

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

MA3125 - ADVANCED MATHEMATICS FOR INDUSTRIAL SAFETY ENGINEERING

Regulation – 2023

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Prepared by

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VALLIAMMAI ENGINEERING COLLEGE (An Autonomous Institution)



SRM Nagar, Kattankulathur – 603 203.

DEPARTMENT OF MATHEMATICS QUESTION BANK

**SUBJECT: MA3125-ADVANCED MATHEMATICS FOR INDUSTRIAL SAFETY
ENGINEERING**

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

UNIT-I RANDOM VARIABLES AND DISTRIBUTIONS

Random variables – Probability function – Moments – Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions.

Q.No	Question	Bloom's Taxonomy Level	Domain	Course Outcome																
PART – A																				
1.	If the events A and B are independent then show that $\bar{A}$ and $\bar{B}$ are independent.	BTL -1	Remembering	CO 1																
2.	If A and B are events in S such that $P(A) = 1/3$, $P(B) = 1/4$ and $P(A \cup B) = 1/2$. Find $P(A \cap \bar{B})$ and $P(\bar{A} \cap B)$.	BTL -2	Understanding	CO 1																
3.	The number of hardware failures of a computer system in a week of operations has the following p.d.f, Calculate the value of K . <table><tr><td>No of failures</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td></tr><tr><td>probability</td><td>K</td><td>$2K$</td><td>$2K$</td><td>K</td><td>$3K$</td><td>K</td><td>$4K$</td></tr></table>	No of failures	0	1	2	3	4	5	6	probability	K	$2K$	$2K$	K	$3K$	K	$4K$	BTL -2	Understanding	CO 1
No of failures	0	1	2	3	4	5	6													
probability	K	$2K$	$2K$	K	$3K$	K	$4K$													
4.	The mean and variance of binomial distribution are 5 and 4 Find the distribution of X .	BTL -2	Understanding	CO 1																
5.	If the probability density function of a random variable X is $f(x) = \frac{1}{4}$ in $-2 < x < 2$ find $P(x > 1)$	BTL -2	Understanding	CO 1																
6.	The mean of Binomial distribution is 20 and standard deviation is 4. Find the parameters of the distribution.	BTL -2	Understanding	CO 1																
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 .	BTL -2	Understanding	CO 1																
8.	Find the Moment generating function of a continuous random variable X whose p.d.f is $f(x) = \begin{cases} xe^{x/2}, & x > 0 \\ 0, & x \leq 0 \end{cases}$	BTL -2	Understanding	CO 1																

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.	BTL -2	Understanding	CO 1														
10.	If a random variable X has the MGF $M_X(t) = \frac{2}{2-t}$. Find the standard deviation of X.	BTL -2	Understanding	CO 1														
11.	Show that the function $f(x) = \begin{cases} e^{-x}, & x \geq 0 \\ 0, & x < 0 \end{cases}$ is a probability density function of a continuous random variable X.	BTL -2	Understanding	CO 1														
12.	Show that the moment generating function of the uniform distribution $f(x) = \frac{1}{2a}$, $-a < x < a$ about origin is $\frac{\sinh(at)}{at}$.	BTL -1	Remembering	CO 1														
13.	If the MGF of a uniform distribution for a RV X is $\frac{1}{t}(e^{5t} - e^{4t})$. Find E(X).	BTL -2	Understanding	CO 1														
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?	BTL -1	Remembering	CO 1														
15.	Define Gamma distribution.	BTL -2	Understanding	CO 1														
16.	If X is a geometric variate, taking values 1, 2, 3... ∞ , find $P(X \text{ is odd})$	BTL -2	Understanding	CO 1														
17.	Write two characteristics of the Normal Distribution	BTL -1	Remembering	CO 1														
18.	State the memory less property of the exponential distribution.	BTL -1	Remembering	CO 1														
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?	BTL -1	Remembering	CO 1														
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?	BTL -1	Remembering	CO 1														
21.	Let X be a Uniformly distributed R. V. over [-3, 3].Determine $P(X \leq 2)$	BTL -2	Understanding	CO 1														
22.	Define Uniform distribution	BTL -1	Remembering	CO 1														
23.	Define Normal distribution	BTL -1	Remembering	CO 1														
24.	State any two properties of normal distribution	BTL -1	Remembering	CO 1														
25.	Suppose that X has a Poisson distribution with parameter $\lambda = 2$. Compute $P[X \geq 1]$.	BTL -2	Understanding	CO 1														
PART-B																		
1.	The probability mass function of a discrete R. V X is given in the following table:<table><tr><td>X</td><td>-2</td><td>-1</td><td>0</td><td>1</td><td>2</td><td>3</td></tr><tr><td>P(X=x)</td><td>0.1</td><td>k</td><td>0.2</td><td>2k</td><td>0.3</td><td>k</td></tr></table>Find (i) the value of k, (ii) $P(X<1)$, (iii) $P(-1< X \leq 2)$, (iv) E(X)	X	-2	-1	0	1	2	3	P(X=x)	0.1	k	0.2	2k	0.3	k	BTL -3	Applying	CO 1
X	-2	-1	0	1	2	3												
P(X=x)	0.1	k	0.2	2k	0.3	k												

