f(x,y) = \frac{x+2y}{27}, x = 0,1,2; y = 0,1,2.$ Find the marginal distributions of X and Y. Also find the conditional distribution of Y given X = 1 also find the conditional distribution of X given Y = 1.	BTL-3	Applying	CO2
2.(b)	The joint pdf a bivariate R.V(X, Y) is given by $f(x,y) = \begin{cases} Kxy, & 0 < x < 1, 0 < y < 1 \\ 0, & otherwise \end{cases}$ (1) Find K. (2) Find P(X+Y<1). (3) Are X and Y independent R.V's.	BTL-3	Applying	CO2
3.(a)	If the joint pdf of (X, Y) is given by P(x, y) = K(2x+3y), x=0, 1, 2, 3, y = 1, 2, 3 Find all the marginal probability distribution. Also find the probability distribution of X+Y.	BTL-3	Applying	CO2
3.(b)	The joint pdf of the RV (X,Y) is given by $f(x,y) = kxye^{-(x^2+y^2)}$, $x > 0, y > 0$. Find the value of k. Also prove that X and Y are independent.	BTL-4	Analyzing	CO2
4.	The following table represents the joint probability distribution of the discrete RV (X,Y). Find all the marginal and conditional distributions.	BTL-3	Applying	CO2

Y	X		
	1	2	3
1	1/2	1/6	0
2	0	1/9	1/5
3	1/18	1/4	2/15

5.	Find the marginal distribution of X and Y and also P($P(X \le 1, Y \le 1), P(X \le 1), P(Y \le 1)$. Check whether X and Y are independent. The joint probability mass function of X and Y is <table><tr><td>X \ Y</td><td>0</td><td>1</td><td>2</td></tr><tr><td>0</td><td>0.10</td><td>0.04</td><td>0.02</td></tr><tr><td>1</td><td>0.08</td><td>0.20</td><td>0.06</td></tr><tr><td>2</td><td>0.06</td><td>0.14</td><td>.030</td></tr></table>	BTL-3	Applying	CO2
6.	<table><tr><td>Y \ X</td><td>$\frac{1}{8}$</td><td>$\frac{3}{8}$</td></tr><tr><td>0</td><td>0</td><td>0</td></tr><tr><td>1</td><td>$\frac{2}{8}$</td><td>$\frac{2}{8}$</td></tr></table> Find the correlation coefficient of X and Y from the above table.	BTL-4	Analyzing	CO2
7.	If the joint pdf of a two-dimensional RV(X,Y) is given by $f(x,y) = \begin{cases} x^2 + \frac{xy}{3}; 0 < x < 1, 0 < y < 2 \\ 0,\ elsewhere \end{cases}$. Find (i) $P\left(X > \frac{1}{2}\right)$ (ii) $P(Y < \frac{1}{2}, X < \frac{1}{2})$ (iii)$P\left(Y < \frac{1}{2} \,/\, X < \frac{1}{2}\right)$.	BTL-3	Applying	CO2
8.	The joint pdf of a two dimensional random variable (X, Y) is given by $f(x,y) = xy^2 + \frac{x^2}{8}, 0 \le x \le 2, 0 \le y \le 1$. Compute (i) $P\left(X > 1 \,/\, Y < \frac{1}{2}\right)$ (ii)$P\left(Y < \frac{1}{2} / X > 1\right)$ (iii) $P(X + Y) \le 1$.	BTL-3	Applying	CO2
9.	(b)The joint pdf of X and Y is given by f(x,y)=$\begin{cases} kx(x-y), 0 < x < 2, -x < y < x \\ 0,\quad otherwise \end{cases}$ (i)Find K (ii) Find $f_x(x)$ and $f_y(y)$	BTL-3	Applying	CO2
10.	Find the Coefficient of Correlation between industrial production and export using the following table <table><tr><td>Production (X)</td><td>14</td><td>17</td><td>23</td><td>21</td><td>25</td></tr><tr><td>Export (Y)</td><td>10</td><td>12</td><td>15</td><td>20</td><td>23</td></tr></table>	BTL-3	Understanding	CO2
11.	Find the correlation coefficient for the following heights of fathers X,their sons Y and also find the equations of regression lines. Hence find the height of son when the height of father is 71 <table><tr><td>X</td><td>65</td><td>66</td><td>67</td><td>67</td><td>68</td><td>69</td><td>70</td><td>72</td></tr><tr><td>Y</td><td>67</td><td>68</td><td>65</td><td>68</td><td>72</td><td>72</td><td>69</td><td>71</td></tr></table>	BTL-3	Applying	CO2
12.	Obtain the lines of regression <table><tr><td>X</td><td>50</td><td>55</td><td>50</td><td>60</td><td>65</td><td>65</td><td>65</td><td>60</td><td>60</td></tr><tr><td>Y</td><td>11</td><td>14</td><td>13</td><td>16</td><td>16</td><td>15</td><td>15</td><td>14</td><td>13</td></tr></table>	BTL-3	Applying	CO2
13.	If $f(x,y) = \frac{6-x-y}{8}$, $0 \le x \le 2$, , $2 \le y \le 4$ for a bivariate random variable (X,Y), Evaluate the correlation coefficient ρ.	BTL-4	Analyzing	CO2
14.	Two random variables X and Y have the joint density function $f(x,y) = x + y, 0 \le x \le 1, 0 \le y \le 1$. Evaluate the Correlation coefficient between X and Y.	BTL-4	Analyzing	CO2
15.	Three balls are drawn at random without replacement from a box containing 2 white, 3 red and 4 blue balls. If X denotes the number of white balls drawn and Y denotes the number of red balls drawn, Find	BTL-3	Applying	CO2

	the probability distribution of X and Y.			
