SRM VALLIAMMAI ENGINEERING COLLEGE
(An Autonomous Institution)

S.R.M. Nagar, Kattankulathur - 603203

DEPARTMENT OF MATHEMATICS

QUESTION BANK

V SEMESTER

B. E- ARTIFICIAL INTELLIGENCE&DATA SCIENCE

1918502 – PROBABILITY RANDOM PROCESSES AND STATISTICS

Regulation – 2019

Academic Year – 2022 - 2023

Prepared by

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DEPARTMENT OF MATHEMATICS

SUBJECT : 1918502 – PROBABILITY RANDOM PROCESSES AND STATISTICS

SEM / YEAR: IV / II year B.E. (AI&DS)

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Probability – Axioms of probability – Conditional probability – Baye‘s theorem - Discrete and continuous random variables – Moments – Moment generating functions</td></tr>
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<tr><td colspan="4">PART – A</td></tr>
<tr><td>1.</td><td>Define probability</td><td>BTL -1</td><td>Remembering</td></tr>
<tr><td>2.</td><td>Define Axioms of probability</td><td>BTL -1</td><td>Remembering</td></tr>
<tr><td>3.</td><td>Define Moment Generating function of a random variable.</td><td>BTL -1</td><td>Remembering</td></tr>
<tr><td>4.</td><td>A die is rolled, find the probability that an even number is obtained.</td><td>BTL -2</td><td>Understanding</td></tr>
<tr><td>5.</td><td>If A and B are independent events then A and $\bar{B}$ also independent</td><td>BTL -3</td><td>Applying</td></tr>
<tr><td>6.</td><td>If A and B are independent events then $\bar{A}$and B also independent</td><td>BTL -3</td><td>Applying</td></tr>
<tr><td>7.</td><td>State Multiplication theorem of Probability</td><td>BTL -2</td><td>Understanding</td></tr>
<tr><td>8.</td><td>Define Moment Generating function of a random variable.</td><td>BTL-2</td><td>Understanding</td></tr>
<tr><td>9.</td><td>A random variables X has the following probability distribution.
Find the value of K and P(X$\geq$ 3)<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>3K</td><td>5K</td><td>7K</td><td>9K</td></tr></table></td><td>BTL -3</td><td>Applying</td></tr>
<tr><td>10.</td><td>If A and B are independent events then $\bar{A}$ and $\bar{B}$ also independent</td><td>BTL -2</td><td>Understanding</td></tr>
<tr><td>11.</td><td>A card is drawn from a well shuffled pack of 52 cards. What is the probability of getting queen or club card?</td><td>BTL -4</td><td>Analyzing</td></tr>
<tr><td>12.</td><td>Two coins are tossed, find the probability that two heads are obtained.</td><td>BTL -3</td><td>Applying</td></tr>
<tr><td>13.</td><td>If $f(x) = \begin{cases} ke^{-x}, x > 0 \\ 0, otherwise \end{cases}$ is the pdf of a random variable X, then find the value of k.</td><td>BTL -4</td><td>Analyzing</td></tr>
<tr><td>14.</td><td>For a continuous distribution $f(x) = k(x - x^2), 0 \leq x \leq 1$, where k is a constant. Find k.</td><td>BTL-5</td><td>Evaluating</td></tr>
<tr><td>15.</td><td>If a random variable X has the MGF M_X(t) = $\frac{2}{2-t}$. Find the mean of X.</td><td>BTL -4</td><td>Analyzing</td></tr>
<tr><td>16.</td><td>The p.d.f of a continuous random variable X is
$f(x) = k(1 + x), 2 < x < 5$, Find k.</td><td>BTL-5</td><td>Evaluating</td></tr>
<tr><td>17.</td><td>Show that the function $f(x) = \begin{cases} e^{-x} & ,x \geq 0 \\ 0, & x < 0 \end{cases}$ is a probability density function of a continuous random variable X.</td><td>BTL -4</td><td>Analyzing</td></tr>
<tr><td>18.</td><td>State Multiplication theorem of Probability</td><td>BTL -2</td><td>Understanding</td></tr>
<tr><td>19.</td><td>If the pdf of a random variable is f(x)=x/2 0$\leq$ x $\leq$2 find P(X > 1.5).</td><td>BTL-6</td><td>Creating</td></tr>
<tr><td>20.</td><td>A card is drawn at random from a deck of cards. Find the probability of getting the 3 of diamond</td><td>BTL -3</td><td>Applying</td></tr>
<tr><td>21.</td><td>State Baye's Theorem.</td><td>BTL -2</td><td>Understanding</td></tr>
</table>

<table>
<tr><td>22.</td><td>A continuous random variable X has a p.d.f $f(x)=2x, 0 \le x \le 1$. Find $P(X > 0.5)$.</td><td>BTL -4</td><td>Analyzing</td></tr>
<tr><td>23.</td><td>If $f(x)=kx^2$, $0< x < 3$, is to be a density function, find the value of k.</td><td>BTL-6</td><td>Creating</td></tr>
<tr><td>24.</td><td>Write any two properties of mathematical Expectation</td><td>BTL -2</td><td>Understanding</td></tr>
<tr><td>25.</td><td>If $f(x)=k(1+x)$, $0< x < 2$ is to be a density function, find the value of k.</td><td>BTL-6</td><td>Creating</td></tr>
<tr><td colspan="4">PART – B</td></tr>
<tr><td>1.</td><td>The probability mass function of a discrete R.V X is given in the following 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>BTL2</td><td>Understanding</td></tr>
<tr><td>2.(a)</td><td>A letter of the English Alphabet is chosen at random calculate the probability that the letter so chosen (i) is a vowel (ii) precedes m and is a vowel (iii) follows m and is a vowel.</td><td>BTL2</td><td>Understanding</td></tr>
<tr><td>2.(b)</td><td>If A and B are two events with $P(A)=3/8$ and $(B)=1/2$, $P(A\cap B)=1/4$, find $P(A^c \cap B^c)$.</td><td>BTL2</td><td>Understanding</td></tr>
<tr><td>3.</td><td>The probability distribution of an infinite discrete distribution is 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>BTL4</td><td>Analyzing</td></tr>
<tr><td>4.(a)</td><td>(b) 4 coins were tossed simultaneously. What is the probability of getting (i) 2 heads, (ii) atleast 2 heads, (iii) at most 2 heads.</td><td>BTL6</td><td>Creating</td></tr>
<tr><td>4.(b)</td><td>If $P(AUB)=5/6$, $P(A\cap B)=1/3$ and $P(\overline{B})=1/2$, Show that A and B are independent.</td><td>BTL -3</td><td>Applying</td></tr>
<tr><td>5.</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 (i) the value of k, (ii) $P(X<1)$, (iii) $P(-1< X \le 2)$, (iv) E(X) (v) Var(X).</td><td>BTL2</td><td>Understanding</td></tr>
<tr><td>6.(a)</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>BTL4</td><td>Analyzing</td></tr>
<tr><td>6.(b)</td><td>Two events A and B are such that $P(A)=1/4$, $P(A/B)=1/2$ and $P(B/A)=1/2$, find $P(A/\overline{B})$</td><td>BTL -3</td><td>Applying</td></tr>
<tr><td>7.</td><td>If $f(x) = \begin{cases} ax, & 0 \le x \le 1 \\ a, & 1 \le x \le 2 \\ 3a - ax, & 2 \le x \le 3 \\ 0, & elsewhere \end{cases}$ 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 -3</td><td>Applying</td></tr>
<tr><td>8.(a)</td><td>If the two dice are thrown, what is the probability that the sum is (a) greater that 8,and (b) neither 7 nor 11?</td><td>BTL -4</td><td>Analyzing</td></tr>
<tr><td>8.(b)</td><td>A continuous random variable has the probability density function $f(x)=k(1-x)^3$, $1\le x \le 3$ Find (i) k (ii) The distribution function F(x).</td><td>BTL -3</td><td>Applying</td></tr>
</table>

