SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institution)

S.R.M. Nagar, Kattankulathur - 603203

DEPARTMENT OF MATHEMATICS

QUESTION BANK

II YEAR / IV SEMESTER

B.E Agriculture Engineering

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B.TECH-Information Technology

1918404 - PROBABILITY AND STATISTICS

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DEPARTMENT OF MATHEMATICS

UNIT I - RANDOM VARIABLES

Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions.

S. No	QUESTIONS	BT Level	Competence
	PART - A (2 Marks)		
1.	Define Discrete Random variables	BTL1	Remembering
2.	If f(x) = K $(x + x^2)$ in $1< x < 5$ is a p.d.f of a continuous random variables. Find the value of K.	BTL1	Remembering
3.	Define Continuous Random variables.	BTL1	Remembering
4.	The mean of Binomial distribution is 20 and standard deviation is 4. Find the parameters of the distribution.	BTL1	Remembering
5.	If 3% of the electric bulbs manufactured by a company are defective, Find the probability that in a sample of 100 bulbs exactly 5 bulbs are defective.	BTL1	Remembering
6.	Suppose that, on an average, in every three pages of a book there is one typographical error. If the number of typographical errors on a single page of the book is a Poisson random variable. What is the probability if at least one error on a specific page of the book?	BTL1	Remembering
7.	The probability that a candidate can pass in an examination is 0.6. What is the probability that he will pass in third trial?	BTL2	Understanding
8.	Define Moment Generating function of a random variable.	BTL2	Understanding
9.	Suppose that the life of industrial lamp (in thousands of hours) is exponentially distributed with mean life of 3000 hours, find the probability that the lamp will last between 2000 and 3000 hours.	BTL2	Understanding
10.	State the memory less property of the exponential distribution.	BTL2	Understanding
11.	If a random variable X has the MGF $M_X(t) = \frac{2}{2-t}$. Find the mean of X.	BTL3	Applying
12.	Show that the function $f(x) = \begin{cases} e^{-x}, x \geq 0 \\ 0, \quad x < 0 \end{cases}$ is a probability density function of a continuous random variable X.	BTL3	Applying
13.	Find the MGF of Uniform distribution.	BTL3	Applying
14.	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. No. of failures: 0, 1, 2, 3, 4, 5, 6 Probability: .18, .28, .25, .18, .06, .04, .01	BTL4	Analyzing
15.	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. No. of failures: 0, 1, 2, 3, 4, 5, 6 Probability: K, 2 K, 2 K, K, 3 K, K, 4 K	BTL4	Analyzing
16.	A continuous random variable X has p.d.f $f(x) = 2x, 0 \leq x \leq 1$. Find$P(X > 05)$.	BTL4	Analyzing

17.	The p.d.f of a continuous random variable X is $f(x) = k(1+x), 2 < x < 5$, Find k.	BTL5	Evaluating
18.	For a continuous distribution$f(x) = k(x - x^2), 0 \le x \le 1$, where k is a constant. Find k.	BTL5	Evaluating
19.	If $f(x) = kx^2, 0 < x < 3$, is to be a density function, find the value of k.	BTL6	Creating
20.	If the p.d.f of a RV is $f(x) = \frac{x}{2}, 0 \le x \le 2$, find $P(X > 1.5)$.	BTL6	Creating
	Part – B (13 Marks)		
1. (a)	If the discrete random variable X has the probability function given by the table. x: 1, 2, 3, 4 P(x): k/3, k/6, k/3, k/6 Find the value of k and Cumulative distribution of X.	BTL1	Remembering
1. (b)	Find the MGF of Binomial distribution and hence find its mean and variance	BTL2	Understanding
2. (a)	The atoms of a radioactive element are randomly disintegrating. If every gram of this element, on average, emits 3.9 alpha particles per second, then what is the probability that during the next second the number of alpha particles emitted from 1 gram is (i) at most 6 (ii) at least 2 and (iii) at least and atmost5	BTL1	Remembering
2. (b)	Find the MGF of Geometric distribution and hence find its mean and variance	BTL1	Remembering
3. (a)	The number of monthly breakdowns of a computer is a random variable having a Poisson distribution with mean equal to 1.8. Find the probability that this computer will function for a month (i) without breakdown (ii) with only one breakdown and (iii) with at least one breakdown.	BTL2	Understanding
3. (b)	Derive the MGF of Uniform distribution and hence find its mean and variance	BTL3	Applying
4. (a)	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) $P(1.5 < X < 4.5 / X > 2)$	BTL2	Understanding
4. (b)	Find the MGF of Poisson distribution and hence find its mean and variance	BTL4	Analyzing
5. (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, $2k$, 0.3, k Find (i) Find the value of k, (ii) P(X<1), (iii) P(-1< X ≤ 2)	BTL3	Understanding
5. (b)	Find the MGF of Exponential distribution and hence find its mean and variance	BTL5	Evaluating
6.	The probability mass function of a discrete R. V X is given in the following table X: 0, 1, 2, 3, 4, 5, 6, 7, 8 P(X): a, 3a, 5a, 7a, 9a, 11a, 13a, 15a, 17a Find (i) the value of a , (ii) $P(X < 3)$, (iii) Mean of X and (iv) Variance of X.	BTL6	Evaluating
7. (a)	The probability mass function of a RV X is given by $P(X = r) = kr^3$, $r = 1,2,3,4$. Find (i) the value of k, (ii) $P(\frac{1}{2} < X < \frac{5}{2} / X > 1)$	BTL5	Evaluating
7. (b)	State and Prove the memory less property of Exponential distribution	BTL2	Understanding