16.	The two regression lines are 4x-5y+33=0 and 20x-9y=107. Find the mean of X and Y. Also find the correlation coefficient between them	BTL-3	Applying	CO2
17.	Out of the two lines of regression given by $x + 2y - 5 = 0$ and $2x + 3y - 8 = 0$, which one is the regression line of X on Y? Analyze the equations to find the means of X and Y. If the variance of X is 12, find the variance of Y.	BTL-4	Analyzing	CO2
18.	From the following data, Find (i)The two regression equations (ii) The coefficient of correlation between the marks in Mathematics and Statistics (iii) The most likely marks in Statistics when marks in Mathematics are 30 Marks in Maths : 25 28 35 32 31 36 29 38 34 32 Marks in Statistics: 43 46 49 41 36 32 31 30 33 39	BTL-4	Analyzing	CO2
UNIT-III RANDOM PROCESSES **6L** Classification – Stationary process – Markov process – Poisson process.				COS
PART-A(2 Mark Questions)				
1.	What are the four types of a stochastic process?	BTL-1	Remembering	CO3
2.	Define Discrete Random sequence with example.	BTL-1	Remembering	CO3
3.	Define Discrete Random Process with example.	BTL-1	Remembering	CO3
4.	Define Continuous Random sequence with example.	BTL-1	Remembering	CO3
5.	Define Continuous Random Process with example.	BTL-1	Remembering	CO3
6.	Define wide sense stationary process.	BTL-1	Remembering	CO3
7.	Define Strict Sense Stationary Process.	BTL-1	Remembering	CO3
8.	Define first order stationary Process.	BTL-1	Understanding	CO3
9.	Define second order stationary Process.	BTL-1	Understanding	CO3
10.	Define stationary process.	BTL-1	Remembering	CO3
11.	Define Markov Process.	BTL-1	Remembering	CO3
12.	Show that the random process $X(t) = A\cos(\omega_c t + \theta)$ is not stationary if it is assumed that A and ω_c are constants and θ is a uniformly distributed variable on the interval (0,π).	BTL-2	Understanding	CO3
13.	A random process X (t) = A sin *t* + B cos *t* where A and B are independent random variables with zero means and equal standard deviations. Find the mean of the process.	BTL-2	Understanding	CO3
14.	Consider the random process X (*t*) = *cos* (t + ϕ), where ϕ is uniform random variable in $\left(-\pi/2, \pi/2\right)$. Check whether the process is stationary.	BTL-2	Understanding	CO3
15.	Consider the random process X (*t*) = *cos* (ω_0t +θ), where θ is uniform random variable in$(-\pi, \pi)$. Check whether the process is stationary or not.	BTL-2	Understanding	CO3
16.	Define Poisson process.	BTL-1	Remembering	CO3
17.	State and two properties of Poisson process.	BTL-1	Remembering	CO3
18.	Compute the mean value of the random process whose auto correlation function is given by$R_{XX}(\tau) = 25 + \frac{4}{1+6\tau^2}$.	BTL-2	Understanding	CO3
19.	A random process has the autocorrelation function $R_{xx}(\tau) = \frac{4\tau^2+6}{\tau^2+1}$, find the mean square value of the problem.	BTL-2	Understanding	CO3
20.	Define Markov chain.	BTL-1	Remembering	CO3
21.	State Chapman- Kolmogorov theorem.	BTL-1	Remembering	CO3
22.	Consider the Markov chain with 2 states and transition probability	BTL-2	Understanding	CO3

	matrix $P = \begin{bmatrix} \frac{3}{4} & \frac{1}{4} \\ \frac{1}{2} & \frac{1}{2} \end{bmatrix}$. Find the stationary probabilities of the chain.			