9.	Five salesman of A,B,C,D and E of a company are considered for a three member delegation to represent the company in an international trade conference construct the sample space and find the probability that (i)A is selected (ii) A is not selected (iii) Either A or B (not both) is selected	BTL -5	Evaluating
10.(a)	An integer is chosen at random from two hundred digits. What is the probability that the integer is divisible by 6 or 8	BTL -6	Creating
10.(b)	If A and B are independent events with P(A)=1/2 and P(B)=1/3, find $P(\overline{A}\cap\overline{B})$.	BTL -3	Applying
11.	The diameter, say X, of an electric cable, is assumed to be a continuous random variable with p.d.f. : $f(x) = 6x\,(1-x),\ 0\leq x \leq 1$ (i) Check that the above is a p.d.f., (ii) Obtain an expression for the c.d.f. of X., (iii) Compute $(X \leq 1/2 \mid 1/3 \leq X \leq 2/3$, and (iv) Determine the number k such that $P(X < k) = P(X>k)$.	BTL -4	Analyzing
12.(a)	The probability mass function of a discrete R. V X is given in the following table: X: -2, -1, 0, 1, 2, 3 P(X=x): 0.1, *K*, 0.2, 2*k*, 0.3, *k* Find (1) Find the value of *k*, (2) P(X<1),(3) $P(-1< X \leq 2)$	BTL3	Understanding
12.(b)	If P(A)=3/4 and P(B)=3/4,P(AUB)=11/12,find P(A/B)and P(B/A)	BTL -5	Evaluating
13.	From a city population the probability of selecting (i)a male or a smoker is 7/10,(ii).a male smoker is 2/5 and (ii)a male , if a smoker is already selected is 2/3.Find the Probability of selecting (a) a non-smoker (b) a male and (c) a smoker if a male is first selected	BTL -4	Analyzing
14.(a)	Probability of the complementary event $\overline{A}$ of A is given by $P(\overline{A}) = 1-P(A)$.	BTL -1	Remembering
14.(b)	If A and B are any two events (subsets of sample space S) and are not disjoint, then $P(A \cup B)= P(A)+P(B)- P(A\cap B)$	BTL -1	Remembering
15.	Three newspapers A, B and C are published in a certain city. It is estimated from a survey that of the adult population 20% read , 16% read B, 14% read C, 8% read both A and B, 5% read both A and C , 4% read both B and C, 2% read all three. Find what percentage read at least on of the papers?	BTL -4	Analyzing
16.(a)	An MBA applies for a job in two firms X and Y. the probability of his being selected in firm X is 0.7 and being rejected at Y is 0.5, the probability of at least one of his applications being rejected is 0.6. what is probability that he will be selected in one of the firms ?	BTL -4	Analyzing
16.(b)	The events A and B are independent with P(A)=0.5 and P(B)=0.8 .Find the probability that neither of the event occurs.	BTL -3	Applying
17.	For any two events A and B , we have (i) $P(\overline{A}\cap B)= P(B) - P(A \cap B)$ (ii) $P(A \cap \overline{B}) = P(A)-P(A\cap B)$	BTL -1	Remembering
18.(a)	In a class of 100 students 75 are boys and 25 are girls .The chance that a	BTL -3	Applying

	boy gets a first class is 0.25 and the probability that a girl gets first class is 0.21 .Find the probability that a student selected at random gets a first class.		
18.(b)	Two dice are thrown together. Find the probability that (i)The total of the numbers on the top face is 9 and (ii)The top faces are same	BTL -3	Applying
	PART – C		
1.	Out of 2000 families with 4 children each, Find how many family would you expect to have i) at least 1 boy ii) 2 boys iii) 1 or 2 girls iv) no girls	BTL -4	Analyzing
2.	In a shooting test , the probability of hitting the target are 1/2 for A,2/3 for B,3/4 for C.If all of them fire at the target ,find the probability that (i)None of them hits the target (ii) Atleast one of them hits the target. (iii)Exactly one of them hits the target	BTL -4	Analyzing
3.	A bag contains 4 white ,5 red and 6 black balls .Four are drawn at random find the probability that (a) No ball drawn is black (b) Exactly two are black (c) All are of the same colour (d) There is atleast one ball of each colour	BTL -2	Understanding
4.	In a bolt factory machines A,B,C manufacture 25%, 35%, 40% of the total output respectively.Out of their outputs 5,4,2 percent respectively are defective bolts.A bolt is drawn at random from the product and is found to be defective ,what are the probabilities that it was manufactured by machines A,B and C.	BTL -2	Understanding
5.	A random variable X has the following probability distribution: X: 0, 1, 2, 3, 4, 5, 6, 7 P(X): 0, k, $2k$, $2k$, $3k$, k^2, $2k^2$, $7k^2+k$ Find (i) The value of k (ii) Evaluate $P(X<6)$, $P(X\geq 6)$ and $P(0<x<5)$ (iii) $P(X\leq a)>1/2$, find the minimum value of 'a' and (iv)Determine the distribution function of X.	BTL -3	Applying

UNIT II - TWO - DIMENSIONAL RANDOM VARIABLES

Joint Probability distribution function – Marginal Probability distribution function and conditional distributions – Covariance – Correlation and linear regression

Q.No.	Question	BT Level	Competence
	PART – A		
1.	Define Two dimensional Discrete random variables.	BTL -1	Remembering
2.	Define Two dimensional Continuous random variables.	BTL -1	Remembering
3.	Define Marginal probability density function of X.	BTL -1	Remembering
4.	The joint probability distribution of X and Y is given by $p(x,y)=\frac{x+y}{21}, x=0,1,2;\quad y=1,2$. Find the marginal probability distributions of X.	BTL -2	Understanding
5.	Find the probability distribution of X + Y from the bivariate	BTL -3	Applying

<table>
<tr><td></td><td>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></td><td></td></tr>
<tr><td>6</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 -3</td><td>Applying</td></tr>
<tr><td>7.</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></tr>
<tr><td>8</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></tr>
<tr><td>9.</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 -3</td><td>Applying</td></tr>
<tr><td>10</td><td>If the joint probability density function of a random variable X and Y is given by $f(x,y) = \begin{cases} \frac{x^3y^3}{16}, 0 < x < 2, 0 < y < 2 \\ 0, \quad\quad otherwise \end{cases}$. Find the marginal density function of X.</td><td>BTL -2</td><td>Understanding</td></tr>
<tr><td>11.</td><td>What is the condition for two random variables are independent?</td><td>BTL -4</td><td>Analyzing</td></tr>
<tr><td>12.</td><td>The joint probability density of a two dimensional random variable (X,Y) is given by $f(x,y) = \begin{cases} kxe^{-y}; 0 \le x < 2, y > 0 \\ 0, \quad\quad otherwise \end{cases}$. Evaluate k.</td><td>BTL -3</td><td>Applying</td></tr>
<tr><td>13.</td><td>The joint probability density function of a random varaiable (X,Y) is $f(x,y) = k\,e^{-(2x+3y)}, x \ge 0, \; y \ge 0$. Find the value of k.</td><td>BTL -4</td><td>Analyzing</td></tr>
<tr><td>14.</td><td>State the correlation coefficient formula.</td><td>BTL -2</td><td>Understanding</td></tr>
<tr><td>15.</td><td>The regression equations are x + 6y = 14 and 2x + 3y = 1. Find the correlation coefficient between X &Y .</td><td>BTL -4</td><td>Analyzing</td></tr>
<tr><td>16.</td><td>If $\bar{X} = 970$, $\bar{Y} = 18, \sigma_x = 38$, σ_y= 2 and r = 0.6 , Find the line of regression of X on Y.</td><td>BTL -2</td><td>Understanding</td></tr>
<tr><td>17.</td><td>In a partially destroyed laboratory, record of an analysis of correlation data, the following results only are legible; Varaince of X = 9; Regression equations are 8X - 10Y + 66 = 0 and 40X-18Y = 214. Find the mean values of X and Y?</td><td>BTL -4</td><td>Analyzing</td></tr>
<tr><td>18.</td><td>The regression equations are 3x + 2y = 26 and 6x + y = 31. Find the correlation coefficient.</td><td>BTL -2</td><td>Understanding</td></tr>
<tr><td>19.</td><td>What is the formula to find the acute angle between the two lines of regression?</td><td>BTL -4</td><td>Analyzing</td></tr>
<tr><td>20.</td><td>If f(x,y)= $\begin{cases} kx^2y, 0 < x < 3, 0 < y < 5 \\ 0 \quad\quad otherwise \end{cases}$ is a pdf of X and Y.Find the value of k.</td><td>BTL -3</td><td>Applying</td></tr>
<tr><td>21.</td><td>Define Marginal probability density function of Y.</td><td>BTL -1</td><td>Remembering</td></tr>
<tr><td>22.</td><td>Let X be a continuous random variable having the pdf of</td><td>BTL -4</td><td>Analyzing</td></tr>
</table>