2.	Find the MGF of Binomial distribution and hence find its mean and variance.	BTL -3	Applying	CO 1
3.	Find the moment generating function of a geometric random variable. Also find its mean and variance.	BTL -3	Applying	CO 1
4.	The probability distribution of an infinite discrete distribution is given by $P[X = j] = \frac{1}{2^j} \quad (j = 1, 2, 3, \dots)$ Find (1) Mean of X, (2) P [X is even], (3) P(X is odd)	BTL -3	Applying	CO 1
5.	Find the MGF of Poisson distribution and hence find its mean and variance.	BTL -3	Applying	CO 1
6.	Find the MGF of Uniform distribution and hence find its mean and variance.	BTL -3	Applying	CO 1
7.	If $f(x) = \begin{cases} ax, & 0 \leq x \leq 1 \\ a, & 1 \leq x \leq 2 \\ 3a - ax, & 2 \leq x \leq 3 \\ 0, & \text{elsewhere} \end{cases}$ is the p.d.f of X. Calculate (i) The value of a, (ii) The cumulative distribution function of X	BTL -4	Analyzing	CO 1
8.	A random variable X has c.d.f $F(x) = \begin{cases} 0, & \text{if } x < -1 \\ a(1+x), & \text{if } -1 < x < 1 \\ 1, & \text{if } x \geq 1 \end{cases}$ Find the value of a. Also $P(X > 1/4)$ and $P(-0.5 \leq X \leq 0)$.	BTL -4	Analyzing	CO 1
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 an 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	CO 1
10.	Find the MGF of Exponential distribution and hence find its mean and variance	BTL -4	Analyzing	CO 1
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	CO 1
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 -3	Applying	CO 1
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	CO 1
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 $\lambda = \frac{1}{2}$ 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 -4	Analyzing	CO 1

14.	The Probability distribution function of a R.V. X is given by $f(x) = \frac{4x(9 - x^2)}{81}$, $0 \leq x \leq 3$. Find the mean, variance and 3 rd moment about origin.	BTL -3	Applying	CO 1																		
15.	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 -4	Analyzing	CO 1																		
16.	A random variable X has the following probability distribution: <table border="1"><tr><td>X</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td></tr><tr><td>P(X)</td><td>0</td><td>k</td><td>2 k</td><td>2 k</td><td>3 k</td><td>k²</td><td>2k²</td><td>7k²+k</td></tr></table> Find (i) the value of k (ii) P(1.5 < X < 4.5)	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	BTL -4	Analyzing	CO 1
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														
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	CO 1																		
18.	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.	BTL -4	Analyzing	CO 1																		

UNIT II - ESTIMATION THEORY

Estimators: Unbiasedness, Consistency, Efficiency and sufficiency – Maximum likelihood estimation – Method of moments.

Q. No.	Question	BT Level	Competence	
PART – A				
1.	Define estimator.	BTL -1	Remembering	CO 2
2.	Define estimation	BTL -2	Understanding	CO 2
3.	Mention the properties of a good estimator.	BTL -2	Understanding	CO 2
4.	Define confidence coefficient.	BTL -1	Remembering	CO 2
5.	What is the level of significance in testing of hypothesis?	BTL -2	Understanding	CO 2
6.	Define confidence limits for a parameter.	BTL -1	Remembering	CO 2
7.	State the conditions under which a binomial distribution becomes a normal distribution.	BTL -2	Understanding	CO 2

8.	Explain how do you calculate 95% confidence interval for the average of the population?	BTL -1	Remembering	CO 2												
9.	Define negatively biased.	BTL -2	Understanding	CO 2												
10.	Distinguish between point estimation.	BTL -1	Remembering	CO 2												
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 -1	Remembering	CO 2												
12.	State any two properties of regression lines.	BTL -1	Remembering	CO 2												
13.	Define unbiasedness of a good estimator.	BTL -2	Understanding	CO 2												
14.	Write the normal equations for fitting a straight line by the method of least squares.	BTL -1	Remembering	CO 2												
15.	What are the merits and demerits of the least square method.	BTL -2	Understanding	CO 2												
16.	Find the maximum likelihood estimates for the population mean when the population variance is known for random sampling from a normal population.	BTL -2	Understanding	CO 2												
17.	Define positively biased.	BTL -2	Understanding	CO 2												
18.	Give the normal equations to fit the parabola $y = a + bx + cx^2$	BTL -1	Remembering	CO 2												
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 -1	Remembering	CO 2												
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 -1	Remembering	CO 2												
21.	Define estimate	BTL -2	Understanding	CO 2												
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 -1	Remembering	CO 2												
23.	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 -2	Understanding	CO 2												
24.	What is meant by maximum likelihood estimator ?	BTL -1	Remembering	CO 2												
25.	Define interval estimation	BTL -2	Understanding	CO 2												
PART –B																
1(a).	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 -3	Applying	CO 2												
1(b).	Find the regression line of Y on X for the data <table><tr><td>x</td><td>1</td><td>4</td><td>2</td><td>3</td><td>5</td></tr><tr><td>y</td><td>3</td><td>1</td><td>2</td><td>5</td><td>4</td></tr></table>	x	1	4	2	3	5	y	3	1	2	5	4	BTL -3	Applying	CO 2
x	1	4	2	3	5											
y	3	1	2	5	4											
2.	Find the most likely price in Bombay corresponding to the price of Rs. 70 at Calcutta from the following :	BTL -3	Applying	CO 2												

