SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institution)

(S.R.M.NAGAR, KATTANKULATHUR-603203)

DEPARTMENT OF MATHEMATICS

QUESTION BANK

I YEAR / I SEMESTER

M.E., INDUSTRIAL SAFETY ENGINEERING

1918107 – PROBABILITY AND STATISTICAL METHODS

Regulation – 2019

Academic Year – 2022- 23

Prepared by

A.Karpagam, Assistant Professor

VALLIAMMAI ENGINEERING COLLEGE
(An Autonomous Institution)
SRM Nagar, Kattankulathur – 603 203.

DEPARTMENT OF MATHEMATICS
QUESTION BANK

SUBJECT : 1918107 – PROBABILITY AND STATISTICAL METHODS

SEM / YEAR : I Sem/ I M.E. INDUSTRIAL SAFETY ENGINEERING

UNIT-I PROBABILITY AND RANDOM VARIABLES

Probability – Axioms of probability – Conditional probability – Baye's theorem – Random variables – Probability function –Moments – Moment generating functions and their properties – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions – Function of a random variable.

Q.No	Question	Bloom's Taxonomy Level	Domain
	PART – A		
1.	If the probability density function of a random variable X is f(x) = ¼ in – 2 < x < 2 find P($\|x\| > 1$)	**BTL1**	**Remembering**
2.	If X is a geometric variate, taking values 1, 2, 3…∞, find $P(X\ is\ odd)$	**BTL1**	**Remembering**
3.	State the memory less property of the exponential distribution.	**BTL1**	**Remembering**
4.	The mean and variance of binomial distribution are 5 and 4 Find the distribution of *X*.	**BTL1**	**Remembering**
5.	The mean of Binomial distribution is 20 and standard deviation is 4. Find the parameters of the distribution.	**BTL1**	**Remembering**
6.	If the events *A* and *B* are independent then show that $\bar{A}$ and $\bar{B}$ are independent.	**BTL1**	**Remembering**
7.	If a random variable X takes values 1, 2, 3, 4 such that 2P (X = 1) = 3P (X = 2) = P(X=3) = 5P (X = 4). Find the probability distribution of X.	**BTL2**	**Understanding**
8.	Find the Moment generating function of a continuous random variable X whose p.d.f is $f(x) = \begin{cases} xe^{x/2}, & x > 0 \\ 0, & x \le 0 \end{cases}$	**BTL2**	**Understanding**
9.	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.	**BTL2**	**Understanding**
10.	If a random variable X has the MGF $M_X(t) = \frac{2}{2-t}$. Find the standard deviation of X.	**BTL2**	**Understanding**
11.	Show that the function $f(x) = \begin{cases} e^{-x}, & x \ge 0 \\ 0, & x < 0 \end{cases}$ is a probability density function of a continuous random variable X.	**BTL3**	**Applying**
12.	Show that the moment generating function of the uniform distribution $f(x) = \frac{1}{2a}, -a < x < a$ about origin is $\frac{sinh(at)}{at}$.	**BTL3**	**Applying**

13.	If the MGF of a uniform distribution for a RV X is $\frac{1}{t}(e^{5t} - e^{4t})$. Find E(X).	**BTL3**	**Applying**
14.	A is known to hit the target in 2 out of 5 shots whereas *B* is known to hit the target in 3 of 4 shots. Find the probability of the target being hit when they both try?	**BTL4**	**Analyzing**
15.	Define Gamma distribution.	**BTL4**	**Analyzing**
16.	If A and B are events in S such that $(A) = 1/3$, $P(B) = 1/4$ and $P(A \cup A) = 1/2$. Find $P(A \cap \bar{B})$ and$P(A/\bar{B})$.	**BTL4**	**Analyzing**
17.	Write two characteristics of the Normal Distribution	**BTL5**	**Evaluating**
18.	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	**BTL5**	**Evaluating**
19.	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?	**BTL6**	**Creating**
20.	The probability that a candidate can pass in an examination is 0.6. What is the probability that he will pass in third trial?	**BTL6**	**Creating**
21.	Suppose that X has a Poisson distribution with parameter λ = 2. Compute P[X ≥ 1].	**BTL4**	**Analyzing**
22.	State Baye's theorem	**BTL5**	**Evaluating**
23.	Define Normal distribution	**BTL5**	**Evaluating**
24.	State any two properties of normal distribution	**BTL6**	**Creating**
25.	Let X be a Uniformly distributed R. V. over [-3, 3].Determine P(X ≤ 2)	**BTL-2**	**Understanding**
	PART-B		
1.	A random variable X has the following probability distribution: X: 0, 1, 2, 3, 4, 5, 6, 7 P(X): 0, k, 2 k, 2 k, 3 k, k^2, $2k^2$, $7k^2$+k Find (i) the value of k (ii) $P(1.5 < X < 4.5 / X > 2)$	**BTL-2**	**Understanding**
2.	Find the MGF of Binomial distribution and hence find its mean and variance.	**BTL-2**	**Understanding**
3(a).	A bolt is manufactured by 3 machines *A, B*, and *C*. *A* turns out twice as many items as *B* and machines *B* and *C* produce equal number of items. 2% of bolts produced by *A* and *B* are defective and 4% of bolts produced by *C* are defective. All bolts are put into 1 stock pile and 1 is chosen from this pile. What is the probability that it is defective?	**BTL -6**	**Creating**
3(b).	Find the moment generating function of a geometric random variable. Also find its mean.	**BTL -3**	**Applying**
4.	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)	**BTL -6**	**Creating**
5.	Find the MGF of Poisson distribution and hence find its mean and variance.	**BTL -6**	**Creating**