	f(x)= $\begin{cases} 8xy, 0 < x < y < 1 \\ 0 \quad otherwise \end{cases}$ find marginal density function of X		
23.	Define Conditional probability distribution function of X given Y=y	BTL -3	Applying
24.	Define Conditional probability distribution function of Y given X=x	BTL -2	Understanding
25.	The joint probability distribution of X and Y is given by f(x,y)= x+y x = 0,1,2; y = 1, 2. Find the marginal probability distributions of X.	BTL -4	Analyzing
	PART – B		
1.	If X, Y are RV's having the joint density function $f(x,y) = k(6-x-y), 0 < x < 2, 2 < y < 4$, Find $(i)\ P(x < 1, y < 3)\ (ii)\ P(x < 1 / y < 3)$ $(iii) P(y < 3/x < 1)\ iv) P(X+Y < 3)$	BTL -3	Applying
2.(a)	The joint distribution of X and Y is given by $f(x,y) = \frac{x+y}{21}$, $x = 1,2,3; y = 1,2$. Find the marginal distributions of X and Y.	BTL -5	Evaluating
2.(b)	If f(x)=3x^{2,} $0 \le x \le 1$ is the pdf of a continuous random variable ,find k such that P(X > k)=0.05	BTL -5	Evaluating
3.	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
4.(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.	BTL -3	Applying
4.(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
5.	From the following table for bivariate distribution of (X, Y). Find (i) $P(X \le 1)$(ii)$P(Y \le 3)$(iii) $P(X \le 1, Y \le 3)$ (iv)$P(X \le 1/ Y \le 3)$(v) $P(Y \le 3/ X \le 1)$ (vi)$P(X+Y \le 4)$	BTL -3	Applying

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	$\frac{2}{64}$

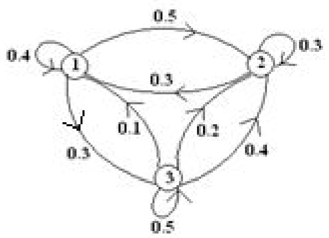
6.(a)	The two dimensional random variable (X, Y) has the joint probability mass function $f(x,y) = \frac{x+2y}{27}, x = 0,1,2; y = 0,1,2$. Find the conditional distribution of Y given X = 1 .	BTL -3	Applying
6.(b)	Find $P(X < Y/X < 2Y)$ if the joint pdf of(X,Y) is $f(x,y) = e^{-(x+y)}, 0 \le x < \infty, \quad 0 \le y < \infty$.	BTL -3	Applying
7.	If the joint pdf of a two-dimensional RV(X,Y) is given by	BTL -1	Remembering

	$f(x,y)=\begin{cases}x^2+\frac{xy}{3}; 0<x<1, 0<y<2\\ 0,\ elsewhere\end{cases}$. Find (i) $P\left(X>\frac{1}{2}\right)$ (ii) $P(Y<\frac{1}{2}, X<\frac{1}{2})$ (iii)$P\left(Y<\frac{1}{2}\ /\ X<\frac{1}{2}\right)$		
8.(a)	Given the joint pdf of X and Y is $f(x,y)=\begin{cases}8xy; 0<x<y<1\\ 0,\ elsewhere\end{cases}$ Find the marginal probability distribution function of X and Y.Are X and Y independent.	BTL -4	Analyzing
8.(b)	Find the Coefficient of Correlation between industrial production and export using the following table : Production (X): 14, 17, 23, 21, 25 Export (Y): 10, 12, 15, 20, 23	BTL -3	Applying
9.	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), Find the correlation coefficient ρ.	BTL -5	Evaluating
10.(a)	The joit pdf of the two dimensional random variable (X,Y) is given by $f(x,y)=\begin{cases}\frac{x^3y^3}{16}; 0\le x,y\le 2\\ 0,\ elsewhere\end{cases}$ (i)Find the marginal densities of X and Y. (ii)Prove that X and Y are independent.	BTL -6	Creating
10.(b)	Two random variables X and Y have the following joint probability density function $f(x,y)=\begin{cases}x+y; 0\le x\le 1, 0\le y\le 1\\ 0,\ otherwise\end{cases}$. Find the marginal density function of X and Y.	BTL -3	Applying
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 X: 65, 66, 67, 67, 68, 69, 70, 72 Y: 67, 68, 65, 68, 72, 72, 69, 71	BTL -4	Analyzing
12	The equation of two regression lines obtained by in a correlation analysis is as follows: 3x + 12y = 19 , 3y + 9x =46. (i) Mean value of X&Y. (ii) Calculate the correlation coefficient.	BTL -3	Applying
13.	Find the correlation coefficient for the following data X: 10, 14, 18, 22, 26, 30 Y: 18, 12, 24, 6, 30, 36	BTL -4	Analyzing
14.(a)	The joint pdf of a two dimensional random variable (X, Y) is given by $f(x,y)=\begin{cases}\frac{6}{5}(x+y^2); 0\le x\le 1, 0\le y\le 1\\ 0,\ otherwise\end{cases}$ Obtain the marginal pdf of X and Y.	BTL -3	Applying
14.(b)	If X and Y have the joint pdf of $f(x,y)=\begin{cases}2-x-y; 0\le x\le 1, 0\le y\le 1\\ 0,\ otherwise\end{cases}$ Find the value of Variance (X).	BTL -3	Applying
15.	The joint probability mass function of X and Y is given below	BTL -4	Analyzing

<table>
<tr><td></td><td>
<table>
<tr><td>Y \ X</td><td>-1</td><td>1</td></tr>
<tr><td>0</td><td>1/8</td><td>3/8</td></tr>
<tr><td>1</td><td>2/8</td><td>2/8</td></tr>
</table>
Find the correlation coefficient of X and Y</td><td></td><td></td></tr>
<tr><td>16.</td><td>The two lines of regression are 4x-5y+33=0 and 20x-9y=107.Calculate the means of x and y and the coefficient of correlation between x and y. Also find σ_y if σ_x=2 and σ_x if σ_y=3.</td><td>BTL -4</td><td>Analyzing</td></tr>
<tr><td>17.</td><td>Two random variables X and Y have the joint density function $f(x,y) = x + y, 0 \leq x \leq 1, 0 \leq y \leq 1$. Calculate the Correlation coefficient between X and Y.</td><td>BTL -4</td><td>Analyzing</td></tr>
<tr><td>18.(a)</td><td>The pdf of X is f(x)= $\begin{cases} cx^4; 0 \leq x \leq 2 \\ 0, \ otherwise \end{cases}$
Find C and E(X).</td><td>BTL -3</td><td>Applying</td></tr>
<tr><td>18.(b)</td><td>The joint pdf a bivariate R.V(X, Y) is given by $f(x,y) = \begin{cases} Kxy \ , \ 0 < x < 1, 0 < y < 1 \\ 0 \ , \ otherwise \end{cases}$
(i)Find K. (ii) Find P(X+Y<1). (iii)Are X and Y independent R.V's.</td><td>BTL -3</td><td>Applying</td></tr>
<tr><td colspan="4">PART – C</td></tr>
<tr><td>1.</td><td>The joint probability distribution of the random variables X and Y is given below
<table>
<tr><td>X \ Y</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>2K</td><td>4K</td><td>4K</td><td>6K</td></tr>
<tr><td>1</td><td>4K</td><td>4K</td><td>8K</td><td>8K</td><td>8K</td><td>8K</td></tr>
<tr><td>2</td><td>2K</td><td>2K</td><td>K</td><td>K</td><td>0</td><td>2K</td></tr>
</table>
Find (i)Value of K and marginal probability distribution of X and Y (ii) $P(X \leq 1)$(iii)$(X \leq 1/Y = 2)$(iv) $P(X < 3/ Y \leq 4)$</td><td>BTL -4</td><td>Analyzing</td></tr>
<tr><td>2.</td><td>Two random variables X and Y have the following joint probability density function $f(x,y) = \begin{cases} x + y; 0 \leq x \leq 1, 0 \leq y \leq 1 \\ 0, \ otherwise \end{cases}$.
Obtain the correlation coefficient between X and Y.</td><td>BTL -4</td><td>Analyzing</td></tr>
<tr><td>3.</td><td>Find the correlation coefficient for the following data
<table>
<tr><td>X</td><td>22</td><td>26</td><td>29</td><td>30</td><td>31</td><td>31</td><td>34</td><td>35</td></tr>
<tr><td>Y</td><td>20</td><td>20</td><td>21</td><td>29</td><td>27</td><td>24</td><td>27</td><td>31</td></tr>
</table></td><td>BTL -2</td><td>Understanding</td></tr>
<tr><td>4.</td><td>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</td><td>BTL -2</td><td>Understanding</td></tr>
<tr><td>5.</td><td>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 onY? Use the equations to find the means of X and Y. If the variance of X is 12, find the variance of Y.</td><td>BTL -3</td><td>Applying</td></tr>
</table>