23.	The one-step transition probability matrix of a Markov chain with states (0,1) is given by $P = \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$, Evaluate whether it is irreducible Markov chain?	BTL-2	Understanding	CO3
24.	Obtain the transition matrix of the following transition diagram.  	BTL-2	Understanding	CO3
25.	Check whether the Markov chain with transition probability matrix $P = \begin{bmatrix} 0 & 1 & 0 \\ 1/2 & 0 & 1/2 \\ 0 & 1 & 0 \end{bmatrix}$ is irreducible or not?	BTL-2	Understanding	CO3
	PART-B (16 Mark Questions)			
1.	The process {X(t)} whose probability distribution under certain conditions is given by $P\{X(t)=n\} = \begin{cases} \frac{(at)^{n-1}}{(1+at)^{n+1}}, & n=1,2 \\ \frac{at}{(1+at)}, & n=0 \end{cases}$ Show that it is not stationary.	BTL-3	Applying	CO3
2.(a)	Show that the random process $X(t) = A \sin(\omega t + \theta)$ is wide-sense stationary process where A and ω are constants and θ is uniformly distributed in (0, 2π).	BTL-3	Applying	CO3
2.(b)	Find the mean and autocorrelation of the Poisson processes	BTL-4	Analyzing	CO3
3.(a)	Given that the random process $X(t) = cos\ (t + \varphi)$ where φ is a random variable with density function $f(x) = \frac{1}{\pi}, \frac{-\pi}{2} < \varphi < \frac{\pi}{2}$, Discuss whether the process is stationary or not.	BTL-3	Applying	CO3
3.(b)	A student's study habits are as follows: If he studies one night, he is 70% sure not to study next night. On the other hand, if he does not study one night, he is 60% sure not to study the next nights as well. In the long run how often does he study?	BTL-3	Applying	CO3
4.(a)	Consider a random process $X(t) = B\ cos\ (50\ t + \Phi)$ where B and Φ are independent random variables. B is a random variable with mean 0 and variance 1.Φ is uniformly distributed in the interval [-π,π]. Determine the mean and auto correlation of the process.	BTL-3	Applying	CO3
4.(b)	Prove that the difference of two independent Poisson process is not a Poisson process.	BTL-3	Applying	CO3
5.(a)	Show that the random process $X(t) = A \cos(\omega t + \theta))$ is wide sense stationary, if A and ω are constant and θ is a uniformly distributed random variable in (0, 2π).	BTL3	Applying	CO3
5.(b)	Prove that the sum of two independent Poisson process is a Poisson process.	BTL4	Analyzing	CO3
6.(a)	Show that the random process $X(t) = A \cos(\omega t + \theta)$ is not	BTL-3	Applying	CO3

	stationary if A and ω are constants and θ is uniformly distributed random variable in$(0, \pi)$.			