6(a).	An urn contains 10 white and 3 black balls. Another urn contains 3 white and 5 black balls. Two balls are drawn at random from the first urn and placed in the second urn and then 1 ball is taken at random from the latter. What is the probability that it is a white ball?	**BTL -6**	**Creating**
6(b).	Find the MGF of Uniform distribution and hence find its mean and variance.	**BTL-2**	**Understanding**
7.	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?	**BTL -3**	**Applying**
8.	A random variable X has c.d.f $F(x) = \begin{cases} 0, if x < -1 \\ a(1+x), if -1 < x < 1 \\ 1, if x \ge 1 \end{cases}$. Find the value of a. Also P(X>1/4) and $P(-0.5 \le X \le 0)$.	**BTL-1**	**Remembering**
9.	State and Prove forget fullness property of exponential distribution. Using this property solve the following problem: The length of the shower on a tropical island during the rainy season has on exponential distribution with parameter 2, time being measured in minutes. What is the probability that a shower will last more than 3 minutes?	**BTL -3**	**Applying**
10(a).	In a normal population with mean 15 and standard deviation 3.5, it is found that 647 observations exceed 16.25. What is the total number of observations in the population?	**BTL -3**	**Applying**
10(b).	If the probability mass function of a RV X is given by $P(X = x) = kx^3$, x = 1, 2, 3, 4. Find the value of k, $P\left[\left(\frac{1}{2} < X < \frac{3}{2}\right)/X > 1\right]$, mean and variance of X.	**BTL -3**	**Applying**
11(a).	The marks obtained by a number of students for a certain subject is assumed to be normally distributed with mean 65 and standard deviation 5. If 3 students are taken at random from this set Find the probability that exactly 2 of them will have marks over 70?	**BTL -3**	**Applying**
11(b).	A bag contains 5 balls and it is not known how many of them are white. Two balls are drawn at random from the bag and they are noted to be white. What is the change that all balls in the bag are white?	**BTL -6**	**Creating**
12.	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 -3**	**Applying**
13.	In a certain city, the daily consumption of electric power in millions of kilowatt hours can be treated as a RV having Gamma distribution with parameters λ = ½ and k =3. If the power plant of this city has a daily capacity of 12 million kilowatts – hours, Find the probability that this power supply will be inadequate on any given day?	**BTL -3**	**Applying**
14.	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	**BTL -3**	**Applying**

	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.		
15(a).	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.	**BTL -3**	**Applying**
15(b).	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.	**BTL -3**	**Applying**
16.	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 (i) the value of *k*, (ii) P(X<1), (iii) P(-1< X ≤ 2), (iv) E(X)	**BTL -4**	**Analyzing**
17.	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).	**BTL -3**	**Applying**
18.	The Probability distribution function of a R.V. X is given by $f(x) = \frac{4x(9-x^2)}{81}$, $0 \le x \le 3$. Find the mean, variance and 3rd moment about origin.	**BTL-5**	**Evaluating**
	PART-C		
1.	State and Prove memory less property of Geometric distribution	**BTL-6**	**Creating**
2.	In a test on 2000 electric bulbs, it was found that bulbs of a particular make, was normally distributed with an average life of 2040 hours and standard deviation of 60 hours. Estimate the number of bulbs likely to burn for 1.more than 2150 hours 2.less than 1950 hours 3.Less than 1980 4.more 1920 hours but less than 2100 hours	**BTL-2**	**Understanding**
3.	8 coins are tossed at a time 256 times. Number of heads observed at each throw is recorded and the results are given below. Find the expected frequencies. What are the theoretical values of mean and standard deviation? Calculate also the mean and S.D of the observed frequencies. No. of heads: 0, 1, 2, 3, 4, 5, 6, 7, 8 Frequency: 2, 6, 30, 52, 67, 56, 32, 10, 1	**BTL-1**	**Remembering**
4.	(i) Derive MGF, Mean and Variance of Poisson distribution. (ii) State and prove Additive property of independent Poisson Variates.	**BTL-6**	**Creating**
5.	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.	**BTL -4**	**Analyzing**

UNIT II - ESTIMATION THEORY

Principle of least squares – Regression – Multiple and Partial Correlations – Estimation of parameters – Maximum likelihood estimates – Method of Moments.