8.	(a) Find the mean and variance of the following probability distribution X_i: 1	2	3	4	5	6	7	8 P_i: 0.08	0.12	0.19	0.24	0.16	0.10	0.07	0.04	BTL4	Analyzing
	(b) State and Prove the memory less property of Geometric distribution.			BTL1	Remembering
9. (a)	Messages arrive at a switch board in a Poisson manner at an average rate of 6 per hour. Find the probability that exactly 2 messages arrive within one hour, no messages arrives within one hour and at least 3 messages arrive within one hour.			BTL1	Remembering
9. (b)	4 coins were tossed simultaneously. What is the probability of getting (i) 2 heads, (ii) at least 2 heads, (iii) at most 2 heads.			BTL6	Creating
10.	The probability distribution of an infinite discrete distribution is given by P[X = j] = $\frac{1}{2^j}$ (j = 1,2,3…) Find (i)Mean of X, (ii)P [X is even], (iii) P(X is odd)			BTL1	Remembering
11. (a)	A normal distribution has mean $\mu = 20$ and standard deviation$\sigma = 10$. Find$P(15 \leq X \leq 40)$.			BTL1	Remembering
11. (b)	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.			BTL2	Understanding
12. (a)	Suppose that the life of an industrial lamp in 1,000 of hours is exponentially distributed with mean life of 3,000 hours. Find the probability that (i) The lamp last more than the mean life, (ii) The lamp last between 2,000 and 3,000 hours (iii) The lamp last another 1,000 hours given that it has already lasted for 250 hours.			BTL2	Understanding
12. (b)	Assume that 50% of all engineering students are good in mathematics. Determine the probabilities that among 18 engineering students (i) Exactly 10, (ii) at least 10 are good in mathematics.			BTL1	Remembering
13. (a)	The life (in years) of a certain electrical switch has an exponential distribution with an average life of $\frac{1}{\lambda} = 2$. If 100 of these switches are installed in different systems; find the probability that at most 30 fail during the first year.			BTL1	Remembering
13. (b)	Let X be a Uniformly distributed R. V. over [-5, 5]. Determine (i) P(X ≤ 2) , (ii) P(|X| > 2) (iii) Cumulative distribution function of X (iv) Var(X)			BTL1	Remembering
14.	In a test on 2000 electric bulbs, it was found that the life of a particular make was normally distributed with an average life of 2040 hours and Standard Deviation of 60 hours. Find the number of bulbs likely to burn for (i) more than 2150 hours (ii) less than 1950 hours and (iii) more than 1920 hours bus less than 2160 hours.			BTL1	Remembering

PART C (15 Marks)

Q. No.	Question	BT Level	Competence
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 and iv) no girls	BTL1	Remembering
2.	If a random variable X has p.d.f $f(x) = \begin{cases} \frac{1}{4}, & \|X\| < 2 \\ 0, & Otherwise \end{cases}$ Find (i) $P(X < 1)$, (ii) $P(\|X\| > 1)$, (iii) $P(2X + 3 > 5)$.	BTL6	Evaluating
3.	In an Engineering examination, a student is considered to have failed, secured	BTL2	Understanding

	second class, first class and distinction, according as he scores less than 45%,between 45% and 60% between 60% and 75% and above 75% respectively. In a particular year 10% of the students failed in the examination and 5% of the students get distinction. Find the percentage of students who have got first class and second class. Assume normal distribution of marks.		
4.	Buses arrive at a specified stop at 15 minutes interval starting at 6 a.m. i.e., they arrive at 6 a.m., 6.15a.m., 6.30 a.m., and so on. If a passenger arrives at the stop at a time that is uniformly distributed between 6 and 6.30 a.m. Find the probability that he waits (i) Less than 5 minutes for a bus. (ii) More than 10 minutes for a bus.	BTL2	Understanding

UNIT II - TWO - DIMENSIONAL RANDOM VARIABLES

Joint distributions – Marginal and conditional distributions – Covariance – Correlation and linear regression – Transformation of random variables – Central limit theorem.

Q. No.	Question	BT Level	Competence
	PART A		
1.	Define Two dimensional Discrete random variables.	BTL4	Analyzing
2.	Define Two dimensional Continuous random variables.	BTL1	Remembering
3.	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 distributions of X.	BTL2	Understanding
4.	Find the probability distribution of X + Y from the bi-variate distribution of (X,Y) given below: X \ Y: 1 → 0.4, 2 → 0.2; 2 → 0.3, 0.1	BTL1	Remembering
5.	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.	BTL1	Remembering
6.	Let X and Y have the joint p.m.f. Then find P(X+Y > 1) Y \ X: 0 → 0.1, 0.4, 0.1; 1 → 0.2, 0.2, 0	BTL1	Remembering
7.	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 $P(X+Y\le 1)$	BTL2	Understanding
8.	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)	BTL2	Understanding
9.	If the joint probability density function of a random variable X and Y is given by $f(x,y)=\begin{cases}\frac{x^3y^3}{16}, 0<x<2, 0<y<2\\ 0, \qquad otherwise\end{cases}$. Find the marginal density function of X.	BTL2	Understanding
10.	What is the condition for two random variables are independent?	BTL2	Understanding
11.	The joint probability density of a two dimensional random variable (X, Y) is given by $f(x,y)=\begin{cases}kxe^{-y}; 0\le x<2, y>0\\ 0, \qquad otherwise\end{cases}$. Evaluate k.	BTL3	Applying
12.	The joint probability density function of random variables (X, Y) is	BTL3	Applying