6.(b)	Prove that the inter arrival time of the Poisson process follows exponential distribution.	BTL-3	Applying	CO3
7.	Show that the random process $X(t) = Acos\omega t + Bsin\omega t$ is wide sense stationary process if A and B are random variables such that $E(A) = E(B) = 0$,$E(A^2) = E(B^2)$and $E(AB) = 0$.	BTL-3	Applying	CO3
8.	A salesman's territory consists of three regions A, B, C. He never sells in the same region on successive days. If he sells in region A, then the next day he sells in B. However, if he sells either B or C, then the next day he is twice as likely to sell in A as in the other region. Explain How often does he sell in each of the regions in the steady state?	BTL-3	Applying	CO3
9.(a)	If the process$X(t) = P + Qt$, where P and Q are independent random variables with $E(P) = p, E(Q) = q, Var(P) = \sigma_1^2, Var(Q) = \sigma_2^2$, find $E(X(t)), R(t_1, t_2)$. Is the process $\{X(t)\}$ stationary?	BTL-3	Applying	CO3
9.(b)	The probability of a dry day following a rainy day is 1/3 and that the probability of a rainy day following a dry day is ½. Given that May 1st is a dry day. Obtain the probability that May 3rd is a dry day also May 5th is a dry day.	BTL-3	Applying	CO3
10.(a)	Suppose that customers arrive at a bank according to a Poisson process with a mean rate of per minute; Discuss the probability that during a time interval of 2 minutes (a) exactly 4 customers arrive, and (b) more than 4 customers arrive.	BTL-4	Analyzing	CO3
10.(b)	If customers arrive at a counter in accordance with a Poisson process with a mean rate of 2 per minute, Evaluate the probability that the interval between 2 consecutive arrivals is (a) more than 1 minute, (b) between 1 minute and 2 minutes and (c) 4 minutes or less.	BTL-4	Analyzing	CO3
11.	Consider the random process $Y(t) = X(t)cos(\omega_0 t + \theta)$, where $X(t)$ is wide sense stationary process, θ is a Uniformly distributed R.V. over $(-\pi, \pi)$ and ω_0 is a constant. It is assumed that $X(t)$ and θ are independent. Show that $Y(t)$ is a wide sense stationary.	BTL-3	Applying	CO3
12.	The transition probability matrix of a Markov chain $\{X_n\}$, n = 1,2,3, …. having 3 states 1,2 and 3 is $P = \begin{bmatrix} 0.1 & 0.5 & 0.4 \\ 0.6 & 0.2 & 0.2 \\ 0.3 & 0.4 & 0.3 \end{bmatrix}$ and the initial distribution is P(0) = (0.7, 0.2, 0.1). Evaluate i) $P(X_2 = 3)$ ii) $P(X_3 = 2, X_2 = 3, X_1 = 3, X_0 = 2)$.	BTL-3	Applying	CO3
13.	Consider the Markov chain $\{X_n$, n= 0, 1, 2,3…..} having 3 states space S={1,2,3} and one step TPM $P = \begin{bmatrix} 0 & 1 & 0 \\ 1/2 & 0 & 1/2 \\ 0 & 1 & 0 \end{bmatrix}$ and initial probability distribution $P(X_0=i)=1/3$,i= 1,2,3. Compute (1) $P(X_3=2.\ X_2=1, X_1=2, X_0=1)$ (2) $P(X_3=2, X_2=1, X_1=2, X_0=1)$ (3) $P(X_2=2/X_0=2)$ (4) Invariant Probabilities of the Markov Chain.	BTL-3	Applying	CO3
14.	A man either drives a car or catches a train to go to office each day.			

	He never goes 2 days in a row by train but if he drives one day, then the next day he is just as likely to drive again as he is to travel by train. Now suppose that on the first day of the week, the man tossed a fair die and drove to work if and only if 6 appeared. Find (i) the probability that he takes a train on the third day. (ii) the probability that he drives to work in the long run.	BTL-3	Applying	CO3
15.	Three boys A, B and C are throwing a ball to each other. *A* always throws the ball to *B* and *B* always throws the ball to *C* but *C* is just as likely to throw the ball to *B* as to *A*. Show that the process is Markovian. Find the transition probability matrix and classify the states.	BTL-4	Analyzing	CO3
16.	Consider a Markov chain chain$\{X_n$, n= 0, 1, 2,…..$\}$ having states space S={ 1,2} and one step TPM $P = \begin{bmatrix} \frac{4}{10} & \frac{6}{10} \\ \frac{8}{10} & \frac{2}{10} \end{bmatrix}$. (1) Draw a transition diagram. (2) Is the chain irreducible? (3) Is the state-1 ergodic? Explain. (4) Is the chain ergodic? Explain	BTL-4	Analyzing	CO3
17.	Classify the states of the Markov chain for the one-step transition probability matrix $P = \begin{pmatrix} 0 & 1 & 0 \\ \frac{1}{2} & 0 & \frac{1}{2} \\ 0 & 1 & 0 \end{pmatrix}$ with state space S = {1,2,3}	BTL-4	Analyzing	CO3
18.	Consider a Markov chain on (0, 1, 2) having the transition matrix given by $P = \begin{pmatrix} 0 & 0 & 1 \\ 1 & 0 & 0 \\ \frac{1}{2} & \frac{1}{2} & 0 \end{pmatrix}$. Show that the chain is irreducible. Find the steady state distribution.	BTL-4	Analyzing	CO3

UNIT IV- CORRELATION AND SPECTRAL DENSITIES Auto correlation functions – Properties –Power spectral density- Properties.			**6L**	**COs**
PART-A(2 Mark Questions)				
1.	Define autocorrelation function.	BTL -1	Remembering	CO4
2.	Define Cross correlation function.	BTL -1	Remembering	CO4
3.	State any two properties of an auto correlation function.	BTL -1	Remembering	CO4
4.	State any twos properties of cross correlation function.	BTL -1	Remembering	CO4
5.	Give an example of cross – spectral density.	BTL -1	Remembering	CO4
6.	State and prove any one of the properties of cross – spectral density function.	BTL -1	Remembering	CO4
7.	Estimate the variance of the stationary process { X (t)} whose auto correlation function is given by $R(\tau) = 2+4e^{-2\lambda\|\tau\|}$	BTL -2	Understanding	CO4
8.	Estimate the variance of the stationary process {X(t)}, whose auto correlation function is given by $Rxx(\tau) = 16 + (\frac{9}{1+6\tau^2})$.	BTL -2	Understanding	CO4
9.	Given that the autocorrelation function for a stationary ergodic process with no periodic components is $Rxx(\tau) = 25 + (\frac{4}{1+6\tau^2})$. Estimate the mean and variance of the process {X(t)}.	BTL -2	Understanding	CO4
10.	Prove that $R_{xy}(\tau) = R_{yx}(-\tau)$.	BTL -1	Remembering	CO4
11.	The random process X(t) has an autocorrelation function	BTL -1	Remembering	CO4

	$R_{xx}(\tau) = 18 + \frac{2}{6+\tau^2}$ Calculate E(X(t)) and E(X^2 (t)).			