Q. No.	Question	BT Level	Competence
	PART – A		
1.	Define estimator.	**BTL-1**	**Remembering**
2.	Distinguish between point estimation and.	**BTL-1**	**Remembering**
3.	Mention the properties of a good estimator.	**BTL-1**	**Remembering**
4.	Define confidence coefficient.	**BTL-1**	**Remembering**
5.	What is the level of significance in testing of hypothesis?	**BTL-2**	**Understanding**
6.	Define confidence limits for a parameter.	**BTL-1**	**Remembering**
7.	State the conditions under which a binomial distribution becomes a normal distribution.	**BTL-1**	**Remembering**
8.	Explain how do you calculate 95% confidence interval for the average of the population?	**BTL-3**	**Applying**
9.	Define negatively biased.	**BTL-2**	**Understanding**
10.	An automobile repair shop has taken a random sample of 40 services that the average service time on an automobile is 130 minutes with a standard deviation of 26 minutes. Compute the standard error of the mean.	**BTL-4**	**Analyzing**
11.	Two variables X and Y have the regression lines $3X + 2Y - 26 = 0$, $6X + Y - 31 = 0$, Find the mean value of X and Y.	**BTL-4**	**Analyzing**
12.	State any two properties of regression lines.	**BTL-4**	**Analyzing**
13.	Define unbiasedness of a good estimator.	**BTL-1**	**Remembering**
14.	Write the normal equations for fitting a straight line by the method of least squares.	**BTL-2**	**Understanding**
15.	What are the merits and demerits of the least square method.	**BTL-1**	**Remembering**
16.	Find the maximum likelihood estimates for the population mean when the population variance is known for random sampling from a normal population.	**BTL-6**	**Creating**
17.	Define positively biased.	**BTL-1**	**Remembering**
18.	Give the normal equations to fit the parabola $y = a + bx + cx^2$	**BTL-2**	**Understanding**
19.	Can $Y = 5 + 2.8x$ and $X = 3 – 0.5y$ be the estimated regression equations of y on x and x on y respectively ? Explain.	**BTL-4**	**Analyzing**
20.	Obtain the maximum likelihood estimator of $f(x,\theta) = (1+\theta)x^{\theta}, 0 < x < 1$ based on a random sample of size x.	**BTL-3**	**Applying**
21.	Define estimate	**BTL-1**	**Remembering**
22.	Let the lines of regression concerning two variables x and y be given by $y = 32 – x$ and $x = 13 – 0.25y$. Obtain the values of the means.	**BTL-2**	**Understanding**
23.	Define estimation	**BTL-1**	**Remembering**
24.	What is meant by maximum likelihood estimator ?	**BTL-6**	**Creating**
25.	Define interval estimation	**BTL-2**	**Understanding**
	PART –B		
1.	Fit a straight line $y = a + bx$ to the following data, using principle of least squares	**BTL-2**	**Understanding**

	x : 1 2 3 4 6 8 y : 2.4 3 3.6 4 5 6		
2.	Find the most likely price in Bombay corresponding to the price of Rs. 70 at Calcutta from the following : Calcutta Bombay Average Price 65 67 Standard deviation 2.5 3.5 Correlation coefficient between the prices of commodities in the two cities is 0.8.	**BTL-5**	**Evaluating**
3(a).	Fit a straight line y = ax +c to the following data. X: 1 3 5 7 9 11 13 15 17 y: 10 15 20 27 31 35 30 35 40	**BTL-3**	**Applying**
3(b).	Find the regression line of Y on X for the data x: 1 4 2 3 5 y: 3 1 2 5 4	**BTL-2**	**Understanding**
4.	Fit a parabola of second degree to the following data. X : 0 1 2 3 4 Y : 1 5 10 22 38	**BTL-3**	**Applying**
5.	In random sampling from normal population $N(\mu, \sigma^2)$, find the maximum likelihood estimator for μ when σ^2 is unknown.	**BTL-1**	**Remembering**
6.	Let x1,x2…..xn denote a random sample from the distribution with pdf $f(x,\theta) = \theta x^{\theta-1}$, $0<x<1$, $\theta>0$ 0 Elsewhere prove that the product u1(x1,x2,….xn) = x1,x2…xn is a sufficient estimator for θ.	**BTL-4**	**Analyzing**
7.	Let x1,x2,….xn be a random sample from uniform population on [0,θ]. Find a sufficient estimator for θ. Show that for a rectangular population $f(x,\theta) = 1/\theta$, $0 < x < \infty$ 0 elsewhere Find the maximum likelihood estimator for θ.	**BTL-4**	**Analyzing**
8.	For a random sampling from a normal population find the maximum likelihood estimators for i) The population mean, when the population variance is known. ii) The population variance, when the population mean is known. iii) The simultaneous estimation of both the population mean and variance.	**BTL-1**	**Remembering**
9.	Obtain the lines of regression X: 50 55 50 60 65 65 65 60 60 Y: 11 14 13 16 16 15 15 14 13	**BTL-2**	**Understanding**
10.	The price of a commodity during 93-98 are given below. Fit a parabola $y = a + bx + cx^2$ to these data. Calculate the trend values, estimate the period of the commodity for the year 1999. x: 1993 1994 1995 1996 1997 y: 100 107 128 140 181	**BTL-4**	**Analyzing**
11.	The following data relate to the marks of 10 students in the internal test and the university examination for the maximum of 50 in each. Internal Marks : 25 28 30 32 35 36 38 39 42 45 UniversityMarks : 20 26 29 30 25 18 26 35 35 46 a) Obtain the equations of the lines of regression b) The most likely internal mark for the university mark of 25 c) The most likely university mark for the internal mark of 30.	**BTL-1**	**Remembering**
12.	Find the maximum likelihood estimate for the parameter λ of a poisson distribution on the basis of a sample of size n. Also find its variance. Show that the sample mean x is	**BTL-1**	**Remembering**