UNIT III - RANDOM PROCESSES

Classification of random process – Stationary Classification of random process – Stationary processes – Auto correlation function - Bernoulli process - Poisson process – Markov chain

Q.No.	Question	BT Level	Competence
	PART – A		
1.	Define Discrete Random Process with example.	BTL1	Remembering
2.	Define continuous random process, Give an example. .	BTL1	Remembering
3.	Define wide sense stationary process.	BTL1	Remembering
4.	State and two properties of Poisson process.	BTL1	Remembering
5.	What are the four types of a stochastic process?	BTL1	Remembering
6	Consider the Markov chain with 2 states and transition probability 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.	BTL5	Evaluating
7.	The one-step transition probability matrix of a Markov chain with states (0,1) is given by $P=\begin{pmatrix}0 & 1\\ 1 & 0\end{pmatrix}$. Check whether it is irreducible Markov chain?	BTL6	Creating
8	Find the transition matrix of the following transition diagram. 	BTL6	Creating
9.	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 $(0,\pi)$.	BTL3	Applying
10	Define Markov process.	BTL2	Understanding
11.	Define Poisson process	BTL2	Understanding
12.	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?	BTL4	Analyzing
13.	Consider the random process $X(t) = cos\,(t + \phi)$, where ϕ is uniform random variable in $\left(-\pi/2, \pi/2\right)$. Check whether the process is stationary.	BTL5	Evaluating
14.	Define Strict Sense Stationary Process.	BTL3	Applying
15.	Find the mean of a stationary random process whose auto correlation function is given by $R_{XX}(\tau)=18+\frac{2}{6+\tau^2}$	BTL2	Understanding
16.	Derive the auto correlation for a Poisson process with rate λ.	BTL4	Analyzing
17.	A random process X (t) = A sin *t* + B cos *t* where A and B are	BTL3	Applying

	independent random variables with zero means and equal standard deviations. Find the mean of the process.		
18.	Define a Markov chain.	BTL1	Remembering
19.	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 -4	Analyzing
20.	Let A= $\begin{bmatrix} 0 & 1 \\ 1/2 & 1/2 \end{bmatrix}$ be a stochastic matrix.Check whether it is regular.	BTL -3	Applying
21.	Find the mean square value of the random process whose autocorrelation is $\frac{A^2}{2}\cos(\omega\tau)$	BTL -2	Understanding
22.	Define Bernoulli process .	BTL -4	Analyzing
23.	Distinguish between wide sense stationary and strict sense stationary random process.	BTL -3	Applying
24.	Write any two properties of Bernoulli process.	BTL -2	Understanding
25.	Define an Irreducible Markov Chain.	BTL -4	Analyzing
	PART – B		
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
2.	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 -5	Evaluating
3.	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
4.(a)	Given that the random process *X(t) = cos (t + φ)* where *φ* is a random variable with density function $f(x) = \frac{1}{\pi}, \frac{-\pi}{2} < \varphi < \frac{\pi}{2}$ .Check whether the process is stationary or not.	BTL -3	Applying
4.(b)	Consider a markov chain with the state space {0,1} and the TPM P= $\begin{bmatrix} 1 & 0 \\ 1/2 & 1/2 \end{bmatrix}$ (i) Is the state 0 recurrent?.Explain (ii) Is the state 1 transient?.Explain	BTL -3	Applying
5.	Show that the random process $X(t) = A\cos(\omega t+\theta)$ is wide sense	BTL -3	Applying

	stationary, if A and ω are constant and θ is a uniformly distributed random variable in $(0, 2\pi)$.		
6.(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 $[-\pi,\pi]$. Find the mean and auto correlation of the process.	BTL -3	Applying
6.(b)	Verify whether sine wave process $X(t)=Y \cos\omega t$,where Y is uniformly distributed in the interval [0,1] is a SSS process.	BTL -3	Applying
7.	The probability of a dry day following a rainy day is 1/3 and theat the probability of a rainy day following a dry day is ½. Given that May 1st is a dry day. Find the probability that May 3rd is a dry day also May 5th is a dry day.	BTL -1	Remembering
8.	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
9.	Let $\{X_n : n = 1,2,3 \ldots\ldots \}$ be a Markov chain on the space S = $\{1,2,3\}$ with one step t.p.m $P = \begin{bmatrix} 0 & 1 & 0 \\ 1/2 & 0 & 1/2 \\ 1 & 0 & 0 \end{bmatrix}$ (i).Sketch the transition diagram (ii). Is the chain irreducible? Explain.(iii)Is the chain ergodic? Explain.	BTL -5	Evaluating
10.(a)	An engineer analyzing a series of digital signals generated by at testing system observes that only 1 out of 15 highly distorted signal with no recognizable signal whereas 20 out of 23 recognized signals follow recognizable signals with no highly distorted signals between. Given that only highly distorted signals are not recognizable, find the fraction of signals that are highly distorted.	BTL -6	Creating
10.(b)	If the customers arrive in accordance with the Poisson process, with rate of 2 per minute, Find the probability that the interval between 2 consecutive arrivals is (i) more than 1 minute, (ii) between 1 and 2 minutes, (iii) less than 4 minutes.	BTL -3	Applying
11.	Let $\{X_n, n= 0, 1, 2,3\ldots..\}$ be a markov chain with state space S=$\{0,1,2\}$ and one step TPM $P = \begin{pmatrix} 0 & 1 & 0 \\ 1/4 & 1/2 & 1/4 \\ 0 & 1 & 0 \end{pmatrix}$ (i)Is the chain ergodic? Explain. (ii)Find the invariant Probability	BTL -4	Analyzing
12.(a)	Check whether the Poisson process $X(t)$ given by the probability law $P\{X(t) = n\} = \frac{e^{-\lambda t}(\lambda t)^n}{n!}, n = 0,1,2,\cdots$ is stationary or not.	BTL -3	Applying
12.(b)	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