	$f(x,y)=k\,e^{-(2x+3y)}, x\geq 0,\ y\geq 0$. Find the value of *k*.		
13.	State the correlation coefficient formula.	BTL3	Applying
14.	The regression equations are x + 6y = 14 and 2x + 3y = 1. Find the correlation coefficient between X & Y.	BTL4	Analyzing
15.	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.	BTL4	Analyzing
16.	In a partially destroyed laboratory, record of an analysis of 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?	BTL4	Analyzing
17.	The regression equations are 3x + 2y = 26 and 6x + y = 31. Find the correlation coefficient.	BTL5	Evaluating
18.	Define Marginal probability density function of X.	BTL5	Evaluating
19.	What is the acute angle between the two lines of regression?	BTL6	Creating
20.	State Central Limit Theorem.	BTL6	Creating
	Part – B(13 Marks)		
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) and (iv) P(x + y < 3)	BTL1	Remembering
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.	BTL1	Remembering
2.(b)	The joint pdf a bivariate R.V(X, Y) is given by $f(x,y)=\begin{cases} Kxy & , 0<x<1, 0<y<1 \\ 0 & , otherwise \end{cases}$ Find (i) K. (ii) Find P(X+Y<1). (iii)Are X and Y independent R.V's.	BTL2	Understanding
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 $X+Y$.	BTL1	Remembering
3.(b)	The joint pdf of X and Y is given by $f(x,y)=\begin{cases} kx(x-y), 0<x<2, -x<y<x \\ 0, otherwise \end{cases}$ (i)Find k (ii) Find $f_x(x)$ and $f_y(y)$	BTL3	Applying
4.	The joint pdf of a two dimensional random variable (X, Y) is given by $f(x,y)=xy^2+\frac{x^2}{8}, 0\leq x\leq 2, 0\leq y\leq 1$. Compute (i) $P\left(X>1 / Y<\frac{1}{2}\right)$ (ii)$P\left(Y<\frac{1}{2}/X>1\right)$ (iii) $P(X+Y)\leq 1$.	BTL3	Applying
5.	From the following table for bi-variate 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) $P(X+Y\leq 4)$	BTL3	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 also find the conditional distribution of X given Y = 1.	BTL3	Applying
6.(b)	(b) Find $P(X < Y/X < 2Y)$ if the joint pdf of(X,Y) is $f(x,y) = e^{-(x+y)}$, $0 \le x < \infty$, $0 \le y < \infty$.	BTL6	Creating
7.(a)	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) $P(Y < X)$	BTL3	Applying
8	If f(x, y) = $\frac{6-x-y}{8}$, $0 \le x \le 2$, , $2 \le y \le 4$ for a bi-variate R.V (X, Y). Find the correlation coefficientρ.	BT3	Applying
9. (a)	If $X_1, X_2, X_3, \cdots X_n$ are Poisson variates with mean 2, use central limit theorem to estimate $P(120 < S_n < 160)$ where $S_n = X_1 + X_2 + X_3 + \cdots + X_n$ and n=75.	BTL2	Understanding
9. (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	BTL5	Evaluating
10.	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	BTL3	Applying
11.	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 probability density function of the random variable U = XY.	BTL6	Creating
12.	If X and Y independent Random Variables with pdf $e^{-x}, x \ge 0$ and $e^{-y}, y \ge 0$ Find the density function of $U = \frac{X}{X+Y}$ and $V = X + Y$. Are they independent?	BTL1	Remembering
13.(a)	If X and Y each follow an exponential distribution with parameter 1 and are independent, find the pdf of U = X-Y.	BTL3	Applying
13.(b)	20 dice are thrown. Find the approximate probability that the sum obtained is between 65 and 75 using central limit theorem.	BTL3	Applying
14.	Two random variables X and Y have the joint density function $f(x,y) = x + y, 0 \le x \le 1, 0 \le y \le 1$. Calculate the Correlation coefficient between X and Y.	BTL1	Remembering

PART C (15 Marks)

Q. No.	Question	BT Level	Competence
1.	The lifetime of a certain brand of an electric bulb may be considered a RV with mean 1200h and standard deviation 250h. Find the probability, using central limit theorem, that the average life time of 60 bulbs exceeds 1250 h.	BTL 4	Analyzing
2.	Three balls are drawn at random without replacement from a box containing 2	BTL1	Remembering

	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 the probability distribution of X and Y.		
3.	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	BTL2	Understanding
4.	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.	BTL2	Understanding

UNIT III -TESTING OF HYPOTHESIS

Sampling distributions - Estimation of parameters - 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.