12.	If a random process $X(t)$ is defined as $X(t) = \begin{cases} A, 0 \le t \le 1 \\ 0, \ otherwise \end{cases}$ where A is a r.v uniformly distributed from $-\theta$ to θ. P.T the autocorrelation function of $X(t)$ is $\frac{\theta^2}{3}$.	BTL -1	Remembering	CO4
13.	Check whether $\frac{1}{1+9\tau^2}$. is a valid auto correlation function of a random process.	BTL -2	Understanding	CO4
14.	If $R(\tau) = e^{-2\lambda\|\tau\|}$ is the auto correlation function of a random process {X(t)}. Point out the spectral density of {X(t)}.	BTL -2	Understanding	CO4
15.	The autocorrelation function of the random telegraph signal process is given by $R_{xx}(\tau) = a^2 e^{-2r\|\tau\|}$. Point out the power density spectrum of the random telegraph signal.	BTL -2	Understanding	CO4
16.	Point out the auto correlation function whose spectral density is $S(\omega) = \begin{cases} \pi, & \|\omega\| \le 1 \\ 0, & otherwise \end{cases}$	BTL -2	Understanding	CO4
17.	Evaluate the power spectral density of a random signal with autocorrelation function $e^{-\lambda\|\tau\|}$.	BTL -2	Understanding	CO4
18.	Check whether $R_{xx}(\tau) = \tau^3 + \tau^2$ is valid auto correlation function of a random process.	BTL -2	Understanding	CO4
19.	Given the power spectral density: $Sxx(\omega) = (\frac{1}{4+\omega^2})$ formulate the average power of the process .	BTL -2	Understanding	CO4
20.	Find the mean square value of the random process whose autocorrelation is $\frac{A2}{2} cos\, \omega\tau$.	BTL -2	Understanding	CO4
21.	Define spectral density.	BTL -1	Remembering	CO4
22.	Find the mean of a stationary random process whose auto correlation function is given by $R_{XX}(\tau) = 18 + \frac{2}{6+\tau^2}$.	BTL -1	Remembering	CO4
23.	State Wiener-Khinchine relation.	BTL -1	Remembering	CO4
24.	Find the mean of a stationary random process whose auto correlation function is given by $R_{(Z)} = \frac{25Z^2 + 36}{6.25Z^2 + 4}$.	BTL -1	Remembering	CO4
25.	Find the auto correlation function whose spectral density is $S_{XX}(\omega) = \begin{cases} 1, & \|\omega\| < \omega_0 \\ 0, & elsewhere \end{cases}$.	BTL -2	Understanding	CO4
	PART-B (16 Mark Questions)			
1.	Find the power spectral density of a WSS process with autocorrelation function $R(\tau) = e^{-\sigma\tau^2}$	BTL -3	Applying	CO4
2.	Identify the power spectral density of a random binary transmission process where auto correlation function is $R(\tau) = 1 - \frac{\|\tau\|}{T}; \|\tau\| \le T$.	BTL -3	Applying	CO4
3.	If the power spectral density of a continuous process is $S_{xx}(\omega) = \frac{\omega^2+9}{\omega^4+5\omega^2+4}$, Give the mean value, mean- square value of the process.	BTL -4	Analyzing	CO4
4.	The power spectrum of a wide sense stationary process X(t) is given by $S_{xx}(\omega) = \frac{1}{(1+\omega^2)^2}$ .Calculate the auto correlation function.	BTL -4	Analyzing	CO4

5.	Find the auto correlation function of the process {X(t)}, if its power spectral density is given by $S(\omega) = \begin{cases} 1+\omega^2, for\ \|\omega\| \le 1 \\ 0, for\ \ \ \ \ \|\omega\| \ge 1 \end{cases}$	BTL -4	Analyzing	CO4
6.	A random process {X(t)} is given by $X(t) = Acospt + B\ sinpt$, where A and B are independent RV's such that E(A)=E(B)= 0 and $E(A^2) = E(B^2) = \sigma^2$. Calculate the power spectral density of the process.	BTL -3	Applying	CO4
7.	Find the mean-square value of the Processes whose power spectral density is $\frac{\omega^2+2}{\omega^4+13\omega^2+36}$.	BTL -3	Applying	CO4