13.	Show that the random process $X(t) = A\cos(\omega t + \theta)$ is not stationary if $A$and ω are constants and θ is uniformly distributed random variable in $(0, \pi)$.	BTL -4	Analyzing
14.	Consider a Markov chain chain $\{X_n, n= 0, 1, 2,\ldots\}$ 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 -3	Applying
15.	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 -4	Analyzing
16.(a)	Find the mean and autocorrelation of the Poisson processes	BTL -4	Analyzing
16.(b)	At an intersection, a working traffic light will be out of order the next day with probability 0.07, and an out of order traffic light will be working on the next day with probability 0.88. Find the state space and tpm. Also find $P(X_2=1)$.	BTL -3	Applying
17.	Consider the Markov chain $\{X_n, n= 0, 1, 2,3\ldots\}$ having 3 states space S={1,2,3} and one step TPM $P = \begin{bmatrix} 0 & 1 & 0 \\ \frac{1}{2} & 0 & \frac{1}{2} \\ 0 & 1 & 0 \end{bmatrix}$ 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 -4	Analyzing
18.(a)	Suppose the customers arrive in a bank according to the Poisson process, with a mean rate of 3 per minute, Find the probability that during a time interval 0f 2 minute (i)Exactly 4 customers arrive and (ii) more than 4 customers arrive	BTL -3	Applying
18.(b)	Prove that the sum of two independent Poisson process is a Poisson process.	BTL -3	Applying
PART – C			
1.	The transition probability matrix of a Markov process$\{X_n\}$, n = 1,2,3, …. having 3 states 0,1 and 2 is $P = \begin{pmatrix} 3/4 & 1/4 & 0 \\ 1/4 & 1/2 & 1/4 \\ 0 & 3/4 & 1/4 \end{pmatrix}$ and the initial distribution is $P^{(0)} = (1/3, 1/3, 1/3)$. Evaluate (i) $P(X_3=2/\ X_2=1)$ (ii) $P(X_2=2, X_1=1,X_0=2)$ (iii) $P(X_3=1, X_2=2,X_1=1, X_0=2)$ (iv) $P(X_2=2)$	BTL -4	Analyzing
2.	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	BTL -4	Analyzing

	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.		
3.	A machine goes out of order whenever a component fails. The failure of this part follows a Poisson process with mean rate of 1 per week. Find the probability that 2 weeks have a elapsed since last failure. If there are 5 spare parts of this component in an inventory and that the next supply is not due in 10 weeks, find the probability that the machine will not be out of order in the next 10 weeks.	BTL -2	Understanding
4.	A fair die is tossed repeatedly. If X_n denotes the maximum of the numbers occurring in the first n tosses, find the transition probability matrix P of the Markov chain $\{X_n\}$. Find also $P\{X_2 = 6\}$ and P^2.	BTL -2	Understanding
5.	Suppose 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 is1/2.Given that may 1 is a dry day .Find the probability that (i)May 3 is a dry day and (ii) May 5 is a dry day	BTL -3	Applying

UNIT IV - TESTING OF HYPOTHESIS

Sampling distributions - Estimation of parameters and interval estimation - Statistical hypothesis - Large sample tests based on Normal distribution for single mean and difference of means -Tests based on t, Chi-square and F distributions for mean, variance and proportion - Contingency table (test for independent) - Goodness of fit.

Q.No.	Question	BT Level	Competence
	PART – A		
1.	Define the following terms (i)Statistic, (ii)parameter	BTL -1	Remembering
2.	What are null and alternate hypothesis?	BTL -1	Remembering
3.	Mention the various steps involved in testing of hypothesis.	BTL -1	Remembering
4.	What is the essential difference between confidence limits and tolerance limits?	BTL -1	Remembering
5.	What are the parameters and statistics in sampling	BTL -1	Remembering
6	State level of significance.	BTL -1	Remembering
7.	Define standard error	BTL -2	Understanding
8	Define Hypothesis	BTL -2	Understanding
9.	Define Null hypothesis	BTL -2	Understanding
10	What is the assumption before applying t-test for equality of two means?	BTL -2	Understanding
11.	Write down the formula of test statistic 't' to test the significance of difference between the means.	BTL -3	Applying
12.	What are the applications of t-test?	BTL -3	Applying
13.	State any two applications of ψ^2-test.	BTL -6	Creating
14.	Write the application of 'F' test.	BTL -4	Analyzing
15.	Define 'F' variate.	BTL -4	Analyzing
16.	What are the properties of "F" test?	BTL -3	Applying
17.	What is the assumption of t-test?	BTL -5	Evaluating
18.	Write the formula for the chi- square test of goodness of fit of a random sample to a hypothetical distribution.	BTL -5	Evaluating
19.	Give the main use of ψ^2-test	BTL -6	Creating

<table>
<tr><td>20.</td><td>What are the expected frequencies of 2x2 contingency table?<table><tr><td>a</td><td>b</td></tr><tr><td>c</td><td>d</td></tr></table></td><td>BTL -4</td><td>Analyzing</td></tr>
<tr><td>21.</td><td>What is a test of hypothesis?</td><td>BTL -2</td><td>Understanding</td></tr>
<tr><td>22.</td><td>Define Type-I and Type-II errors</td><td>BTL -4</td><td>Analyzing</td></tr>
<tr><td>23.</td><td>Define one tailed and two tailed test</td><td>BTL -3</td><td>Applying</td></tr>
<tr><td>24.</td><td>Write down 1% and 5% level critical values for both two tailed and one tailed large sample tests</td><td>BTL -2</td><td>Understanding</td></tr>
<tr><td>25.</td><td>Write down the test statistic for checking the equality of two population means using smll samples.</td><td>BTL -4</td><td>Analyzing</td></tr>
<tr><td colspan="4">PART – B</td></tr>
<tr><td>1.</td><td>A simple sample of heights of 6400 Englishmen has a mean of 170cms and a standard deviation of 6.4cms, while a simple sample of heights of 1600 Americans has a mean of 172 cm and a standard deviation of 6.3cms. Do the data indicate that Americans are, on the average, taller than Englishmen?</td><td>BTL -3</td><td>Applying</td></tr>
<tr><td>2.(a)</td><td>A sample of 100 students is taken from a large population. The mean height of the students in this sample is 160cms. Can it be reasonably regarded that this sample is from a population of mean 165 cm and standard deviation 10 cm?</td><td>BTL -1</td><td>Remembering</td></tr>
<tr><td>2.(b)</td><td>Test of fidelity and selectivity of 190 radio receivers produced the results shown in the following table
Fidelity<table><tr><td>Selectivity</td><td>Low</td><td>Average</td><td>High</td></tr><tr><td>Low</td><td>6</td><td>12</td><td>32</td></tr><tr><td>Average</td><td>33</td><td>61</td><td>18</td></tr><tr><td>High</td><td>13</td><td>15</td><td>0</td></tr></table>Use 0.01 level of significance to test whether there is a relationship between fidelity and selectivity.</td><td>BTL -1</td><td>Remembering</td></tr>
<tr><td>3.</td><td>Given the following table for hair color and eye color, identify the value of Chi-square. Is there good association between hair color and eye color?<table><tr><td colspan="6">Hair color</td></tr><tr><td rowspan="5">Eye color</td><td></td><td>Fair</td><td>Brown</td><td>Black</td><td>Total</td></tr><tr><td>Blue</td><td>15</td><td>5</td><td>20</td><td>40</td></tr><tr><td>Grey</td><td>20</td><td>10</td><td>20</td><td>50</td></tr><tr><td>Brown</td><td>25</td><td>15</td><td>20</td><td>60</td></tr><tr><td>Total</td><td>60</td><td>30</td><td>60</td><td>150</td></tr></table></td><td>BTL -1</td><td>Remembering</td></tr>
<tr><td>4.(a)</td><td>A standard sample of 200 tins of coconut oil gave an average weight of 4.95 kg with a standard deviation of 0.21 kg. Do we accept that the net weight is 5 kg per tin at 5% level of significance?</td><td>BTL -3</td><td>Applying</td></tr>
<tr><td>4.(b)</td><td>A sample of 20 items has mean 42 units and standard deviation 5 units test the hypothesis that it is a random sample from a normal population with mean 45 units</td><td>BTL -3</td><td>Applying</td></tr>
</table>