	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.																							
3.	Fit a straight line $y = a + bx$ to the following data, using principle of least squares x : 1 2 3 4 6 8 y : 2.4 3 3.6 4 5 6	BTL -3	Applying	CO 2																				
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	CO 2																				
5.	In random sampling from normal population $N(\mu, \sigma^2)$, find the maximum likelihood estimator for μ when σ^2 is unknown.	BTL -3	Applying	CO 2																				
6.	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 -4	Analyzing	CO 2																				
7.	Let $x_1, x_2, \dots, x_n$ be a random sample from uniform population on $[0, \theta]$. Find a sufficient estimator for θ . Show that for a rectangular population $f(x, \theta) = 1/\theta, 0 < x < \theta$ Find the maximum likelihood estimator for θ .	BTL -4	Analyzing	CO 2																				
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 -3	Applying	CO 2																				
9.	Obtain the lines of regression <table><tr><td>X</td><td>50</td><td>55</td><td>50</td><td>60</td><td>65</td><td>65</td><td>65</td><td>60</td><td>60</td></tr><tr><td>Y</td><td>11</td><td>14</td><td>13</td><td>16</td><td>16</td><td>15</td><td>15</td><td>14</td><td>13</td></tr></table>	X	50	55	50	60	65	65	65	60	60	Y	11	14	13	16	16	15	15	14	13	BTL -4	Analyzing	CO 2
X	50	55	50	60	65	65	65	60	60															
Y	11	14	13	16	16	15	15	14	13															
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. <table><tr><td>x</td><td>1993</td><td>1994</td><td>1995</td><td>1996</td><td>1997</td><td>1998</td></tr><tr><td>y</td><td>100</td><td>107</td><td>128</td><td>140</td><td>181</td><td>192</td></tr></table>	x	1993	1994	1995	1996	1997	1998	y	100	107	128	140	181	192	BTL -3	Applying	CO 2						
x	1993	1994	1995	1996	1997	1998																		
y	100	107	128	140	181	192																		
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 University Marks : 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 -3	Applying	CO 2																				
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 $\bar{x}$ is sufficient for estimating the parameter λ of the poisson distribution.	BTL -3	Applying	CO 2																				
13.	Fit a straight line $y = ax + c$ to the following data. <table><tr><td>X</td><td>1</td><td>3</td><td>5</td><td>7</td><td>9</td><td>11</td><td>13</td><td>15</td><td>17</td></tr><tr><td>y</td><td>10</td><td>15</td><td>20</td><td>27</td><td>31</td><td>35</td><td>30</td><td>35</td><td>40</td></tr></table>	X	1	3	5	7	9	11	13	15	17	y	10	15	20	27	31	35	30	35	40	BTL -4	Analyzing	CO 2
X	1	3	5	7	9	11	13	15	17															
y	10	15	20	27	31	35	30	35	40															
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 .	BTL -3	Applying	CO 2																				

	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 .																					
15.	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 $x = 70$ <table><tr><td>X</td><td>71</td><td>68</td><td>73</td><td>69</td><td>67</td><td>65</td><td>66</td><td>67</td></tr><tr><td>y</td><td>69</td><td>72</td><td>70</td><td>70</td><td>68</td><td>67</td><td>68</td><td>64</td></tr></table>	X	71	68	73	69	67	65	66	67	y	69	72	70	70	68	67	68	64	BTL -4	Analyzing	CO 2
X	71	68	73	69	67	65	66	67														
y	69	72	70	70	68	67	68	64														
16.	For the double poisson distribution $P(X = x) = \frac{1}{2} \frac{e^{-m_1} m_1^x}{x!} + \frac{1}{2} \frac{e^{-m_2} m_2^x}{x!}$, $x = 0, 1, 2, \dots$ 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	CO 2																		
17.	Fit the model $y = ax^b$ to the following data. <table><tr><td>X</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td></tr><tr><td>y</td><td>2.98</td><td>4.26</td><td>5.21</td><td>6.10</td><td>6.80</td><td>7.50</td></tr></table>	X	1	2	3	4	5	6	y	2.98	4.26	5.21	6.10	6.80	7.50	BTL -3	Applying	CO 2				
X	1	2	3	4	5	6																
y	2.98	4.26	5.21	6.10	6.80	7.50																
18.	Fit an equation of the form $y = ab^x$ to the following data <table><tr><td>x</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td></tr><tr><td>y</td><td>144</td><td>172.8</td><td>207.4</td><td>248.8</td><td>298.5</td></tr></table>	x	2	3	4	5	6	y	144	172.8	207.4	248.8	298.5	BTL -4	Analyzing	CO 2						
x	2	3	4	5	6																	
y	144	172.8	207.4	248.8	298.5																	