	sufficient for estimating the parameter λ of the poisson distribution.		
13.	Fit a straight line y = a + bx for the following data by the principle of least squares. X : 0 1 2 3 4 Y : 1 1.8 3.3 4.5 6.3 Also find the value of y when x = 1.5	**BTL-4**	**Analyzing**
14.	A random sample (X_1,X_2,X_3,X_4,X_5) of size 5 is drawn from a population with unknown mean μ. Consider the following estimators to estimate μ. $t_1 = \frac{(x_1 + x_2 + x_3 + x_4 + x_5)}{5}$, $t_2 = \frac{(x_1 + x_2)}{2} + X_3$ *and* $t_3 = \frac{(2x_1 + x_2 + \lambda x_3)}{3}$ *where* λ is such that t_3 is an unbiased estimator of μ. Find λ.*Are* t_1 and t_2 unbiased ? State giving reason, the estimator which is best among t_1,t_2,and t_3.	**BTL-1**	**Remembering**
15(a).	Let $X_1,X_2,\ldots X_n$ be a random sample of size n from a normal distribution with known variance. Obtain the maximum likelihood estimator of μ.	**BTL-1**	**Remembering**
15(b).	Let $X_1,X_2\ldots X_n$ be a random sample size n from the Poisson distribution $f(x/\lambda) = \frac{\lambda^x e^{-\lambda}}{x!}$ *where* $0 \le \lambda \le \infty$. Obtain the maximum likelihood estimator of λ	**BTL-4**	**Analyzing**
16.	For the double poisson distribution $P(X = x) = \frac{1}{2}\frac{e^{-m_1} m^x{}_1}{x!} + \frac{1}{2}\frac{e^{-m_2{}^x}}{x!}, x = 0,1,2...$ Show that the estimates for m_1 and m_2 by the method of moments are $\mu_1 \pm \sqrt{\mu_2' - \mu_1' - \mu_1'^2}$	**BTL-4**	**Analyzing**
17.	The following are the measurements of the air velocity and evaporation coeffiecient of burning fuel droplets in an impulse engine Air Velocity (cm/s) : 20 60 100 140 180 220 260 300 340 380 Evaporation Coeff : 0.18 0.37 0.35 0.78 0.56 0.75 1.18 1.36 1.17 1.65 Fit a straight line to these data by the method of least squares, and use it to estimate the evaporation coefficient of a droplet when the air velocity is 190 cm/s.	**BTL-4**	**Analyzing**
18.	Fit an equation of the form $y = ab^x$ to the following data x: 2 3 4 5 6 y: 144 172.8 207.4 248.8 298.5	**BTL-3**	**Applying**

PART-C

1.	Prove that the ML estimator of the parameter α of the population having pdf $f(x,\alpha) = 2/\alpha^2 (\alpha - x)$. $0 < x < \alpha$ for the sample of unit size is 2x, x being the sample value. Show also that the estimator is not unbiased.	**BTL-1**	**Remembering**
2.	Fit a straight line trend of the form y = a + bx to the data given below by the method of least squares and predict the value of y when x = 70 X: 71 68 73 69 67 65 66 67 y: 69 72 70 70 68 67 68 64	**BTL-3**	**Applying**
3.	Fit the model $y = ax^b$ to the following data. X: 1 2 3 4 5 6 y: 2.98 4.26 5.21 6.10 6.80 7.50	**BTL-3**	**Applying**

4.	If the two variables x and y have the regression lines 3x + 2y = 26 and 6x + y = 31. Find i) Find the mean value of x and y ii) Find the correlation coefficient of x and y.	**BTL-5**	**Evaluating**
5.	Obtain the equation of regression lines y = ax + b from the following data, using the method of least squares. x: 6 3 6 9 3 9 6 3 9 6 3 9 y: 526 421 581 630 412 560 434 443 590 570 346 672	**BTL-3**	**Applying**

UNIT III -TESTING OF HYPOTHESIS

Sampling distributions – Small and Large samples and problems – Tests based on Normal, t distribution, Chi-square, Goodness of fit and F distributions

PART – A

Q. No.	Question	BT Level	Competence
1.	Define the following terms Standard error	**BTL -1**	**Remembering**
2.	Mention the various steps involved in testing of hypothesis	**BTL -1**	**Remembering**
3.	What are null and alternate 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.	State the applications of Z-test.	**BTL -2**	**Understanding**
8.	A sample of size 13 gave an estimated population variance of 3.0 while another sample of size15 gave an estimate of 2.5. Could both samples be from populations with the same variance?	**BTL-1**	**Remembering**
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.	When does the Z-test apply?	**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.	What is the assumption of t-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.	State any two applications of ψ^2-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**

<table>
<tr><td>21.</td><td>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.($Z_{0.05} = 1.645$)</td><td>BTL-4</td><td>Analyzing</td></tr>
<tr><td>22.</td><td>What are the conditions for Large samples?</td><td>BTL -5</td><td>Evaluating</td></tr>
<tr><td>23.</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 -6</td><td>Creating</td></tr>
<tr><td>24.</td><td>What are the conditions for small samples?</td><td>BTL -4</td><td>Analyzing</td></tr>
<tr><td>25.</td><td>Write the properties of t-distribution?</td><td>BTL -4</td><td>Analyzing</td></tr>
<tr><td colspan="4">PART – B</td></tr>
<tr><td>1.</td><td>Given a sample mean of 83, a sample standard deviation of 12.5 and a sample size of 22, test the hypothesis that the value of the population mean is 70 against the alternative that it is more than 70. Use the 0.25 significance level.</td><td>BTL -1</td><td>Remembering</td></tr>
<tr><td>2.</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>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? Also estimate the 95% fiducial limits for the mean.</td><td>BTL -1</td><td>Remembering</td></tr>
<tr><td>4(a).</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 -2</td><td>Understanding</td></tr>
<tr><td>4(b).</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>5.</td><td>Two independent samples of 8 and 7 items respectively had the following
<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>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 -4</td><td>Analyzing</td></tr>
<tr><td>6.</td><td>A group of 10 rats fed on diet A and another group of 8 rats fed on diet B,</td><td>BTL -5</td><td>Evaluating</td></tr>
</table>