PART – A (2 Marks)

Q. No.	Question	BT Level	Competence
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.	A random sample of 25 cups from a certain coffee dispensing machine yields a mean x = 6.9 occur per cup. Use 0.05 level of significance to test, on the average, the machine dispense $\mu = 7.0$ ounces against the null hypothesis that, on the average, the machine dispenses $\mu < 7.0$ ounces. Assume that the distribution of ounces per cup is normal, and that the variance is the known quantity σ^2=0.01 ounces	BTL 2	Understanding
8.	Twenty people were attacked by a disease and only 18 were survived. The hypothesis is set in such a way that the survival rate is 85% if attacked by this disease. Will you reject the hypothesis that it is more at 5% level? ($Z_{0.05} = 1.645$).	BTL 2	Understanding
9.	In a large city A, 20 percent of a random sample of 900 school boys had a slight physical defect. In another large city B, 18.5 percent of a random sample of 1600 school boys had some defect. Is the difference between the proportions significant?	BTL 2	Understanding
10.	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?	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
20.	What are the expected frequencies of 2x2 contingency table? a b c d	BTL 4	Analyzing

PART – B (13 Marks)

1.(a)	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?	BTL1	Remembering
1.(b)	Test of fidelity and selectivity of 190 radio receivers produced the results shown in the following table Fidelity Selectivity / Low / Average / High Low / 6 / 12 / 32 Average / 33 / 61 / 18 High / 13 / 15 / 0 Use 0.01 level of significance to test whether there is a relationship between fidelity and selectivity.	BTL1	Remembering
2.	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? Hair color Eye color / Fair / Brown / Black / Total Blue / 15 / 5 / 20 / 40 Grey / 20 / 10 / 20 / 50 Brown / 25 / 15 / 20 / 60 Total / 60 / 30 / 60 / 150	BTL1	Remembering
3.	Two independent samples of sizes 8 and 7 contained the following values. Sample I: 19 17 15 21 16 18 16 14 Sample II: 15 14 15 19 15 18 16 Test if the two populations have the same mean.	BTL2	Understanding
4.	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.	BTL4	Analyzing

	<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>		
5. (a)	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)	BTL5	Evaluating
5.(b)	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.	BTL2	Understanding
6.	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?	BTL3	Applying
7.	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.	BTL4	Analyzing
8.	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?	BTL6	Creating
9.(a)	The nicotine content in milligram of two samples of tobacco 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 were from normal population with the same mean.	BTL1	Remembering
9.(b)	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?	BTL1	Remembering

<table>
<tr><td>10.</td><td>Two random samples gave the following results:
<table><tr><th>Sample</th><th>Size</th><th>Sample mean</th><th>Sum of squares of deviation from the mean</th></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>BTL1</td><td>Remembering</td></tr>
<tr><td>11.</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>BTL3</td><td>Applying</td></tr>
<tr><td>12.</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>BTL1</td><td>Remembering</td></tr>
<tr><td>13.</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>BTL1</td><td>Remembering</td></tr>
<tr><td>14.</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>BTL1</td><td>Remembering</td></tr>
<tr><td colspan="4">PART – C(15 Marks)</td></tr>
<tr><td>Q. No.</td><td>Question</td><td>BT Level</td><td>Competence</td></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><td></td><td>Place A</td><td>Place B</td></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 adult 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>BTL2</td><td>Understanding</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.</td><td></td><td></td></tr>
</table>

	<table><tr><td></td><td>Type I</td><td>Type II</td></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?	BTL3	Applying
3.	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.	BTL4	Analyzing
4.	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?	BTL4	Analyzing

UNIT IV-DESIGN OF EXPERIMENTS

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

PART – A(2 Marks)

Q. No.	Question	BT Level	Competence
1.	What is the aim of design of experiments?	BTL1	Remembering
2.	Write the basic assumptions in analysis of variance.	BTL1	Remembering
3.	When do you apply analysis of variance technique?	BTL1	Remembering
4.	Define Replication.	BTL1	Remembering
5.	Define Randomization.	BTL1	Remembering
6.	Define Local control.	BTL1	Remembering
7.	What is meant by tolerance limits?	BTL2	Understanding
8.	What is a completely randomized design?	BTL2	Understanding
9.	Explain the advantages of a Latin square design?	BTL2	Understanding
10.	What are the basic elements of a Completely Randomized Experimental Design?	BTL2	Understanding
11.	Demonstrate the purpose of blocking in a randomized block design?	BTL3	Applying
12.	Manipulate the Basic principles of the design of experiment?	BTL3	Applying
13.	Why a 2x2 Latin square is not possible? Explain.	BTL3	Applying
14.	Demonstrate main advantage of Latin square Design over Randomized Block Design?	BTL4	Analyzing
15.	Analyze the advantages of the Latin square design over the other design.	BTL4	Analyzing
16.	Write any two differences between RBD and LSD.	BTL4	Analyzing
17.	What is ANOVA?	BTL5	Evaluating
18.	What are the uses of ANOVA?	BTL5	Evaluating
19.	Define experimental error.	BTL6	Creating
20.	Write any two advantages of RBD over CRD.	BTL4	Analyzing

PART-B (13 Marks)