8.	If the power spectral density of a WSS process is given by $S(\omega) = \begin{cases} \frac{b}{a}(a-\|\omega\|), \|\omega\| \le a \\ 0, \ \ \ \ \ \ \|\omega\| > a \end{cases}$ Evaluate auto correlation function	BTL -4	Analyzing	CO4
9.	Consider the random process X(t) = Ycosωt, t ≥ 0, where ω is a constant and Y is a uniform random variable over (0,1) Find the auto correlation function $R_{xx}(t, s)$ of X(t)and auto covariance $C_{xx}(t, s)$ of X(t).	BTL -4	Analyzing	CO4
10.	Consider two random processes X(t) = 3 cos(ωt + θ) and Y(t) = 2 cos (ωt + θ - π/2) where θ is a random variable uniformly distributed in (0 , 2 π). Prove that $\sqrt{R_{xx}(0)R_{yy}(0)} \ge \|R_{xy}(\tau)\|$.	BTL -3	Applying	CO4
11.	Show that the Random Process $X(t) = A\sin(\omega t + \phi)$, where A and ω are constants, $\emptyset$ is a Random variable uniformly distributed in $(0\ ,2\pi)$.Find the autocorrelation function of the process.	BTL -3	Applying	CO4
12.	If the autocorrelation function of X(t) is $R_{XX}(\tau) = Ae^{-\alpha\|\tau\|}\cos(\omega_0\tau)$ where $A > 0, \alpha > 0$ *and* ω_0 *are constants. Find* the power spectrum of X(t)	BTL -4	Analyzing	CO4
13.	Find the power spectral density function whose auto correlation function is given by $R_{XX}(\tau) = \frac{A^2}{2}\cos(\omega_0\tau)$.	BTL -3	Applying	CO4
14.	The auto correlation function for a stationary process is given by $R_{XX}(\tau) = 9 + 2e^{-\|\tau\|}$. Find the mean value of the random variable $Y = \int_0^2 X(t)dt$ and the variance of $X(t)$.	BTL -4	Evaluating	CO4
15.	Estimate the power spectral density of the random process, if its auto correlation function is given by $R_{xx}(T) = e^{-\alpha\tau^2}cosw_0\tau$.	BTL -4	Analyzing	CO4
16.	If $Y(t) = X(t+a) - X(t-a)$, Examine $R_{YY}(\tau) = 2R_{XX}(\tau) - R_{XX}(\tau+2a) - R_{XX}(\tau-2a)$. Hence examine $S_{YY}(\omega) = 4sin^2a\omega S_{XX}(\omega)$.	BTL -4	Analyzing	CO4
17.	Given the power density spectrum $S_{XX}(\omega) = \frac{157+12\ \omega^2}{(\omega^2+16)(\omega^2+9)}$. Find the auto correlation function.	BTL -3	Applying	CO4
18.	Consider a random process X (t) = B cos(50t + φ) where B and φ are independent random variables. B is a random variable with mean 0 and variance 1. φ is uniformly distributed in the interval (−π ,π). Find mean and auto correlation of the process.	BTL -4	Analyzing	CO4

UNIT V- LINEAR SYSTEM WITH RANDOM INPUTS **6L** Linear time invariant system-System transfer function-Auto correlation and cross correlation functions of input and output.	**COS**

PART-A (2 Mark Questions)				
1.	Define a linear system with random input.	BTL -1	Remembering	CO5
2.	Define White Noise.	BTL -1	Remembering	CO5
3.	Define Band –Limited white noise.	BTL -1	Remembering	CO5
4.	Define system weighting function.	BTL -1	Remembering	CO5
5.	Define a system when is it called memory less system.	BTL -1	Remembering	CO5
6.	Define stable system.	BTL -1	Remembering	CO5
7.	Give an example for a linear system.	BTL -2	Understanding	CO5
8.	Check whether the system y(t)=$x^3(t)$ is a linear or not.	BTL -2	Understanding	CO5
9.	Give the properties of a linear system.	BTL -2	Understanding	CO5
10.	Give the relation between input and output of a linear time invariant system.	BTL -2	Understanding	CO5
11.	Show that Y(t) = t X(t) is linear.	BTL -2	Understanding	CO5
12.	Find the autocorrelation function of the white noise.	BTL -2	Understanding	CO5