<table>
<tr><td></td><td>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></td><td></td></tr>
<tr><td>7.</td><td>Two independent samples of sizes 8 and 7 contained the following values. Test if the two populations have the same variance.
<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></td><td>BTL -2</td><td>Understanding</td></tr>
<tr><td>8.</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>9.</td><td>Samples of two types of electric bulbs were tested for length of life and following data were obtained.
<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?</td><td>BTL -3</td><td>Applying</td></tr>
<tr><td>10.</td><td>The mean produce of wheat from a sample of 100 fields comes to 200kg per acre and another sample of 150 fields gives a mean 220 kg per acre. Assuming the standard deviation of the yield at 11 kg for the universe, test if there is a significant difference between the means of the samples?</td><td>BTL -2</td><td>Understanding</td></tr>
<tr><td>11(a).</td><td>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 where from normal population with the same mean.</td><td>BTL -1</td><td>Remembering</td></tr>
<tr><td>11(b).</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 -1</td><td>Remembering</td></tr>
<tr><td>12.</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 -1</td><td>Remembering</td></tr>
<tr><td>13.</td><td>A certain medicine administered to each of 10 patients resulted in the</td><td>BTL -1</td><td>Remembering</td></tr>
</table>

<table>
<tr><td></td><td>following increases in the B.P. 8, 8, 7, 5, 4, 1, 0, 0, -1, -1. Can it be concluded that the medicine was responsible for the increase in B.P. 5% l.o.s</td><td></td><td></td></tr>
<tr><td>14.</td><td>5 coins were tossed 320 times. The number of heads observed is given below:
No. of heads : 0 1 2 3 4 5
Observed frequencies : 15 45 85 95 60 20
Examine whether the coin is unbiased .Use 5% level of significance.</td><td>BTL -5</td><td>Evaluating</td></tr>
<tr><td>15.</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 -1</td><td>Remembering</td></tr>
<tr><td>16.</td><td>A certain stimulus administered to each of 12 patients resulted in the following increase of blood pressure 5,2,8, -1,3,0, -2,1,5,0, 4 & 6. Can it be concluded that the stimulus will, in general, be accompanied by an increase in blood pressure?</td><td>BTL -6</td><td>Creating</td></tr>
<tr><td>17.</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>BTL -2</td><td>Understanding</td></tr>
<tr><td>18.</td><td>In a random sample of 1000 people from city A, 400 are found to be consumers of rice. In a sample of 800 from city B, 400 are found to be consumers of rice. Does this data give a significant difference between the two cities as far as the proportion of rice consumers is concerned?</td><td>BTL -4</td><td>Analyzing</td></tr>
<tr><td colspan="4">PART C</td></tr>
<tr><td>1.</td><td>The means of two random samples of size 9 and 7 are 196.42 and 198.92 respectively. The sums of the squares of the deviation from the mean are 26.94 and 18.73 respectively. Can the sample be considered to have been drawn from the same normal population?</td><td>BTL -6</td><td>Creating</td></tr>
<tr><td>2.</td><td>Two horses A and B were tested according to the time (in seconds) to run a particular track with the following results.
<table>
<tr><td>Horse A</td><td>28</td><td>30</td><td>32</td><td>33</td><td>33</td><td>29</td><td>34</td></tr>
<tr><td>Horse B</td><td>29</td><td>30</td><td>30</td><td>24</td><td>27</td><td>27</td><td>-</td></tr>
</table>
Test whether you can discriminate between two horses. You can use the fact that 5 % value of t for 11 degrees of freedom is 2.2</td><td>BTL-2</td><td>Understanding</td></tr>
<tr><td>3.</td><td>An sample analysis of examination results of 500 students was made. It was found that 220 students had failed. 170 had secured a third class, 90 were placed in second class and 20 got first class. Do these figures commensurate</td><td>BTL -5</td><td>Evaluating</td></tr>
</table>

	with the general examination result which is in the ration 4: 3:2:1 for the various categories respectively.		
4.	Random samples of 400 men and 600 women were asked whether they would like to have a flyover near their residence. 200 men and 325 women were in favor of the proposal. Test the hypothesis that proportions of men and women in favor of the proposal are same at 5 % level.	**BTL-2**	**Understanding**
5.	In a year there are 956 births in a town A of which 52.5% were male while in towns A and B combined, this proportion in a total of 1406 births was 0.496.Is there any significant difference in the proportion of male births in the two Rows ?	**BTL -2**	**Understanding**

UNIT IV-DESIGN OF EXPERIMENTS

Analysis of variance - Completely randomized design – Randomized block design – Latin square design - 2^2 factorial designs.

PART – A

Q. No.	Question	BT Level	Competence
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 Randomization.	**BTL -1**	**Remembering**
5.	Define Replication.	**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 a2x2 Latin square is not possible? Explain.	**BTL -3**	**Applying**
14.	Analyze the advantages of the Latin square design over the other design.	**BTL -4**	**Analyzing**
15.	Demonstrate main advantage of Latin square Design over Randomized Block 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.	Express 2^2 factorial designs.	**BTL -6**	**Creating**
21.	Explain SSB and SSW in ANOVA.	**BTL -5**	**Evaluating**
22.	What is the advantages of CRD?	**BTL -5**	**Evaluating**

<table>
<tr><td>23.</td><td>What is RBD?</td><td>BTL -4</td><td>Analyzing</td></tr>
<tr><td>24.</td><td>What is the disadvantages of RBD?</td><td>BTL -4</td><td>Analyzing</td></tr>
<tr><td>25.</td><td>Write any two differences between RBD and CRD.</td><td>BTL -1</td><td>Remembering</td></tr>
<tr><td colspan="4">PART-B</td></tr>
<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>BTL -1</td><td>Remembering</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>
<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>BTL -2</td><td>Understanding</td></tr>
<tr><td>3.</td><td>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
<table>
<tr><td>A</td><td>B</td><td>C</td></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>BTL -1</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>BTL -2</td><td>Understanding</td></tr>
<tr><td>5.</td><td>Perform a 2-way ANOVA on the data given below:
<table>
<tr><td></td><td colspan="3">Treatment 1</td></tr>
<tr><td></td><td>1</td><td>2</td><td>3</td></tr>
</table></td><td>BTL -3</td><td>Applying</td></tr>
</table>