<table>
<tr><td>1.</td><td>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</td><td>BTL1</td><td>Remembering</td></tr>
<tr><td>2.</td><td>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.</td><td>BTL1</td><td>Remembering</td></tr>
<tr><td>3.</td><td>In order to determine whether the significant difference in the durability of 3 makes 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<table><tr><th>A</th><th>B</th><th>C</th></tr><tr><td>5</td><td>8</td><td>7</td></tr><tr><td>6</td><td>10</td><td>3</td></tr><tr><td>8</td><td>11</td><td>5</td></tr><tr><td>9</td><td>12</td><td>4</td></tr><tr><td>7</td><td>4</td><td>1</td></tr></table></td><td>BTL1</td><td>Remembering</td></tr>
<tr><td>4.</td><td>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)<table><tr><td></td><td colspan="5">Treatment</td></tr><tr><td>Doctor</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr><tr><td>A</td><td>10</td><td>14</td><td>23</td><td>18</td><td>20</td></tr><tr><td>B</td><td>11</td><td>15</td><td>24</td><td>17</td><td>21</td></tr><tr><td>C</td><td>9</td><td>12</td><td>20</td><td>16</td><td>19</td></tr><tr><td>D</td><td>8</td><td>13</td><td>17</td><td>17</td><td>20</td></tr><tr><td>E</td><td>12</td><td>15</td><td>19</td><td>15</td><td>22</td></tr></table>Estimate the difference between (a) doctors and (b)treatments for the above data at 5% level.</td><td>BTL2</td><td>Understanding</td></tr>
<tr><td>5.</td><td>Perform a 2-way ANOVA on the data given below:<table><tr><td colspan="2"></td><td colspan="3">Treatment 1</td></tr><tr><td colspan="2"></td><td>1</td><td>2</td><td>3</td></tr><tr><td rowspan="5">Treatment 2</td><td>1</td><td>30</td><td>26</td><td>38</td></tr><tr><td>2</td><td>24</td><td>29</td><td>28</td></tr><tr><td>3</td><td>33</td><td>24</td><td>35</td></tr><tr><td>4</td><td>36</td><td>31</td><td>30</td></tr><tr><td>5</td><td>27</td><td>35</td><td>33</td></tr></table></td><td>BTL3</td><td>Applying</td></tr>
</table>

<table>
<tr><td></td><td>Use the coding method subtracting 30 from the given no.</td><td></td><td></td></tr>
<tr><td>6.</td><td>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
<table>
<tr><td colspan="2" rowspan="2"></td><td colspan="5">BOLT</td></tr>
<tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr>
<tr><td rowspan="4">CHEMICAL</td><td>1</td><td>73</td><td>68</td><td>74</td><td>71</td><td>67</td></tr>
<tr><td>2</td><td>73</td><td>67</td><td>75</td><td>72</td><td>70</td></tr>
<tr><td>3</td><td>75</td><td>68</td><td>78</td><td>73</td><td>68</td></tr>
<tr><td>4</td><td>73</td><td>71</td><td>75</td><td>75</td><td>69</td></tr>
</table>
Does the tensile strength depend on chemical? Test at 10% level of significance.</td><td>BTL2</td><td>Understanding</td></tr>
<tr><td>7.</td><td>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 devices were encapsulated using five different plastics. With the following result ,expressed as pounds of force required to break the bond
<table>
<tr><td>Plastics/ operator</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr>
<tr><td>1</td><td>A3</td><td>B2.4</td><td>C1.9</td><td>D2.2</td><td>E1.7</td></tr>
<tr><td>2</td><td>B2.1</td><td>C2.7</td><td>D2.3</td><td>E2.5</td><td>A3.1</td></tr>
<tr><td>3</td><td>C2.1</td><td>D2.6</td><td>E2.5</td><td>A2.9</td><td>B2.1</td></tr>
<tr><td>4</td><td>D2.0</td><td>E2.5</td><td>B3.2</td><td>B2.5</td><td>C2.2</td></tr>
<tr><td>5</td><td>E2.1</td><td>A3.6</td><td>B2.4</td><td>C2.4</td><td>D2.1</td></tr>
</table>
Analyze these results and test with .01 level of significance.</td><td>BTL4</td><td>Analyzing</td></tr>
<tr><td>8.</td><td>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.
<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>BTL1</td><td>Remembering</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 $\alpha=0.05$ and $\alpha=0.01$ levels of significance.</td><td>BTL1</td><td>Remembering</td></tr>
</table>

10.	Set up the analysis of variance for the following results of a Latin Square Design(use $\alpha = 0.01$) level of significance A12 C19 B10 D8 C18 B12 D6 A7 B22 D10 A5 C21 D12 A7 C27 B17	BTL4	Analyzing
11.	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	BTL6	Creating
12.	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	BTL3	Applying
13.	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 samples means can be attributed to chance. Test at a level of significance $\alpha = 0.01$. Technician: I, II, III, IV 6 14 10 9 14 9 12 12 10 12 7 8 8 10 15 10 11 14 11 11	BTL4	Analyzing
14.	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?	BTL4	Analyzing
PART-C (15 Marks)			
Q. No.	**Question**	**BT Level**	**Competence**
1.	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.	BTL2	Understanding

	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		
2.	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: Salesmen: Season / 1 / 2 / 3 / 4 Summer: 45 / 40 / 28 / 37 Winter: 43 / 41 / 45 / 38 Monsoon: 39 / 39 / 43 / 41 Carry out an Analysis of variances.	BTL2	Understanding
3.	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	BTL5	Evaluating
4.	A laboratory technician measures the breaking strength of each of five kinds of linen threads by using four different measuring instruments, and obtains the following results. Thread / Instruments: I1 I2 I3 I4 1: 20.9 20.4 19.9 21.9 2: 25 26.2 27.0 24.8 3: 25.5 23.1 21.5 24.4 4: 24.8 21.2 23.5 25.7 5: 19.6 21.2 22.1 22.1 Perform a 2-way ANOVA using the 0.05 level of significance.	BTL1	Understanding

UNIT 5- STATISTICAL QUALITY CONTROL

Control charts for measurements (X and R charts) – Control charts for attributes (p, c and np charts) – Tolerance limits – Acceptance sampling

PART-A(2 Marks)