UNIT III -TESTING OF HYPOTHESIS

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

PART – A

Q. No.	Question	BT Level	Competence	
1.	What are the parameters and statistics in sampling	BTL -1	Remembering	CO 3
2.	Mention the various steps involved in testing of hypothesis	BTL -2	Understanding	CO 3
3.	Define the following terms Standard error	BTL -2	Understanding	CO 3
4.	What is the essential difference between confidence limits and tolerance limits?	BTL -1	Remembering	CO 3
5.	What are null and alternate hypothesis?	BTL -2	Understanding	CO 3
6.	State level of significance.	BTL -1	Remembering	CO 3
7.	State the applications of Z-test.	BTL -2	Understanding	CO 3
8.	A sample of size 13 gave an estimated population variance of 3.0 while another sample of size 15 gave an estimate of 2.5. Could both samples be from populations with the same variance?	BTL -1	Remembering	CO 3
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	BTL -2	Understanding	CO 3

	random sample of 1600 school boys had some defect. Is the difference between the proportions significant?							
10.	When does the Z-test apply?	BTL -1	Remembering	CO 3				
11.	Write down the formula of test statistic‘t’ to test the significance of difference between the means.	BTL -1	Remembering	CO 3				
12.	What are the applications of t-test?	BTL -1	Remembering	CO 3				
13.	What is the assumption of t-test?	BTL -2	Understanding	CO 3				
14.	Write the application of ‘F’ test.	BTL -1	Remembering	CO 3				
15.	Define ‘F’ variate.	BTL -2	Understanding	CO 3				
16.	What are the properties of “F” test?	BTL -2	Understanding	CO 3				
17.	State any two applications of ψ^2 -test.	BTL -2	Understanding	CO 3				
18.	Write the formula for the chi- square test of goodness of fit of a random sample to a hypothetical distribution.	BTL -1	Remembering	CO 3				
19.	Give the main use of ψ^2 -test	BTL -1	Remembering	CO 3				
20.	Write the properties of t-distribution?	BTL -1	Remembering	CO 3				
21.	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	CO 3				
22.	What are the conditions for Large samples?	BTL -1	Remembering	CO 3				
23.	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	CO 3				
24.	What are the conditions for small samples?	BTL -1	Remembering	CO 3				
25.	What are the expected frequencies of 2x2 contingency table? <table border="1"><tr><td>a</td><td>b</td></tr><tr><td>c</td><td>d</td></tr></table>	a	b	c	d	BTL -2	Understanding	CO 3
a	b							
c	d							
PART – B								
1.	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.	BTL -3	Applying	CO 3				
2.	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	BTL -3	Applying	CO 3				

	Can it be said that this samples where from normal population with the same mean.																									
3.	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.	BTL -3	Applying	CO 3																						
4.	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>Mo n</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>	Days	Sun	Mo n	Tues	Wed	Thu	Fri	Sat	No. of accidents	14	16	08	12	11	9	14	BTL -3	Applying	CO 3						
Days	Sun	Mo n	Tues	Wed	Thu	Fri	Sat																			
No. of accidents	14	16	08	12	11	9	14																			
5.	Two independent samples of 8 and 7 items respectively had the <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> 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.	Sample I	9	11	13	11	15	9	12	14	Sample II	10	12	10	14	9	8	10		BTL -3	Applying	CO 3				
Sample I	9	11	13	11	15	9	12	14																		
Sample II	10	12	10	14	9	8	10																			
6.	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)	Diet A	5	6	8	1	12	4	3	9	6	10	Diet B	2	3	6	8	10	1	2	8	-	-	BTL -3	Applying	CO 3
Diet A	5	6	8	1	12	4	3	9	6	10																
Diet B	2	3	6	8	10	1	2	8	-	-																
7.	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>	Sample I	19	17	15	21	16	18	16	14	Sample II	15	14	15	19	15	18	16		BTL -4	Analyzing	CO 3				
Sample I	19	17	15	21	16	18	16	14																		
Sample II	15	14	15	19	15	18	16																			
8.	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 $p = \frac{1}{2} = q$.	BTL -4	Analyzing	CO 3																						
9.	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?		Type I	Type II	Sample Size	8	7	Sample Mean	1234hrs	1036hrs	Sample S.D	36hrs	40hrs	BTL -3	Applying	CO 3										
	Type I	Type II																								
Sample Size	8	7																								
Sample Mean	1234hrs	1036hrs																								
Sample S.D	36hrs	40hrs																								