	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.						
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						**BTL -2**	**Understanding**
			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.							
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 devices were encapsulated using five different plastics. With the following result ,expressed as pounds of force required to break the bond						**BTL -4**	**Analyzing**
	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.							
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 -1**	**Remembering**
	A 16	B 17	C 20					
	B 16	C 21	A 15					
	C 15	A 12	B 13					
	Test the hypothesis and infer that there is no difference between the burners.							
9.	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.						**BTL -1**	**Remembering**
	A18	C21	D25	B11				

D22	B12	A15	C19
B15	A20	C23	D24
C22	D21	B10	A17

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.

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	**BTL -4**	**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	**BTL -6**	**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	**BTL -3**	**Applying**
13.	Find out the main effects and interaction effects in the following 2^2 factorial experiment and write down the analysis of variance table BLOCKS | (1) 00 | a 10 | b 01 | ab 11 I | 64 | 25 | 30 | 60 II | 75 | 14 | 50 | 33 III | 76 | 12 | 41 | 17 IV | 75 | 33 | 25 | 10	**BTL -3**	**Applying**
14.	As part of the investigation of the collapse of the roof of a building, a testing laboratory is given all the available bolts that connected all the steel structure at three different positions on the roof. The forces required to shear each of these bolts (coded values) are as follows: Position 1: 90 82 79 98 83 91 Position 2: 105 89 93 104 89 95 86 Position 3: 83 89 80 94 Analyze an analysis of variance to test at 0.05 level of significance whether the differences among the sample means at the three positions are significant.	**BTL -4**	**Analyzing**

<table>
<tr><td>15.</td><td>Analyze the RBD at 5% level of significance.
<table><tr><td></td><td colspan="3">Variety</td></tr><tr><td>Treatment</td><td>1</td><td>2</td><td>3</td></tr><tr><td>1</td><td>8</td><td>10</td><td>12</td></tr><tr><td>2</td><td>2</td><td>6</td><td>7</td></tr><tr><td>3</td><td>4</td><td>10</td><td>9</td></tr><tr><td>4</td><td>3</td><td>5</td><td>9</td></tr></table></td><td>BTL-2</td><td>Understanding</td></tr>
<tr><td>16.</td><td>Apply ANOVA technique and write your comment regarding the performance of the 4 machines? Test at 1% level of significance.
<table><tr><td rowspan="4">Machines</td><td>A</td><td>8</td><td>9</td><td>11</td><td>12</td></tr><tr><td>B</td><td>6</td><td>8</td><td>10</td><td>4</td></tr><tr><td>C</td><td>14</td><td>12</td><td>18</td><td>9</td></tr><tr><td>D</td><td>20</td><td>22</td><td>25</td><td>23</td></tr></table></td><td>BTL -3</td><td>Applying</td></tr>
<tr><td>17.</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><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>BTL -4</td><td>Analyzing</td></tr>
<tr><td>18.</td><td>A completely randomized design experiment with 10 plots and 3 treatments gave the results given below. Analyze the results for the effects of treatments.
<table><tr><td>Treatement</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-5</td><td>Evaluating</td></tr>
<tr><td colspan="4">PART-C</td></tr>
<tr><td>1.</td><td>An experiment was planned to study the effect of sulphate of potash and super phosphate on the yields of potatoes. All the combinations of 2 levels of super</td><td>BTL -3</td><td>Applying</td></tr>
</table>

	phosphate (p) and two levels of sulphate (k) of potash were studied in a RBD with 4 replication for each. The yields obtained are given in the following table. The yields obtained are given in the following table. Block / Yields (per plot) I: (1) 23, K 25, P 22, KP 38 II: P 40, (1) 26, K 36, KP 38 III: (1) 29, K 20, KP 30, P 20 IV: KP 34, K 31, P 24, (1) 28 Analyze the data and give your conclusion (with $\alpha = 1\%$)		
2.	Four different manufacturing processes were tried at 3 different stations and the average measurements of quality characters of the product by these processes are given in the following table. Perform an analysis of variance of the data and test for the difference between the processes. Processes Stations A B C D 1 7 14 11 11 2 15 16 14 10 3 8 15 10 12	**BTL -6**	**Creating**
3.	A laboratory technician measures the breaking strength of each of 5 kinds of linen threads by using 4 different measuring instruments, and obtains the following results, in ounces. I_1 I_2 I_3 I_4 Thread 1 20.9 20.4 19.9 21.9 Thread 2 25.0 26.2 27.0 24.8 Thread 3 25.5 23.1 21.5 24.4 Thread 4 24.8 21.2 23.5 25.7 Thread 5 19.6 21.2 22.1 22.1 Perform a 2-way ANOVA using the 0.05 level of significance for both tests.	**BTL -2**	**Understanding**
4.	The figures in the following 5x5 Latin square are the numbers of minutes, engines E_1, E_2, E_3, E_4 and E_5, tuned up by mechanics M_1, M_2, M_3, M_4 and M_5, ran with a gallon of fuel A, B, C, D and E. E_1 E_2 E_3 E_4 E_5 M_1 A31 B24 C20 D20 E18 M_2 B21 C27 D23 E25 A31 M_3 C21 D27 E25 A29 B21 M_4 D21 E25 A33 B25 C22 M_5 E21 A37 B24 C24 D20 Use the level of significance $\alpha = 0.01$ to test 1. The null hypothesis H_0 that there is no difference in the performance of the five engines 2. H_0 that the persons who tuned up these engines have no effect on their performance. 3. H_0 that the engines perform equally well with each of the fuels.	**BTL-4**	**Analyzing**