Q. No.	Question	BT Level	Competence
1.	What is Statistical quality control?	BTL2	Understanding
2.	Write down advantage of SQC.	BTL1	Remembering
3.	What is meant by chance variation?	BTL2	Understanding
4.	What is meant by Assignable variation?	BTL1	Remembering
5.	Name the types of Control Chart.	BTL1	Remembering
6.	Define product control	BTL2	Understanding
7.	Define process control	BTL2	Understanding
8.	What is control Chart?	BTL1	Remembering
9.	Write down uses of Mean Chart.	BTL3	Applying
10.	Write down types of Acceptance sampling plan	BTL1	Remembering
11.	Define OC Curve	BTL3	Applying

<table>
<tr><td>12.</td><td>Write down types of Causes variation.</td><td>BTL4</td><td>Analyzing</td></tr>
<tr><td>13.</td><td>Write the formula for np chart.</td><td>BTL4</td><td>Analyzing</td></tr>
<tr><td>14.</td><td>What is meant by AQL and LTPD</td><td>BTL4</td><td>Analyzing</td></tr>
<tr><td>15.</td><td>What is the formula for c chart and p chart</td><td>BTL1</td><td>Remembering</td></tr>
<tr><td>16.</td><td>Define Acceptance Sampling.</td><td>BTL5</td><td>Evaluating</td></tr>
<tr><td>17.</td><td>Explain producers Risk and Consumer Risk.</td><td>BTL3</td><td>Applying</td></tr>
<tr><td>18.</td><td>Define Tolerance limits.</td><td>BTL6</td><td>Creating</td></tr>
<tr><td>19.</td><td>Define one-sided Tolerance limits.</td><td>BTL1</td><td>Remembering</td></tr>
<tr><td>20.</td><td>Define Two-Sided Tolerance limits.</td><td>BTL2</td><td>Understanding</td></tr>
<tr><td></td><td colspan="2">PART-B(13 Marks)</td><td></td></tr>
<tr><td>1.(a)</td><td>What do you understand by SQC. Discuss its utility and limitations?</td><td>BTL1</td><td>Remembering</td></tr>
<tr><td>1.(b)</td><td>The following data give the weight of an automobile part. Five samples of four items each were taken on a random sample basis (at an interval of 1 hour each).Draw the mean Control Chart and find out if the production process is in control.
<table>
<tr><td>Sample</td><td colspan="4">Weight of the parts in ounces</td></tr>
<tr><td>1</td><td>10</td><td>12</td><td>10</td><td>12</td></tr>
<tr><td>2</td><td>10</td><td>12</td><td>13</td><td>13</td></tr>
<tr><td>3</td><td>10</td><td>10</td><td>9</td><td>11</td></tr>
<tr><td>4</td><td>11</td><td>10</td><td>9</td><td>14</td></tr>
<tr><td>5</td><td>12</td><td>12</td><td>12</td><td>12</td></tr>
</table></td><td>BTL6</td><td>Creating</td></tr>
<tr><td>2.</td><td>You are given the value of sample means ($\bar{X}$) and Range for 10 samples of size 5 each. Draw mean chart and comment on the state of control of the process.
<table>
<tr><td>Sample No</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><td>9</td><td>10</td></tr>
<tr><td>($\bar{X}$)</td><td>43</td><td>49</td><td>37</td><td>44</td><td>45</td><td>37</td><td>51</td><td>46</td><td>43</td><td>47</td></tr>
<tr><td>R</td><td>5</td><td>6</td><td>5</td><td>7</td><td>7</td><td>4</td><td>8</td><td>6</td><td>4</td><td>6</td></tr>
</table></td><td>BTL2</td><td>Understanding</td></tr>
<tr><td>3.</td><td>For a sampling plan N = 1,200, n = 64 and c = 1, determine the probability of acceptance of the following lots; (i) 0.5%defective, (ii) 0.8%defective, (iii) 1%defective, (iv) 2%defective, (v) 4% defective, (vi) 10%defective. Also draw and OC curve.</td><td>BTL2</td><td>Understanding</td></tr>
<tr><td>4.</td><td>10 samples each of size 50 were inspected and the number of defectives in the inspection were: 2,1,1,2,3,5,5,1,2,3.Draw the appropriate control chart for defectives.</td><td>BTL1</td><td>Remembering</td></tr>
<tr><td>5.(a)</td><td>A machine is set to deliver packets of a given weight, 10 samples of size 5 each were recorded. Below are given the relevant data:
<table>
<tr><td>Sample No</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><td>9</td><td>10</td></tr>
<tr><td>($\bar{X}$)</td><td>15</td><td>17</td><td>15</td><td>18</td><td>17</td><td>14</td><td>18</td><td>15</td><td>17</td><td>16</td></tr>
<tr><td>R</td><td>7</td><td>7</td><td>4</td><td>9</td><td>8</td><td>7</td><td>12</td><td>4</td><td>11</td><td>5</td></tr>
</table>
Calculate the values of the Central Line and the control limits for the mean chart and the range chart and then comment on the state of control. (Conversion factors for $n = 5$ are $A_2 = 0.58$ $D_3 = 0, D_4 = 2.115$)</td><td>BTL3</td><td>Applying</td></tr>
<tr><td>5.(b)</td><td>Explain in detail the R-Chart clearly?</td><td>BTL1</td><td>Remembering</td></tr>
</table>