13.	Prove that the mean of the output process is the convolution of the mean of the input process and the impulse response.	BTL -2	Applying	CO5
14.	If {X (t)}& {Y(t) } in the system Y(t) = $\int_{-\infty}^{\infty} h(u)X\,(\,t-u)du$ are WSS process explain how the auto correlation function related.	BTL -2	Understanding	CO5
15.	Define a system when is it called linear system?	BTL -1	Remembering	CO5
16.	If the input of a linear filter is a Gaussian random process, comment about the output random process.	BTL -2	Understanding	CO5
17.	Assume that the input X(t) to a linear time-invariant system is white noise. What is the power spectral density of the output process Y(t) if the system response H(ω) = $\begin{cases} 1\,, \omega_1 < \lvert\omega\rvert < \omega_2 \\ 0, otherweise \end{cases}$ is given?	BTL -2	Understanding	CO5
18.	Evaluate the system Transfer function ,if a Linear Time Invariant system has an impulse function H(t) = $\begin{cases} \frac{1}{2c}\,, \lvert t\rvert \le c \\ 0, \lvert t\rvert \ge c \end{cases}$	BTL -2	Understanding	CO5
19.	State any two properties of cross power density spectrum.	BTL -2	Understanding	CO5
20.	What is unit impulse response of a system? Why is it so called?	BTL -2	Understanding	CO5
21.	State the convolution form of the output of linear time invariant system.	BTL -1	Remembering	CO5
22.	Write a note on noise in communication system.	BTL -1	Remembering	CO5
23.	Define (a) Thermal Noise (b) White Noise.	BTL -1	Remembering	CO5
24.	If the system function of a convolution type of linear system is given by H(t) = $\begin{cases} \frac{1}{2a}\,, \lvert t\rvert \le a \\ 0, \lvert t\rvert \ge a \end{cases}$, find the relation between power spectrum density function of the input and output processes.	BTL -2	Understanding	CO5
25.	Check whether $\frac{1}{9+\tau^2}$ is a valid autocorrelation function of a random process.	BTL -2	Understanding	CO5
PART-B (16 Mark Questions)				
1.(a)	If the input to a time- invariant, stable linear system is a WSS process. prove that the output will also be a WSS process.	BTL -3	Applying	CO5
1.(b)	Show that $S_{yy}(\omega) = \lvert H(\omega)\rvert^2 S_{xx}(\omega)$, where $S_{xx}(\omega)$ and $S_{yy}(\omega)$ are the power spectral density functions of the input X(t) , output Y(t) and H(ω) is the system transfer function.	BTL -3	Applying	CO5

2.	Identify the output power density spectrum and output correlation function for a system $h(t) = e^{-t}, t \geq 0$, for an input power density system $\frac{h_0}{2}, -\infty < f < \infty$.	BTL -3	Applying	CO5
3.	A random process X(t) with $R_{xx}(\tau) = e^{-2\|\tau\|}$ is the input to a linear system whose impulse response is $h(t) = 2e^{-t}, t > 0$. Identify the cross correlation coefficient $R_{xy}(\tau)$ between the input process X(t) and output process Y(t).	BTL -3	Applying	CO5
4.	A system has an impulse response h(t) = $e^{-\beta t}$ U(t), Express the p.s.d. of the output Y(t) corresponding to the input X(t).	BTL -3	Applying	CO5
5.	Let X(t) be a stationary process with mean 0 and autocorrelation function $e^{-2\|\tau\|}$. If X(t) isthe input to a linear system and Y(t) is the output process , Calculate (i) E[Y(t)] (ii) $S_{YY}(\omega)$ and (iii) $R_{YY}(\|\tau\|)$, if the system function $H(\omega)=\frac{1}{\omega+2i}$.	BTL -3	Applying	CO5