5.	Analysis the variance of Latin square of yields (in Kgs) of paddy where P, Q,R,,S denotes the different methods of cultivation. S122 P121 R123 Q122 Q124 R123 P122 S125 P120 Q119 S120 R121 R122 S123 Q121 P122 Examine whether the different methods of cultivation have given significantly different yields.	**BTL -4**	**Analyzing**

UNIT 5- TIME SERIES

Characteristics and representation – Moving averages – Exponential smoothing – Auto regressive processes

PART-A

Q. No.	Question	BT Level	Competence
1.	What is time series? Give two examples	**BTL -1**	**Remembering**
2.	Describe the limitation of time series	**BTL -3**	**Applying**
3.	Write the limitation of method of moving average	**BTL -1**	**Remembering**
4.	Define weighted moving average	**BTL -1**	**Remembering**
5.	Name any three forecasting methods used in time series analysis	**BTL -1**	**Remembering**
6.	Mention the four basic components of a time series	**BTL -2**	**Understanding**
7.	Mention any two models of Time Series.	**BTL -2**	**Understanding**
8.	Describe the types of forecasting	**BTL -3**	**Applying**
9.	Write 1st order autoregressive model	**BTL -1**	**Remembering**
10.	Define exponential smoothing	**BTL -1**	**Remembering**
11.	Mention the limits of exponential smoothing	**BTL -2**	**Understanding**
12.	Write any two merits of method of moving average	**BTL -1**	**Remembering**
13.	Define Secular trend.	**BTL -1**	**Remembering**
14.	What are the methods used to Cyclical variations	**BTL -2**	**Understanding**
15.	Write the uses of time series	**BTL -1**	**Remembering**
16.	What adjustments need to be in time series	**BTL -2**	**Understanding**
17.	What is moving average	**BTL -1**	**Remembering**
18.	Mention the points indicate time series	**BTL -2**	**Understanding**
19.	Describe the merits of exponential smoothing	**BTL -3**	**Applying**
20.	Mention the types of methods used to measure the trend	**BTL -2**	**Understanding**
21.	Define Cyclical variations	**BTL -1**	**Remembering**
22.	What are the merits of ratio to moving average method?	**BTL -1**	**Remembering**
23.	Write any two steps involved in auto regressive modeling	**BTL -2**	**Understanding**
24.	Mention the causes for random variation in a time series	**BTL -2**	**Understanding**
25.	Define Irregular Variations	**BTL -3**	**Applying**

PART – B

1.	Calculate three yearly moving average of the following data Year: 1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 No. of students: 15 18 17 20 23 25 29 33 36 40	**BTL -3**	**Applying**
2.	Suppose we have the following series of n = 7 consecutive annual values: Year: 1 2 3 4 5 6 7 Series: 31 34 37 35 36 43 40 In developing a first – order autoregressive model for this series, demonstrate the comparisons that need to be made.	**BTL -3**	**Applying**
3.	From the following data calculate seasonal indices by the Ratio to Moving Average method. Year | 1st Quarter | 2nd Quarter | 3rd Quarter | 4th Quarter 1981 | 68 | 62 | 61 | 63 1982 | 65 | 58 | 56 | 61 1983 | 68 | 63 | 63 | 67 1984 | 70 | 59 | 56 | 62 1985 | 60 | 55 | 51 | 58	**BTL -3**	**Applying**
4.	Take a four yearly moving average from the following data: Year: 1961 1962 1963 1964 1965 1966 1967 1968 1969 1970 Production ('000): 464 515 518 467 502 540 557 571 586 612	**BTL -5**	**Evaluating**
5.	Given below are the figures of production (in thousand quintals) of a sugar factory Year | 1974 | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 Production | 77 | 88 | 94 | 85 | 91 | 98 | 90 Fit a straight line by the least square method.	**BTL -3**	**Applying**
6.	From the following values prepare forecast by the method of exponential smoothing taking initial estimates as 100, the value of α = 0.4 and initial trend value zero. Time period (t): 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 Actual value (X): 104 108 118 115 120 155 123 123 128 130	**BTL -3**	**Applying**
7.	The following series of observations is known to have a business cycle with a period of 4 years. Find the trend values by the moving average method: Year | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 Production ('000)tons | 506 | 620 | 735 | 865 | 798 | 663 | 779	**BTL -3**	**Applying**
8.	Suppose we have the following series of n = 7 consecutive annual values: Year: 1 2 3 4 5 6 7	**BTL -3**	**Applying**

	Series	31	34	37	35	36	43	40	
	In developing a second – order autoregressive model for this series, demonstrate the comparisons that would to be made.								
9.	From the following data calculate seasonal indices by the Ratio to trend method.								**BTL -3**	**Applying**

Year	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
1994	60	80	72	68
1995	68	104	100	88
1996	80	116	108	96
1997	108	152	136	124
1998	160	184	172	164

10.	Given the numbers 2, 6, 1, 5, 3, 7, 2; write down the weighted moving average of period 3, the weights being 1, 4, 1.	**BTL -1**	**Remembering**
11.	Work out the centered4-year moving average for the following data:	**BTL -6**	**Creating**

Year	Tonnage of goods carried	Year	Tonnage of goods carried
1976	2204	1982	2904
1977	2500	1983	3098
1978	2360	1984	3172
1979	2680	1985	2952
1980	2424	1986	3248
1981	2634	1987	3172