<table>
<tr><td>6.(a)</td><td>The following data show the values of sample mean $\bar{X}$ and the range.R for the samples of size 5 each. Calculate the values for central line and control limits for mean-chart and range chart and determine whether the process is in control.
<table>
<tr><td>Sample No</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><td>9</td><td>10</td></tr>
<tr><td>($\bar{X}$)</td><td>11.2</td><td>11.8</td><td>10.8</td><td>11.6</td><td>11</td><td>9.6</td><td>10.4</td><td>9.6</td><td>10.6</td><td>10</td></tr>
<tr><td>R</td><td>7</td><td>4</td><td>8</td><td>5</td><td>7</td><td>4</td><td>8</td><td>4</td><td>7</td><td>9</td></tr>
</table>
(Conversion factors for $n = 5$ are $A_2 = 0.577$ $D_3 = 0, D_4 = 2.115$)</td><td>BTL3</td><td>Applying</td></tr>
<tr><td>6.(b)</td><td>Explain in detail the $\bar{X}$ Chart clearly?</td><td>BTL1</td><td>Remembering</td></tr>
<tr><td>7.</td><td>15 tape-recorders were examined for quality control test. The number of defects in each tape-recorder is recorded below. Draw the appropriate control chart and comment on the state of control.
<table>
<tr><td>Unit No (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><td>9</td><td>10</td><td>11</td><td>12</td><td>13</td><td>14</td><td>15</td></tr>
<tr><td>No of defects (c)</td><td>2</td><td>4</td><td>3</td><td>1</td><td>1</td><td>2</td><td>5</td><td>3</td><td>6</td><td>7</td><td>3</td><td>1</td><td>4</td><td>2</td><td>1</td></tr>
</table></td><td>BTL4</td><td>Analyzing</td></tr>
<tr><td>8.</td><td>Construct $\bar{X}$ chart for following data
<table>
<tr><td>Sample No</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 rowspan="3">Observation</td><td>32</td><td>28</td><td>39</td><td>50</td><td>42</td><td>50</td><td>44</td><td>22</td></tr>
<tr><td>36</td><td>32</td><td>52</td><td>42</td><td>45</td><td>29</td><td>52</td><td>35</td></tr>
<tr><td>42</td><td>40</td><td>28</td><td>31</td><td>34</td><td>21</td><td>35</td><td>44</td></tr>
</table>
Also determine whether the process is in control.</td><td>BTL5</td><td>Evaluating</td></tr>
<tr><td>9.</td><td>From the information given below construct an appropriate control chart
<table>
<tr><td>Sample No.(each of 100)</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><td>9</td></tr>
<tr><td>No. of defectives</td><td>12</td><td>7</td><td>9</td><td>8</td><td>10</td><td>6</td><td>7</td><td>11</td><td>8</td></tr>
</table>
State your conclusions. Write all the steps in the construction of the above chart including formula for UCL and LCL.</td><td>BTL5</td><td>Evaluating</td></tr>
<tr><td>10.(a)</td><td>Construct a Control Chart for fraction defectives (p-Chart) for following data.
<table>
<tr><td>Sample No.</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><td>9</td><td>10</td></tr>
<tr><td>Sample Size</td><td>90</td><td>65</td><td>85</td><td>70</td><td>80</td><td>80</td><td>70</td><td>95</td><td>90</td><td>75</td></tr>
<tr><td>No of defectives</td><td>9</td><td>7</td><td>3</td><td>2</td><td>9</td><td>5</td><td>3</td><td>9</td><td>6</td><td>7</td></tr>
</table></td><td>BTL6</td><td>Creating</td></tr>
<tr><td>10.(b)</td><td>Explain Control Limits for the sample mean $\bar{X}$ and sample range R.</td><td>BTL1</td><td>Remembering</td></tr>
<tr><td>11.</td><td>An inspection of 10 samples of size 400 each from 10 lots reveled the following number of defective units17,15,14,26,9,4,19,12,9,6</td><td>BTL6</td><td>Creating</td></tr>
<tr><td>12.</td><td>Construct R chart for following data
<table>
<tr><td>Sample No.</td><td colspan="4">Observation</td></tr>
<tr><td>1</td><td>1.7</td><td>2.2</td><td>1.9</td><td>1.2</td></tr>
<tr><td>2</td><td>0.8</td><td>1.5</td><td>2.1</td><td>0.9</td></tr>
<tr><td>3</td><td>1</td><td>1.4</td><td>1</td><td>1.3</td></tr>
<tr><td>4</td><td>0.4</td><td>0.6</td><td>0.7</td><td>0.2</td></tr>
<tr><td>5</td><td>1.4</td><td>2.3</td><td>2.8</td><td>2.7</td></tr>
<tr><td>6</td><td>1.8</td><td>2</td><td>1.1</td><td>0.1</td></tr>
<tr><td>7</td><td>1.6</td><td>1.</td><td>1.5</td><td>2</td></tr>
<tr><td>8</td><td>2.5</td><td>1.6</td><td>1.8</td><td>1.2</td></tr>
<tr><td>9</td><td>2.9</td><td>2</td><td>0.5</td><td>2.2</td></tr>
</table>
Comment on State of Control.</td><td>BTL4</td><td>Analyzing</td></tr>
</table>