<table>
<tr><td>5.</td><td>Two independent samples of sizes 8 and 7 contained the following values.
<table>
<tr><td>Sample I</td><td>19</td><td>17</td><td>15</td><td>21</td><td>16</td><td>18</td><td>16</td><td>14</td></tr>
<tr><td>Sample II</td><td>15</td><td>14</td><td>15</td><td>19</td><td>15</td><td>18</td><td>16</td><td></td></tr>
</table>
Test if the two populations have the same mean.</td><td>BTL -3</td><td>Applying</td></tr>
<tr><td>6.(a)</td><td>A group of 10 rats fed on diet A and another group of 8 rats fed on diet B, Recorded the following increase the following increase in weight.(gm)
<table>
<tr><td>Diet A</td><td>5</td><td>6</td><td>8</td><td>1</td><td>12</td><td>4</td><td>3</td><td>9</td><td>6</td><td>10</td></tr>
<tr><td>Diet B</td><td>2</td><td>3</td><td>6</td><td>8</td><td>10</td><td>1</td><td>2</td><td>8</td><td>-</td><td>-</td></tr>
</table>
Find the variances are significantly different. (Use F-test)</td><td>BTL -3</td><td>Applying</td></tr>
<tr><td>6.(b)</td><td>The marks obtained by a group of 9 regular course students and another group of 11 part time course students in a test are given below :
<table>
<tr><td>Sample I</td><td>56</td><td>62</td><td>63</td><td>54</td><td>60</td><td>51</td><td>67</td><td>69</td><td>58</td><td></td><td></td></tr>
<tr><td>Sample II</td><td>62</td><td>70</td><td>71</td><td>62</td><td>60</td><td>56</td><td>75</td><td>64</td><td>72</td><td>68</td><td>66</td></tr>
</table>
Examine whether the marks obtained by regular students and part-time students differ significantly at 5% levels of significance.</td><td>BTL -3</td><td>Applying</td></tr>
<tr><td>7.</td><td>
<table>
<tr><td>Sample I</td><td>9</td><td>11</td><td>13</td><td>11</td><td>15</td><td>9</td><td>12</td><td>14</td></tr>
<tr><td>Sample II</td><td>10</td><td>12</td><td>10</td><td>14</td><td>9</td><td>8</td><td>10</td><td></td></tr>
</table>
Two independent samples of 8 and 7 items respectively had the following Values of the variable (weight in kgs.) Use 0.05 LOS
To test whether the variances of the two population's sample are equal.</td><td>BTL -1</td><td>Remembering</td></tr>
<tr><td>8.</td><td>A sample of 200 persons with a particular disease was selected. Out of these, 100 were given a drug and the others were not given any drug. The result are as follows:
<table>
<tr><td>Number of persons</td><td>Drug</td><td>No drug</td><td>Total</td></tr>
<tr><td>Cured</td><td>65</td><td>55</td><td>120</td></tr>
<tr><td>Not cured</td><td>35</td><td>45</td><td>80</td></tr>
<tr><td>Total</td><td>100</td><td>100</td><td>200</td></tr>
</table>
Test whether the drug is effective or not?</td><td>BTL -4</td><td>Analyzing</td></tr>
<tr><td>9.</td><td>In a certain factory there are two independent processes manufacturing the same item. The average weight in a sample of 250 items produced from one process is found to be 120 Ozs, with a standard deviation of 12 Ozs, while the corresponding figures in a sample of 400 items from the other process are 124 and 14. Is the difference between the two sample means significant?</td><td>BTL -5</td><td>Evaluating</td></tr>
<tr><td>10.</td><td>The nicotine content in milligram of two samples of toboco where found to be as follows
Sample 1 24 27 26 21 25
Sample 2 27 30 28 31 22 36
Can it be said that this samples where from normal population with the</td><td>BTL -6</td><td>Creating</td></tr>
</table>

<table>
<tr><td></td><td>same mean.</td><td></td><td></td></tr>
<tr><td>11.</td><td>Records taken of the number of male and female births in 800 families having four Children are as follows :
Number of male births : 0 1 2 3 4
Number of female births : 4 3 2 1 0
Number of Families : 32 178 290 236 64
Infer whether the data are consistent with the hypothesis that the binomial law holds the chance of a male birth is equal to female birth, namely p = ½ = q.</td><td>BTL -4</td><td>Analyzing</td></tr>
<tr><td>12.</td><td>Certain pesticide is packed in to bags by a machine .A random sample of 10 bags is drawn and their contents are found to weigh(in kg) as follows 50,49,52,44,44,45,48,46,45,49,45 .Test if the average packing can be taken to be 50kg.</td><td>BTL -3</td><td>Applying</td></tr>
<tr><td>13.</td><td>A survey of 320 families with 5 children each revealed the following distribution
<table>
<tr><td>Boys</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td>Girls</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr>
<tr><td>Families</td><td>14</td><td>56</td><td>110</td><td>88</td><td>40</td><td>12</td></tr>
</table>
Is this result consistent with the hypothesis that male and female births are equally probable?</td><td>BTL -4</td><td>Analyzing</td></tr>
<tr><td>14.</td><td>The following data gives the number of aircraft accidents that occurred during the various days of a week. Find whether the accidents are uniformly distributed over the week
<table>
<tr><td>Days</td><td>Sun</td><td>Mon</td><td>Tues</td><td>Wed</td><td>Thu</td><td>Fri</td><td>Sat</td></tr>
<tr><td>No.of accidents</td><td>14</td><td>16</td><td>08</td><td>12</td><td>11</td><td>9</td><td>14</td></tr>
</table></td><td>BTL -3</td><td>Applying</td></tr>
<tr><td>15.</td><td>Two random samples gave the following results:
<table>
<tr><td>Sample</td><td>Size</td><td>Sample mean</td><td>Sum of squares of deviation from the mean</td></tr>
<tr><td>1</td><td>10</td><td>15</td><td>90</td></tr>
<tr><td>2</td><td>12</td><td>14</td><td>108</td></tr>
</table>
Analyze whether the samples have come from the same normal population.</td><td>BTL -4</td><td>Analyzing</td></tr>
<tr><td>16.</td><td>Test if the difference in the means is significant for the following data
Sample I: 76 68 70 43 94 68 33
Sample II: 40 48 92 85 70 76 68 22</td><td>BTL -4</td><td>Analyzing</td></tr>
<tr><td>17.</td><td>Mechanical engineers testing a new arc welding technique, classified welds both with respect to appearance and an X-ray inspection
<table>
<tr><td>X-ray/Appearance</td><td>Bad</td><td>Normal</td><td>Good</td></tr>
<tr><td>Bad</td><td>20</td><td>7</td><td>3</td></tr>
<tr><td>Normal</td><td>13</td><td>51</td><td>16</td></tr>
<tr><td>Good</td><td>7</td><td>12</td><td>21</td></tr>
</table>
Test for independence using 0.05 level of significance.</td><td>BTL -4</td><td>Analyzing</td></tr>
<tr><td>18.</td><td>The nicotine content in milligram of two samples of tobacco where found to be as follows, test the significant difference between means of the two samples.
<table>
<tr><td>Sample I</td><td>21</td><td>24</td><td>25</td><td>26</td><td>27</td><td>-</td></tr>
<tr><td>Sample II</td><td>22</td><td>27</td><td>28</td><td>30</td><td>31</td><td>36</td></tr>
</table></td><td>BTL -3</td><td>Applying</td></tr>
</table>