12.	For the following series of observations, verify that the 6 year centered moving average is equivalent to a 7-year weighted moving average with weights 1, 2, 2, 2, 2, 2, 1 respectively.	**BTL -1**	**Remembering**

Year	Sales (in '000)	Year	Sales (in '000)
1970	2	1976	4
1971	4	1977	6
1972	3	1978	7
1973	6	1979	8
1974	7	1980	10
1975	9		

13.	Suppose the following data represent total revenues (in millions of constant 1995 dollars) by a ca rental agency over the 11 – year period 1987 – 1997: 4.0, 5.0, 7.0, 6.0, 8.0, 9.0, 5.0, 2.0, 3.5, 5.5, 6.5; compute the 5 – year moving averages for this annual time series.	**BTL -3**	**Applying**
14.	The data below give the average quarterly prices of a commodity for four years.	**BTL -1**	**Remembering**

Year	1991	1992	1993	1994	1995	1996	1997	1998
Annual sales (Rs.in crores)	36	43	43	34	44	54	34	24

15.	The following figures relate to the profits of a commercial concern for 8 years.								**BTL -1**	**Remembering**

Year	1976	1977	1978	1979	1980	1981	1982	1983

	Profit (Rs.) | 15,420 | 14,470 | 15,520 | 21,020 | 26,120 | 31,950 | 35,370 | 34,670 Find the trend of profits by calculating five year moving averages.		
16.	Take a five yearly moving average and determine short – term oscillations from the following data: Year | 1969 | 1970 | 1971 | 1972 | 1973 | 1974 | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 Production ('000) | 14 | 17 | 22 | 28 | 26 | 18 | 20 | 24 | 25 | 29 | 30 | 23	**BTL -5**	**Evaluating**
17.	Calculate the trend values by the method of least squares.Also Calculate the sales for the years 1999 and 2000 Year | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 Values | 125 | 128 | 133 | 135 | 140 | 141 | 143	**BTL -3**	**Remembering**
18.	Calculate 3-yearly moving average for the following data: Year | No.of. Workers | Year | No.of. Workers 1976 | 433 | 1982 | 463 1977 | 465 | 1983 | 498 1978 | 449 | 1984 | 488 1979 | 451 | 1985 | 484 1980 | 483 | 1986 | 510 1981 | 464 | 1987 | 500	**BTL -6**	**Creating**
	PART C		
1.	Find the trend of annual sales of a trading organization by Moving Average Method: Year | Annual Sales (Rs. In '000) | Year | Annual Sales (Rs. In '000) 1964 | 80 | 1974 | 84 1965 | 84 | 1975 | 96 1966 | 80 | 1976 | 92 1967 | 88 | 1977 | 104 1968 | 98 | 1978 | 116 1969 | 92 | 1979 | 112 1970 | 84 | 1980 | 102 1971 | 88 | 1981 | 114 1972 | 80 | 1982 | 108 1973 | 100 | 1983 | 126 (Use the most appropriate period of moving average)	**BTL -1**	**Remembering**

<table>
<tr><td>2.</td><td>With the following values for 11 years, prepare forecast by the method of exponential smoothing taking initial estimate as 100 and the value of α = 0.4, 1- α = 0.6 and 1 – α/α = 1.5.
<table>
<tr><td>Time period (t)</td><td>1979</td><td>1980</td><td>1981</td><td>1982</td><td>1983</td><td>1984</td><td>1985</td><td>1986</td><td>1987</td><td>1988</td><td>1989</td></tr>
<tr><td>Actual value (X)</td><td>110</td><td>105</td><td>120</td><td>116</td><td>121</td><td>123</td><td>120</td><td>125</td><td>126</td><td>124</td><td>122</td></tr>
</table></td><td>BTL -3</td><td>Applying</td></tr>
<tr><td>3.</td><td>Calculate five-yearly moving averages of number of students studying in a college from the following figures.
<table>
<tr><td>Year</td><td>1981</td><td>1982</td><td>1983</td><td>1984</td><td>1985</td></tr>
<tr><td>No. of Students</td><td>332</td><td>317</td><td>357</td><td>392</td><td>402</td></tr>
<tr><td>Year</td><td>1985</td><td>1986</td><td>1987</td><td>1988</td><td>1990</td></tr>
<tr><td>No. of Students</td><td>405</td><td>410</td><td>427</td><td>405</td><td>438</td></tr>
</table></td><td>BTL -3</td><td>Applying</td></tr>
<tr><td>4.</td><td>For the following data, verify that the 5 year weighted moving average with weights 1, 2, 3, 3, 1 respectively is equivalent to 4 year centered moving average.
<table>
<tr><td>Year</td><td>1979</td><td>1980</td><td>1981</td><td>1982</td><td>1983</td><td>1984</td><td>1985</td><td>1986</td><td>1987</td><td>1988</td><td>1989</td></tr>
<tr><td>Sales (Rs.in lakhs)</td><td>5</td><td>3</td><td>7</td><td>6</td><td>4</td><td>8</td><td>9</td><td>10</td><td>8</td><td>9</td><td>9</td></tr>
</table></td><td>BTL -5</td><td>Evaluating</td></tr>
<tr><td>5.</td><td>Calculate the trend values by the method of least squares. Calculate the profit for the year 1979.
<table>
<tr><td>Year</td><td>1971</td><td>1972</td><td>1973</td><td>1974</td><td>1975</td><td>1976</td></tr>
<tr><td>Profits</td><td>83</td><td>92</td><td>71</td><td>90</td><td>169</td><td>191</td></tr>
</table></td><td>BTL -3</td><td>Remembering</td></tr>
</table>

****