10.	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?	BTL -4	Analyzing	CO 3																
11.	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.	Selectivity	Low	Average	High	Low	6	12	32	Average	33	61	18	High	13	15	0	BTL -3	Applying	CO 3
Selectivity	Low	Average	High																	
Low	6	12	32																	
Average	33	61	18																	
High	13	15	0																	
12.	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.	Sample	Size	Sample mean	Sum of squares of deviation from the mean	1	10	15	90	2	12	14	108	BTL -3	Applying	CO 3				
Sample	Size	Sample mean	Sum of squares of deviation from the mean																	
1	10	15	90																	
2	12	14	108																	
13.	A certain medicine administered to each of 10 patients resulted in the 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	BTL -3	Applying	CO 3																
14.	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.	BTL -4	Analyzing	CO 3																
15.	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?	Number of persons	Drug	No drug	Total	Cured	65	55	120	Not cured	35	45	80	Total	100	100	200	BTL -3	Applying	CO 3
Number of persons	Drug	No drug	Total																	
Cured	65	55	120																	
Not cured	35	45	80																	
Total	100	100	200																	
16.	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?	BTL -4	Analyzing	CO 3																
17.	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></table>		Place A	Place B	Mean height (in inches)	68.50	65.50	BTL -4	Analyzing	CO 3										
	Place A	Place B																		
Mean height (in inches)	68.50	65.50																		

	S.D (in inches)	2.5	3.0			
	No. of adult males in sample	1200	1500			
	Test at 5 % level, that the mean height is the same for adults in the two places.					
18.	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?			BTL -3	Applying	CO 3

UNIT IV-DESIGN OF EXPERIMENTS

Analysis of variance – Completely randomized design – Randomized block design – Latin square design.

PART – A				
Q. No.	Question	BT Level	Competence	
1.	Define Randomization	BTL -1	Remembering	CO 4
2.	Define Replication.	BTL -2	Understanding	CO 4
3.	Define Local control.	BTL -2	Understanding	CO 4
4.	What is the aim of design of experiments?	BTL -1	Remembering	CO 4
5.	Write the basic assumptions in analysis of variance.	BTL -2	Understanding	CO 4
6.	When do you apply analysis of variance technique?	BTL -1	Remembering	CO 4
7.	What is meant by tolerance limits?	BTL -2	Understanding	CO 4
8.	What is a completely randomized design.	BTL -1	Remembering	CO 4
9.	Explain the advantages of a Latin square design?	BTL -2	Understanding	CO 4
10.	What are the basic elements of an Completely Randomized Experimental Design?	BTL -1	Remembering	CO 4
11.	Demonstrate the purpose of blocking in a randomized block design?	BTL -1	Remembering	CO 4
12.	Manipulate the Basic principles of the design of experiment?	BTL -1	Remembering	CO 4
13.	Why a 2x2 Latin square is not possible? Explain.	BTL -2	Understanding	CO 4
14.	Analyze the advantages of the Latin square design over the other design.	BTL -1	Remembering	CO 4
15.	Demonstrate main advantage of Latin square Design over Randomized Block Design?	BTL -2	Understanding	CO 4
16.	Write any two differences between RBD and LSD.	BTL -2	Understanding	CO 4
17.	What is ANOVA?	BTL -2	Understanding	CO 4

18.	What are the uses of ANOVA?	BTL -1	Remembering	CO 4
19.	Define experimental error.	BTL -1	Remembering	CO 4
20.	What is the Degree is of freedom by one way classification.	BTL -1	Remembering	CO 4
21.	Explain SSB and SSW in ANOVA.	BTL -2	Understanding	CO 4
22.	What is the advantages of CRD?	BTL -1	Remembering	CO 4
23.	What is RBD?	BTL -2	Understanding	CO 4
24.	What is the disadvantages of RBD?	BTL -1	Remembering	CO 4
25.	Write any two differences between RBD and CRD.	BTL -2	Understanding	CO 4

PART-B

1.	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> <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>	A	B	C	5	8	7	6	10	3	8	11	5	9	12	4	7	4	1	BTL -3	Applying	CO 4											
A	B	C																															
5	8	7																															
6	10	3																															
8	11	5																															
9	12	4																															
7	4	1																															
2.	Perform a 2-way ANOVA on the data given below: <table> <tr> <td colspan="2" rowspan="2"></td> <td colspan="3">Treatment 1</td> </tr> <tr> <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> Use the coding method subtracting 30 from the given no.			Treatment 1			1	2	3	Treatment 2	1	30	26	38	2	24	29	28	3	33	24	35	4	36	31	30	5	27	35	33	BTL -3	Applying	CO 4
				Treatment 1																													
		1	2	3																													
Treatment 2	1	30	26	38																													
	2	24	29	28																													
	3	33	24	35																													
	4	36	31	30																													
	5	27	35	33																													
3.	The accompanying data resulted from an experiment comparing the degree of soiling for fabric copolymerized with the 3 different mixtures of met acrylic acid. Analyze the classification. Mixture 1 : 0.56 1.12 0.90 1.07 0.94 Mixture 2 : 0.72 0.69 0.87 0.78 0.91 Mixture 3 : 0.62 1.08 1.07 0.99 0.93	BTL -3	Applying	CO 4																													