<table>
<tr><th colspan="4">PART – C</th></tr>
<tr><td>1.</td><td>Random samples drawn from two places gave the following data relating to the heights of male adults:
<table>
<tr><th></th><th>Place A</th><th>Place B</th></tr>
<tr><td>Mean height (in inches)</td><td>68.50</td><td>65.50</td></tr>
<tr><td>S.D (in inches)</td><td>2.5</td><td>3.0</td></tr>
<tr><td>No. of adut males in sample</td><td>1200</td><td>1500</td></tr>
</table>
Test at 5 % level, that the mean height is the same for adults in the two places.</td><td>BTL -4</td><td>Analyzing</td></tr>
<tr><td>2.</td><td>Samples of two types of electric bulbs were tested for length of life and following data were obtained.
<table>
<tr><th></th><th>Type I</th><th>Type II</th></tr>
<tr><td>Sample Size</td><td>8</td><td>7</td></tr>
<tr><td>Sample Mean</td><td>1234hrs</td><td>1036hrs</td></tr>
<tr><td>Sample S.D</td><td>36hrs</td><td>40hrs</td></tr>
</table>
Analyze that, is the difference in the means sufficient to warrant that type I is superior to type II regarding the length of life?</td><td>BTL -4</td><td>Analyzing</td></tr>
<tr><td>3.</td><td>5 coins were tossed 320 times. The number of heads observed is given below :
<table>
<tr><td>No. of heads</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr>
<tr><td>Observed frequencies</td><td>15</td><td>45</td><td>85</td><td>95</td><td>60</td><td>20</td></tr>
</table>
Examine whether the coin is unbiased .Use 5% level of significance.</td><td>BTL -2</td><td>Understanding</td></tr>
<tr><td>4.</td><td>The theory predicts that the population of beans in the four groups A, B, C and D should be 9:3:3:1. In an experiment among 1600 beans, the number in the four groups was 882,313,287 and 118. Do the experimental results support the survey?</td><td>BTL -2</td><td>Understanding</td></tr>
<tr><td>5.</td><td>The following data relate to the marks obtained by 11 students in two tests one before and the other after an intensive coaching .Do the data indicate that the students have benifitted by coaching?
Test I : 19 23 16 24 17 18 20 18 21 19 20
Test II: 17 24 20 24 20 22 20 20 18 22 19</td><td>BTL -3</td><td>Applying</td></tr>
</table>

UNIT V - DESIGN OF EXPERIMENTS

One way and two way classifications - Completely randomized design – Randomized block design – Latin square design

Q.No.	Question	BT Level	Competence
	PART – A		
1.	What is the aim of design of experiments?	BTL -1	Remembering
2.	Write the basic assumptions in analysis of variance.	BTL -1	Remembering
3.	When do you apply analysis of variance technique?	BTL -1	Remembering
4.	Define Replication.	BTL -1	Remembering
5.	Define Randomization.	BTL -1	Remembering
6	Define Local control.	BTL -1	Remembering
7.	What is meant by tolerance limits?	BTL -2	Understanding
8	What is a completely randomized design.	BTL -2	Understanding

9.	Explain the advantages of a Latin square design?	BTL -2	Understanding
10	What are the basic elements of an Completely Randomized Experimental Design?	BTL -2	Understanding
11.	Demonstrate the purpose of blocking in a randomized block design?	BTL -3	Applying
12.	Manipulate the Basic principles of the design of experiment?	BTL -3	Applying
13.	Why a 2x2 Latin square is not possible? Explain.	BTL -3	Applying
14.	Demonstrate main advantage of Latin square Design over Randomized Block Design?	BTL -4	Analyzing
15.	Analyze the advantages of the Latin square design over the other design.	BTL -4	Analyzing
16.	Write any two differences between RBD and LSD.	BTL -4	Analyzing
17.	What is ANOVA?	BTL -5	Evaluating
18.	What are the uses of ANOVA?	BTL -5	Evaluating
19.	Define experimental error.	BTL -6	Creating
20.	Write any two advantages of RBD over CRD.	BTL -4	Analyzing
21.	Write the basic design of experiments	BTL -2	Understanding
22.	Write the ANOVA table for RBD	BTL -4	Analyzing
23.	Write merits of RBD	BTL -3	Applying
24.	Write the ANOVA table for CRD	BTL -2	Understanding
25.	Write the ANOVA table for Latin Square Design	BTL -4	Analyzing
	PART – B		
1.	The accompanying data resulted from an experiment comparing the degree of soiling for fabric copolymerized with the 3 different mixtures of met acrylic acid. Analyze the classification. Mixture 1 : 0.56 1.12 0.90 1.07 0.94 Mixture 2 : 0.72 0.69 0.87 0.78 0.91 Mixture 3 : 0.62 1.08 1.07 0.99 0.93	BTL -1	Remembering
2.	The following table shows the lives in hours of four brands of electric lamps brand A: 1610, 1610, 1650, 1680, 1700, 1720, 1800 B: 1580, 1640, 1640, 1700, 1750 C: 1460, 1550, 1600, 1620, 1640, 1660, 1740, 1820 D: 1510, 1520, 1530, 1570, 1600, 1680 Identify an analysis of variance and test the homogeneity of the mean lives of the four brands of lamps.	BTL -5	Evaluating
3.	In order to determine whether the significant difference in the durability of 3makes of computers, samples of size 5 are selected from each make and the frequency of repair during the first year of purchase is observed. The results are as follows: In view of the above data, what conclusion can you draw? Makes A / B / C 5 / 8 / 7 6 / 10 / 3 8 / 11 / 5 9 / 12 / 4 7 / 4 / 1	BTL -3	Applying
4.	Five doctors each test five treatments for a certain disease and observe the number of days each patient takes to recover. The results are as follows (recovery time in days)	BTL -3	Applying

	Treatment				
Doctor	1	2	3	4	5
A	10	14	23	18	20
B	11	15	24	17	21
C	9	12	20	16	19
D	8	13	17	17	20
E	12	15	19	15	22

Estimate the difference between (a) doctors and(b)treatments for the above data at 5% level.

5. Perform a 2-way ANOVA on the data given below:

		Treatment 1		
		1	2	3
Treatment 2	1	30	26	38
	2	24	29	28
	3	33	24	35
	4	36	31	30
	5	27	35	33

Use the coding method subtracting 30 from the given no.

BTL -3 | Applying

6. A chemist wishes to test the effect of four chemical agents on the strength of a particular type of cloth. Because there might be variability from one bolt to another , the chemist decides to use a randomized block design ,with the bolts of cloth consider as blocks ,she selects five bolts and applies all four chemical in random order to each bolt, The resulting tensile strength follows

		BOLT				
		1	2	3	4	5
CHEMICAL	1	73	68	74	71	67
	2	73	67	75	72	70
	3	75	68	78	73	68
	4	73	71	75	75	69

Does the tensile strength depend on chemical? Test at 10% level of significance.

BTL -3 | Applying

7. A latin square design was used to compare the bond strength of gold semiconductor lead wires bounded to the lead terminal by five different methods A, B, C, D & E. The bonds were made by five different operators and the device were encapsulated using five different plastics. With the following result ,expressed as pounds of force required to break the bond

Plastics/ operator	1	2	3	4	5
1	A3	B2.4	C1.9	D2.2	E1.7
2	B2.1	C2.7	D2.3	E2.5	A3.1
3	C2.1	D2.6	E2.5	A2.9	B2.1
4	D2.0	E2.5	B3.2	B2.5	C2.2
5	E2.1	A3.6	B2.4	C2.4	D2.1

Analyze these results and test with .01 level of significance.

BTL -1 | Remembering

8. The following data resulted from an experiment to compare three burners A, B, C. A Latin square design was used as the tests were made on 3 engines and were spread over 3 days.