<table>
<tr><td>13.</td><td>The following data gives the number of defectives in 10 samples each of size 100.Constuct a np chart for these data and also determine whether the process is in control
<table>
<tr><td>Sample No.</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><td>9</td><td>10</td></tr>
<tr><td>No. of defectives</td><td>24</td><td>38</td><td>62</td><td>34</td><td>26</td><td>36</td><td>38</td><td>52</td><td>33</td><td>44</td></tr>
</table></td><td>BTL4</td><td>Analyzing</td></tr>
<tr><td>14.</td><td>The following data relate to the number of defects in each of 15 units drawn randomly from a production process. Draw the control chart or the number of defects and comment on the state of control. The Units are 6, 4, 9, 10, 11, 12, 20, 10, 9, 10, 15, 10, 20, 15, 10</td><td>BTL2</td><td>Understanding</td></tr>
<tr><td colspan="4">PART-C(15 Marks)</td></tr>
<tr><td>1.</td><td>A machine fills boxes with dry cereal. 15 samples of 4 boxes are drawn randomly. The weights of the sampled boxes are shown as follows. Draw the control charts for the sample mean and sample range and determine whether the process is in a state of control.
<table>
<tr><td>Sample No.</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><td>9</td><td>10</td><td>11</td><td>12</td><td>13</td><td>14</td><td>15</td></tr>
<tr><td rowspan="4">Weight of Boxes (X)</td><td>10</td><td>10.3</td><td>11.5</td><td>11</td><td>11.3</td><td>10.7</td><td>11.3</td><td>12.3</td><td>11</td><td>11.3</td><td>12.5</td><td>11.9</td><td>12.1</td><td>11.9</td><td>10.6</td></tr>
<tr><td>10.2</td><td>10.9</td><td>10.7</td><td>11.1</td><td>11.6</td><td>11.4</td><td>11.4</td><td>12.1</td><td>13.1</td><td>12.1</td><td>11.9</td><td>12.1</td><td>11.1</td><td>12.1</td><td>11.9</td></tr>
<tr><td>11.3</td><td>10.7</td><td>11.4</td><td>10.7</td><td>11.9</td><td>10.7</td><td>11.1</td><td>12.7</td><td>13.1</td><td>10.7</td><td>11.8</td><td>11.6</td><td>12.1</td><td>13.1</td><td>11.7</td></tr>
<tr><td>12.4</td><td>11.7</td><td>12.4</td><td>11.4</td><td>12.1</td><td>11</td><td>10.3</td><td>10.7</td><td>12.4</td><td>11.5</td><td>11.3</td><td>11.4</td><td>11.7</td><td>12</td><td>12.1</td></tr>
</table></td><td>BTL6</td><td>Creating</td></tr>
<tr><td>2.</td><td>The following are the $\overline{X}$ and R values for 20 samples of readings. Draw $\overline{X}$ chart and R chart and write your conclusion.
<table>
<tr><td>Samples</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><td>9</td><td>10</td></tr>
<tr><td>$\overline{X}$</td><td>34</td><td>31.6</td><td>30.8</td><td>33</td><td>35</td><td>33.2</td><td>33</td><td>32.6</td><td>33.8</td><td>37.8</td></tr>
<tr><td>R</td><td>4</td><td>4</td><td>2</td><td>3</td><td>5</td><td>2</td><td>5</td><td>13</td><td>19</td><td>6</td></tr>
<tr><td>Samples</td><td>11</td><td>12</td><td>13</td><td>14</td><td>15</td><td>16</td><td>17</td><td>18</td><td>19</td><td>20</td></tr>
<tr><td>$\overline{X}$</td><td>35.8</td><td>38.4</td><td>34</td><td>35</td><td>38.8</td><td>31.6</td><td>33</td><td>28.2</td><td>31.8</td><td>35.6</td></tr>
<tr><td>R</td><td>4</td><td>4</td><td>14</td><td>4</td><td>7</td><td>5</td><td>5</td><td>3</td><td>9</td><td>6</td></tr>
</table>
(Given for $n = 5$ are $A_2 = 0.58$ $D_3 = 0, D_4 = 2.12$)</td><td>BTL2</td><td>Understanding</td></tr>
<tr><td>3.</td><td>The following table gives the inspection data relating to 10 samples of 100 items each, concerning the production of bottle corks.
<table>
<tr><td>Sample Number</td><td>Size of Sample</td><td>Number of Defectives</td><td>Fraction Defective</td></tr>
<tr><td>1</td><td>100</td><td>5</td><td>.05</td></tr>
<tr><td>2</td><td>100</td><td>3</td><td>.03</td></tr>
<tr><td>3</td><td>100</td><td>3</td><td>.03</td></tr>
<tr><td>4</td><td>100</td><td>6</td><td>.06</td></tr>
<tr><td>5</td><td>100</td><td>5</td><td>.05</td></tr>
<tr><td>6</td><td>100</td><td>6</td><td>.06</td></tr>
<tr><td>7</td><td>100</td><td>8</td><td>.08</td></tr>
<tr><td>8</td><td>100</td><td>10</td><td>.10</td></tr>
<tr><td>9</td><td>100</td><td>10</td><td>.10</td></tr>
</table></td><td>BTL2</td><td>Understanding</td></tr>
</table>

10	100	4	.04	

Construct a p- chart.

4. The following data relate to the life (in hours) of 10 samples of 6 electric bulbs each drawn at an interval of one hour from a production process. Draw the control chart for $\bar{X}$ and R comment.

Sample No.	Life time (in hours)					
1	620	687	666	689	738	686
2	501	585	524	585	653	668
3	673	701	686	567	619	660
4	646	626	572	628	631	743
5	494	984	659	643	660	640
6	634	755	625	582	683	555
7	619	710	664	693	770	534
8	630	723	614	535	550	570
9	482	791	533	612	497	499
10	706	524	626	503	661	754

(Given for n = 6,$A_2 = 0.483$ $D_3 = 0, D_4 = 2.004$)

BTL3 | Applying