6.	A random process X(t) having the auto correlation function $R_{XX}(\tau) = \rho e^{-\alpha\|\tau\|}$, where $\rho$and α are positive constants is applied the input of the system with impulse response h(t) = $\begin{cases} \lambda e^{-\lambda t}, & t > 0 \\ 0, & elsewhere \end{cases}$ where λ is a positive constant. Calculate the autocorrelation function of the networks response function Y(t).	BTL -3	Applying	CO5
7.	If X(t) is a WSS process and if y(t) = $\int_{-\infty}^{\infty} h(u).X(t-u)du$, then Formulate (i) $R_{XY}(\tau) = R_{XX}(\tau)*h(\tau)$ (ii) $R_{YY}(\tau) = R_{XY}(\tau)*h(\tau)$ if X(t) and Y(t) are jointly WSS where * denotes convolution operation.	BTL -4	Analyzing	CO5
8.	Consider a Gaussian white noise of zero mean and power spectral density $\frac{N_0}{2}$ applied to a low pass filter whose transfer function is $H(f) = \frac{1}{1+i2\pi fRC}$. Evaluate the auto correlation function.	BTL -4	Analyzing	CO5
9.	Analyze the mean of the output of a linear system is given by $\mu_Y = H(0)\mu_X$ where X(t) is WSS.	BTL -4	Analyzing	CO5
10.	A random process X(t) is the input to a linear system whose impulse function is h(t) = $2e^{-t}$, $t \geq 0$ .The auto correlation function of the process is $R_{XX}(\tau) = e^{-2\|\tau\|}$, Identify the power spectral density of the output process Y(t).	BTL -4	Analyzing	CO5
11.	If $x(t)$ is the input voltage to a circuit and $y(t)$is the output voltage, $\{X(t)\}$ is a stationary random process with $E(X) = 0$ and $R_{XX}(\tau) = e^{-2\|\tau\|}$. Find $E(Y), S_{XX}(\omega)$ and $S_{YY}(\omega)$, if the system function is given by $H(\omega) = \frac{1}{\omega^2+2^2}$.	BTL -4	Analyzing	CO5
12.	If $Y(t) = A\cos(\omega_0 t + \theta) + N(t)$, where A is a constant, θ is a random variable with a uniform distribution in (-π , π) and{N(t)} is a band limited Gaussian whit noise with a power spectral density $S_{NN}(\omega) = \begin{cases} \frac{N_o}{2}, & for\ \|\omega - \omega_0\| < \omega_B \\ 0, & elsewhere \end{cases}$ Calculate the power spectral density of {Y(t)}. Assume that N(t) and θ are independent.	BTL -3	Applying	CO5
13.	If $X(t)$ is the input and $Y(t)$is the output of the system. The autocorrelation of $X(t)$is $R_{XX}(\tau) = 3.\delta(\tau)$. Find the power spectral density, autocorrelation function and mean-square value of the output $Y(t)$with $H(\omega) = \frac{1}{6+j\omega}$.	BTL -3	Applying	CO5

14.	A circuit has an impulse response given by $h(t) = \begin{cases} \frac{1}{T}; 0 \le t \le T \end{cases}$. Express $S_{YY}(\omega)$ in terms of $S_{xx}(\omega)$.	BTL -3	Applying	CO5
15.	A wide sense stationary noise Process $N(t)$ has an autocorrelation function $R_{XX}(\tau) = B\, e^{-3\,\lvert\tau\rvert}$,where B is a constant. Find its Power Spectrum.	BTL -4	Analyzing	CO5
16.	(b) If the input $X(t)$ and its output $Y(t)$ are related by $Y(t) = \int_{-\infty}^{\infty} h(u)X(t-u)du$, then show that the system is a linear time – Invariant system.	BTL -4	Analyzing	CO5
17.	If $\{N(t)\}$ is a band limited white noise centered at a carrier frequency ω_0 such that $S_{NN}(\omega) = \begin{cases} \frac{N_o}{2}, & for\ \lvert\omega - \omega_0\rvert < \omega_B \\ 0, & elsewhere \end{cases}$ Identify the auto correlation function of $\{N(t)\}$.	BTL -4	Analyzing	CO5
18.	A linear system is described by the impulse response $h(t) = \frac{1}{RC} e^{-\frac{t}{RC}} u(t)$. Assume an input process whose auto correlation function is $A\delta(\tau)$. Point out the mean and the autocorrelation function of the output function.	BTL -4	Analyzing	CO5

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