4.	Five doctors each test five treatments for a certain disease and observe the number of days each patient takes to recover. The results are as follows (recovery time in days) <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.		Treatment					Doctor	1	2	3	4	5	A	10	14	23	18	20	B	11	15	24	17	21	C	9	12	20	16	19	D	8	13	17	17	20	E	12	15	19	15	22	BTL -3	Applying	CO 4
	Treatment																																													
Doctor	1	2	3	4	5																																									
A	10	14	23	18	20																																									
B	11	15	24	17	21																																									
C	9	12	20	16	19																																									
D	8	13	17	17	20																																									
E	12	15	19	15	22																																									
5.	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.		Salesmen				Season	1	2	3	4	Summer	45	40	28	37	Winter	43	41	45	38	Monsoon	39	39	43	41	BTL -3	Applying	CO 4																	
	Salesmen																																													
Season	1	2	3	4																																										
Summer	45	40	28	37																																										
Winter	43	41	45	38																																										
Monsoon	39	39	43	41																																										
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 <table><tr><td colspan="2"></td><td colspan="5">BOLT</td></tr><tr><td colspan="2"></td><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 5% level of significance.			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	BTL -3	Applying	CO 4			
		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																																								
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 <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></table>	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	BTL -4	Analyzing	CO 4												
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. <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.						A 16	B 17	C 20	B 16	C 21	A 15	C 15	A 12	B 13	BTL -4	Analyzing	CO 4							
A 16	B 17	C 20																							
B 16	C 21	A 15																							
C 15	A 12	B 13																							
9.	A farmer wishes to test the effects of four different fertilizers A,B,C,D on 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 $\alpha = 0.05$ levels of significance.						A18	C21	D25	B11	D22	B12	A15	C19	B15	A20	C23	D24	C22	D21	B10	A17	BTL -3	Applying	CO 4
A18	C21	D25	B11																						
D22	B12	A15	C19																						
B15	A20	C23	D24																						
C22	D21	B10	A17																						
10.	Set up the analysis of variance for the following results of a Latin Square Design <table><tr><td>A12</td><td>C19</td><td>B10</td><td>D8</td></tr><tr><td>C18</td><td>B12</td><td>D6</td><td>A7</td></tr><tr><td>B22</td><td>D10</td><td>A5</td><td>C21</td></tr><tr><td>D12</td><td>A7</td><td>C27</td><td>B17</td></tr></table>						A12	C19	B10	D8	C18	B12	D6	A7	B22	D10	A5	C21	D12	A7	C27	B17	BTL -4	Analyzing	CO 4
A12	C19	B10	D8																						
C18	B12	D6	A7																						
B22	D10	A5	C21																						
D12	A7	C27	B17																						
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 -3	Applying	CO 4																
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	CO 4																
13.	Find out the main effects and interaction effects in the following 2^2 factorial experiment and write down the analysis of variance table <table><tr><td>BLOCKS</td><td>(1)</td><td>a</td><td>b</td><td>ab</td></tr><tr><td></td><td>00</td><td>10</td><td>01</td><td>11</td></tr></table>						BLOCKS	(1)	a	b	ab		00	10	01	11	BTL -3	Applying	CO 4						
BLOCKS	(1)	a	b	ab																					
	00	10	01	11																					

		I	64	25	30	60																												
		II	75	14	50	33																												
		III	76	12	41	17																												
		IV	75	33	25	10																												
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	CO 4																								
15.	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>								Variety			Treatment	1	2	3	1	8	10	12	2	2	6	7	3	4	10	9	4	3	5	9	BTL -3	Applying	CO 4
	Variety																																	
Treatment	1	2	3																															
1	8	10	12																															
2	2	6	7																															
3	4	10	9																															
4	3	5	9																															
16.	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>							Machines	A	8	9	11	12	B	6	8	10	4	C	14	12	18	9	D	20	22	25	23	BTL -4	Analyzing	CO 4			
Machines	A	8	9	11	12																													
	B	6	8	10	4																													
	C	14	12	18	9																													
	D	20	22	25	23																													
17.	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 $\alpha = 0.01$. <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></table>							Technician				I	II	III	IV	6	14	10	9	14	9	12	12	10	12	7	8	8	10	15	10	BTL -4	Analyzing	CO 4
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			
18.	A completely randomized design experiment with 10 plots and 3 treatments gave the results given below. Analyze the results for the effects of treatments.					BTL -3	Applying	CO 4
	Treatem et	Replications						
	A	5	7	1	3			
	B	4	4	7				
	C	3	1	5				