BTL -3 | Applying

<table>
<tr><td></td><td><table><tr><td>A 16</td><td>B 17</td><td>C 20</td></tr><tr><td>B 16</td><td>C 21</td><td>A 15</td></tr><tr><td>C 15</td><td>A 12</td><td>B 13</td></tr></table>Test the hypothesis and infer that there is no difference between the burners.</td><td></td><td></td></tr>
<tr><td>9.</td><td>A farmer wishes to test the effects of four different fertilizers A,B,C, Don the yield of Wheat. In order to eliminate sources of error due to variability in soil fertility, he uses the fertilizers, in a Latin square arrangement a syndicated in the following table, where the numbers indicate yields per unit area.<table><tr><td>A18</td><td>C21</td><td>D25</td><td>B11</td></tr><tr><td>D22</td><td>B12</td><td>A15</td><td>C19</td></tr><tr><td>B15</td><td>A20</td><td>C23</td><td>D24</td></tr><tr><td>C22</td><td>D21</td><td>B10</td><td>A17</td></tr></table>Design an analysis of variance to determine if there is a significant difference between the fertilizers at α=0.05 and α=0.01 levels of significance.</td><td>BTL -5</td><td>Evaluating</td></tr>
<tr><td>10.</td><td>Set up the analysis of variance for the following results of a Latin Square Design(use α = 0.01) level of significance<table><tr><td>A12</td><td>C19</td><td>B10</td><td>D8</td></tr><tr><td>C18</td><td>B12</td><td>D6</td><td>A7</td></tr><tr><td>B22</td><td>D10</td><td>A5</td><td>C21</td></tr><tr><td>D12</td><td>A7</td><td>C27</td><td>B17</td></tr></table></td><td>BTL -3</td><td>Applying</td></tr>
<tr><td>11.</td><td>In a 5x5 Latin square experiment, the data collected is given in the matrix below Yield per plot is given in quintals for the five different cultivation treatments A, B, C,D and E. Perform the analysis of variance.
A48 E66 D56 C52 B61
D64 B62 A50 E64 C63
B69 A53 C60 D61 E67
C57 D58 E67 B65 A55
E67 C57 B66 A60 D57</td><td>BTL -4</td><td>Analyzing</td></tr>
<tr><td>12.</td><td>In a Latin square experiment given below are the yields in quintals per acre on the paddy crop carried out for testing the effect of five fertilizers A, B, C, D, E. Analyze the data for variations.
B25 A18 E27 D30 C27
A19 D31 C29 E26 B23
C28 B22 D33 A18 E27
E28 C26 A20 B25 D33
D32 E25 B23 C28 A20</td><td>BTL -3</td><td>Applying</td></tr>
<tr><td>13.</td><td>The following are the number of mistakes made in 5 successive days by four technicians working for a photographic laboratory. Test whether the difference among the four sample means can be attributed to chance. Test at a level of significance α = 0.01.<table><tr><td colspan="4">Technician</td></tr><tr><td>I</td><td>II</td><td>III</td><td>IV</td></tr><tr><td>6</td><td>14</td><td>10</td><td>9</td></tr><tr><td>14</td><td>9</td><td>12</td><td>12</td></tr></table></td><td>BTL -4</td><td>Analyzing</td></tr>
</table>

<table>
<tr><td></td><td><table><tr><td>10</td><td>12</td><td>7</td><td>8</td></tr><tr><td>8</td><td>10</td><td>15</td><td>10</td></tr><tr><td>11</td><td>14</td><td>11</td><td>11</td></tr></table></td><td></td><td></td></tr>
<tr><td>14.</td><td>A random sample is selected from each of three makes of ropes and their breaking strength (in pounds) are measured with the following results
Sample I : 70 72 75 80 83
Sample II : 100 110 108 112 113 120 107
Sample III: 60 65 57 84 87 73
Test whether the breaking strength of the ropes differs significantly?</td><td>BTL -3</td><td>Applying</td></tr>
<tr><td>15.</td><td>The table below gives the yields per hectare of a certain variety of paddy in a particular type of soil treated with manures A,B and C.Analyse the results for manure effects<table><tr><td>A</td><td>49</td><td>50</td><td>48</td><td>49</td></tr><tr><td>B</td><td>48</td><td>48</td><td>49</td><td>47</td></tr><tr><td>C</td><td>50</td><td>50</td><td>51</td><td>49</td></tr></table></td><td>BTL -4</td><td>Analyzing</td></tr>
<tr><td>16.</td><td>If A,B,C represent the fertilizer treatment, as in the previous problem ,test for the difference between the treatment at 0.05 level of significance<table><tr><td>A75</td><td>B78</td><td>C80</td></tr><tr><td>C81</td><td>A76</td><td>B79</td></tr><tr><td>B73</td><td>C75</td><td>A77</td></tr></table></td><td>BTL -3</td><td>Applying</td></tr>
<tr><td>17.</td><td>A completely randomized design experiment with 10 plots and three treatments gave the results given in the following table<table><tr><td>Treatment</td><td colspan="4">Replications</td></tr><tr><td>A</td><td>5</td><td>7</td><td>1</td><td>3</td></tr><tr><td>B</td><td>4</td><td>4</td><td>7</td><td></td></tr><tr><td>C</td><td>3</td><td>1</td><td>5</td><td></td></tr></table></td><td>BTL -4</td><td>Analyzing</td></tr>
<tr><td>18.</td><td>Four farmers each used four types of manures for a crop(area and other considerations are same) and obtained the yields (in quintals) as below<table><tr><td>farmer</td><td colspan="4">manures</td></tr><tr><td>A</td><td>22</td><td>16</td><td>21</td><td>12</td></tr><tr><td>B</td><td>23</td><td>17</td><td>19</td><td>13</td></tr><tr><td>C</td><td>21</td><td>14</td><td>18</td><td>11</td></tr><tr><td>D</td><td>22</td><td>15</td><td>19</td><td>10</td></tr></table></td><td>BTL -3</td><td>Applying</td></tr>
<tr><td colspan="4">PART – C</td></tr>
<tr><td>1.</td><td>A set of data involving 4 tropical food stuffs A, B, C, D tried on 20 chicks is given below. All the 20 chicks are treated alike in all respects except the feeding treatments and each feeding treatment is given to 5 chicks. Analyze the data:
A 55 49 42 21 52
B 61 112 30 89 63
C 42 97 81 95 92
D 169 137 169 85 154</td><td>BTL -4</td><td>Analyzing</td></tr>
<tr><td>2.</td><td>A company appoints 4 salesmen A, B, C and D and observes their sales in 3 seasons, summer winter and monsoon. The figures are given in the following table:<table><tr><td></td><td colspan="4">Salesmen</td></tr><tr><td>Season</td><td>1</td><td>2</td><td>3</td><td>4</td></tr><tr><td>Summer</td><td>45</td><td>40</td><td>28</td><td>37</td></tr></table></td><td>BTL -4</td><td>Analyzing</td></tr>
</table>

<table>
<tr><td></td><td><table><tr><td>Winter</td><td>43</td><td>41</td><td>45</td><td>38</td></tr><tr><td>Monsoon</td><td>39</td><td>39</td><td>43</td><td>41</td></tr></table>Carry out an Analysis of variances.</td><td></td><td></td></tr>
<tr><td>3.</td><td>A variable trial was conducted on wheat with 4 varieties in a Latin square design. The plan of the experiment and the per plot yield are given below.
C25 B23 A20 D20
A19 D19 C21 B18
B19 A14 D17 C20
D17 C20 B21 A15</td><td>BTL -2</td><td>Understanding</td></tr>
<tr><td>4.</td><td>A laboratory technician measures the breaking strength of each of five kinds of linen threads by using four different measuring instruments, and obtain the following results.<table><tr><td rowspan="7">Thread</td><td></td><td colspan="4">Instruments</td></tr><tr><td></td><td>I1</td><td>I2</td><td>I3</td><td>I4</td></tr><tr><td>1</td><td>20.9</td><td>20.4</td><td>19.9</td><td>21.9</td></tr><tr><td>2</td><td>25</td><td>26.2</td><td>27.0</td><td>24.8</td></tr><tr><td>3</td><td>25.5</td><td>23.1</td><td>21.5</td><td>24.4</td></tr><tr><td>4</td><td>24.8</td><td>21.2</td><td>23.5</td><td>25.7</td></tr><tr><td>5</td><td>19.6</td><td>21.2</td><td>22.1</td><td>22.1</td></tr></table>Perform a 2-way ANOVA using the 0.05 level of significance.</td><td>BTL -2</td><td>Understanding</td></tr>
<tr><td>5.</td><td>Three machines A,B,C gave the production of pieces in four days as below . Is there a significant difference between machines<table><tr><td>A</td><td>17</td><td>16</td><td>14</td><td>13</td></tr><tr><td>B</td><td>15</td><td>12</td><td>19</td><td>18</td></tr><tr><td>C</td><td>20</td><td>8</td><td>11</td><td>17</td></tr></table></td><td>BTL -3</td><td>Applying</td></tr>
</table>