UNIT V- 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	CO 5
2.	Define Secular trend.	BTL -2	Understanding	CO 5
3.	Describe the limitation of time series	BTL -2	Understanding	CO 5
4.	Define weighted moving average	BTL -1	Remembering	CO 5
5.	Name any three forecasting methods used in time series analysis	BTL -2	Understanding	CO 5
6.	Write the limitation of method of moving average	BTL -1	Remembering	CO 5
7.	Mention any two models of Time Series.	BTL -2	Understanding	CO 5
8.	Describe the types of forecasting	BTL -1	Remembering	CO 5
9.	Write 1 st order autoregressive model	BTL -2	Understanding	CO 5
10.	Define exponential smoothing	BTL -1	Remembering	CO 5
11.	Mention the limits of exponential smoothing	BTL -1	Remembering	CO 5
12.	Write any two merits of method of moving average	BTL -1	Remembering	CO 5
13.	Mention the four basic components of a time series	BTL -2	Understanding	CO 5
14.	What are the methods used to Cyclical variations	BTL -1	Remembering	CO 5
15.	Write the uses of time series	BTL -2	Understanding	CO 5
16.	What adjustments need to be in time series	BTL -2	Understanding	CO 5

17.	What is moving average	BTL -2	Understanding	CO 5
18.	Mention the points indicate time series	BTL -1	Remembering	CO 5
19.	Describe the merits of exponential smoothing	BTL -1	Remembering	CO 5
20.	Mention the types of methods used to measure the trend	BTL -1	Remembering	CO 5
21.	Define Cyclical variations	BTL -2	Understanding	CO 5
22.	What are the merits of ratio to moving average method?	BTL -1	Remembering	CO 5
23.	Write any two steps involved in auto regressive modeling	BTL -2	Understanding	CO 5
24.	Mention the causes for random variation in a time series	BTL -1	Remembering	CO 5
25.	Define Irregular Variations	BTL -2	Understanding	CO 5

PART – B

1.	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:							BTL -3	Applying	CO 5				
	Year	1989	1990	1991	1992	1993	1994				1995			
	Production ('000)tons	506	620	735	865	798	663				779			
2.	Suppose we have the following series of n = 7 consecutive annual values:							BTL -3	Applying	CO 5				
	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.														
3.	From the following data calculate seasonal indices by the Ratio to Moving Average method.							BTL -3	Applying	CO 5				
	Year	1 st Quarter		2 nd Quarter		3 rd Quarter					4 th 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			
4.	Take a four yearly moving average from the following data:										BTL -3	Applying	CO 5	
	Year	1961	1962	1963	1964	1965	1966	1967	1968	1969				1970
	Production ('000)	4644	5156	518	467	502	540	557	571	586				612
5.	Given below are the figures of production (in thousand quintals) of a sugar factory							BTL -3	Applying	CO 5				

	<table><tr><td>Year</td><td>1974</td><td>1975</td><td>1976</td><td>1977</td><td>1978</td><td>1979</td><td>1980</td></tr><tr><td>Production</td><td>77</td><td>88</td><td>94</td><td>85</td><td>91</td><td>98</td><td>90</td></tr></table> Fit a straight line by the least square method.	Year	1974	1975	1976	1977	1978	1979	1980	Production	77	88	94	85	91	98	90															
Year	1974	1975	1976	1977	1978	1979	1980																									
Production	77	88	94	85	91	98	90																									
6.	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>	Year	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	Sales (Rs.in lakhs)	5	3	7	6	4	8	9	10	8	9	9	BTL -3	Applying	CO 5				
Year	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989																					
Sales (Rs.in lakhs)	5	3	7	6	4	8	9	10	8	9	9																					
7.	Calculate three yearly moving average of the following data <table><tr><td>Year</td><td>1971</td><td>1972</td><td>1973</td><td>1974</td><td>1975</td><td>1976</td><td>1977</td><td>1978</td><td>1979</td><td>1980</td></tr><tr><td>No. of students</td><td>15</td><td>18</td><td>17</td><td>20</td><td>23</td><td>25</td><td>29</td><td>33</td><td>36</td><td>40</td></tr></table>	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 -4	Analyzing	CO 5						
Year	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980																						
No. of students	15	18	17	20	23	25	29	33	36	40																						
8.	Suppose we have the following series of n = 7 consecutive annual values: <table><tr><td colspan="8">Year</td></tr><tr><td></td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td></tr><tr><td>Series</td><td>31</td><td>34</td><td>37</td><td>35</td><td>36</td><td>43</td><td>40</td></tr></table> In developing a second – order autoregressive model for this series, demonstrate the comparisons that would to be made.	Year									1	2	3	4	5	6	7	Series	31	34	37	35	36	43	40	BTL -4	Analyzing	CO 5				
Year																																
	1	2	3	4	5	6	7																									
Series	31	34	37	35	36	43	40																									
9.	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>	Year	1971	1972	1973	1974	1975	1976	Profits	83	92	71	90	169	191	BTL -3	Applying	CO 5														
Year	1971	1972	1973	1974	1975	1976																										
Profits	83	92	71	90	169	191																										
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 -4	Analyzing	CO 5																												
11.	Work out the centered 4-year moving average for the following data: <table><tr><td>Year</td><td>Tonnage of goods carried</td><td>Year</td><td>Tonnage of goods carried</td></tr><tr><td>1976</td><td>2204</td><td>1982</td><td>2904</td></tr><tr><td>1977</td><td>2500</td><td>1983</td><td>3098</td></tr><tr><td>1978</td><td>2360</td><td>1984</td><td>3172</td></tr><tr><td>1979</td><td>2680</td><td>1985</td><td>2952</td></tr><tr><td>1980</td><td>2424</td><td>1986</td><td>3248</td></tr><tr><td>1981</td><td>2634</td><td>1987</td><td>3172</td></tr></table>	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	BTL -3	Applying	CO 5
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. <table><tr><td>Year</td><td>Sales (in ‘000)</td><td>Year</td><td>Sales (in ‘000)</td></tr><tr><td>1970</td><td>2</td><td>1976</td><td>4</td></tr></table>	Year	Sales (in ‘000)	Year	Sales (in ‘000)	1970	2	1976	4	BTL -3	Applying	CO 5																				
Year	Sales (in ‘000)	Year	Sales (in ‘000)																													
1970	2	1976	4																													

	<table><tr><td>1971</td><td>4</td><td>1977</td><td>6</td></tr><tr><td>1972</td><td>3</td><td>1978</td><td>7</td></tr><tr><td>1973</td><td>6</td><td>1979</td><td>8</td></tr><tr><td>1974</td><td>7</td><td>1980</td><td>10</td></tr><tr><td>1975</td><td>9</td><td></td><td></td></tr></table>	1971	4	1977	6	1972	3	1978	7	1973	6	1979	8	1974	7	1980	10	1975	9											
1971	4	1977	6																											
1972	3	1978	7																											
1973	6	1979	8																											
1974	7	1980	10																											
1975	9																													
13.	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>	Year	1981	1982	1983	1984	1985	No. of Students	332	317	357	392	402	Year	1985	1986	1987	1988	1990	No. of Students	405	410	427	405	438	BTL -3	Applying	CO 5		
Year	1981	1982	1983	1984	1985																									
No. of Students	332	317	357	392	402																									
Year	1985	1986	1987	1988	1990																									
No. of Students	405	410	427	405	438																									
14.	The data below give the average quarterly prices of a commodity for four years. <table><tr><td>Year</td><td>1991</td><td>1992</td><td>1993</td><td>1994</td><td>1995</td><td>1996</td><td>1997</td><td>1998</td></tr><tr><td>Annual sales (Rs.in crores)</td><td>36</td><td>43</td><td>43</td><td>34</td><td>44</td><td>54</td><td>34</td><td>24</td></tr></table>	Year	1991	1992	1993	1994	1995	1996	1997	1998	Annual sales (Rs.in crores)	36	43	43	34	44	54	34	24	BTL -4	Analyzing	CO 5								
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. <table><tr><td>Year</td><td>1976</td><td>1977</td><td>1978</td><td>1979</td><td>1980</td><td>1981</td><td>1982</td><td>1983</td></tr><tr><td>Profit (Rs.)</td><td>15,420</td><td>14,470</td><td>15,520</td><td>21,020</td><td>26,120</td><td>31,950</td><td>35,370</td><td>34,670</td></tr></table> Find the trend of profits by calculating five year moving averages.	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	BTL -3	Applying	CO 5								
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																						
16.	Take a five yearly moving average and determine short – term oscillations from the following data: <table><tr><td>Year</td><td>1969</td><td>1970</td><td>1971</td><td>1972</td><td>1973</td><td>1974</td><td>1975</td><td>1976</td><td>1977</td><td>1978</td><td>1979</td><td>1980</td></tr><tr><td>Production ('000)</td><td>14</td><td>17</td><td>22</td><td>28</td><td>26</td><td>18</td><td>20</td><td>24</td><td>25</td><td>29</td><td>30</td><td>23</td></tr></table>	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 -4	Analyzing	CO 5
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																		
17.	Calculate the trend values by the method of least squares.Also Calculate the sales for the years 1999 and 2000 <table><tr><td>Year</td><td>1991</td><td>1992</td><td>1993</td><td>1994</td><td>1995</td><td>1996</td><td>1997</td></tr><tr><td>Values</td><td>125</td><td>128</td><td>133</td><td>135</td><td>140</td><td>141</td><td>143</td></tr></table>	Year	1991	1992	1993	1994	1995	1996	1997	Values	125	128	133	135	140	141	143	BTL -4	Analyzing	CO 5										
Year	1991	1992	1993	1994	1995	1996	1997																							
Values	125	128	133	135	140	141	143																							
18.	Calculate 3-yearly moving average for the following data: <table><tr><td>Year</td><td>No.of. Workers</td><td>Year</td><td>No.of. Workers</td></tr><tr><td>1976</td><td>433</td><td>1982</td><td>463</td></tr><tr><td>1977</td><td>465</td><td>1983</td><td>498</td></tr><tr><td>1978</td><td>449</td><td>1984</td><td>488</td></tr><tr><td>1979</td><td>451</td><td>1985</td><td>484</td></tr></table>	Year	No.of. Workers	Year	No.of. Workers	1976	433	1982	463	1977	465	1983	498	1978	449	1984	488	1979	451	1985	484	BTL -3	Applying	CO 5						
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			

