

12 a) A study conducted a year back claims that the high school students spend on average 11 hours per week on internet. From a sample of 100 students studied recently found that they spend on average 9 hours per week on internet with a standard deviation of 2.2 hours.

- i) Test the hypotheses that the current students spend less than 11 hours on internet. Use $\alpha = 0.05$.
- ii) What is the p-value for the test?
- iii) Determine the 95% confidence interval for the mean time.

(OR)

b) A chemical engineer has conducted an experiment to study the effect of temperature and pressure on the reaction time of a chemical process. The two factors were investigated at three levels. The following data were obtained from two replications. Analyse the data and draw conclusions.

Pressure (MPa)	Temperature ($^{\circ}\text{C}$)		
	100	120	140
100	23	31	36
	25	32	39
110	35	34	31
	36	35	34
120	28	27	26
	27	25	24

13 a) An experiment was performed to improve the yield of a chemical process. Three factors were selected, and two replicates of a completely randomized experiment were run. The results are shown in the following table:

Treatment Combinatio	Replicat I	Replicat II
(1)	90	93
<i>a</i>	74	78
<i>b</i>	81	85
<i>ab</i>	83	80
<i>c</i>	77	78
<i>ac</i>	81	80
<i>bc</i>	88	82
<i>abc</i>	73	70

Set up a scheme for confounding ABC in both the replications and Perform Analysis of variance to identify the significant effects

(OR)

- b) An engineer has used a 2^{5-2} design to investigate the effects of $A =$ condensation, $B =$ amount of material 1, $C =$ solvent volume, $D =$ condensation time, and $E =$ amount of material 2 on yield. The results obtained are as follows:

$e = 23.2$	$ad = 16.9$	$cd = 23.8$	$bde = 16.8$
$ab = 15.5$	$bc = 16.2$	$ace = 23.4$	$abcde = 18.1$

- Verify that the design generators used were $I = ACE$ and $I = BDE$.
- Write down the complete defining relation and aliases for this design.

- 14 a) A customer wants to compare the life of electric bulbs of four different brands (A,B,C and D) of same wattage and price. The output characteristic for life (Y_0) = 1000 hours and the consumer loss $A_0 =$ Rs. 10/-. The data on the life of bulbs has been obtained for the four brands which are shown below. Which brand would you recommend based on quality loss?

Data on life of bulbs

A	800	850	900	750	950	700	800	750	900	800
B	950	750	850	900	700	790	800	790	900	950
C	860	650	780	920	880	780	910	820	650	750
D	750	690	880	870	810	910	750	780	680	900

(OR)

- An experimenter wants to study the effect of five main factors A,B,C,D, and E each at two levels and two factor interactions AC, BC, AD, AE, BD, and BE. Design an OA experiment.
- In an experiment with four factors, two factors A and B has to be studied at three levels and factors C and D at two levels. Design an OA experiment.

- 15 a) An experiment was conducted to improve the contact resistance of wire wound resistors. Four factors each at three levels has been studied using L_9 OA. The objective is to maximize the resistance. The data collected are shown below.

Trial No.	Col.	1	2	3	4	Response		
		A	B	C	D	Rep1	Rep2	Rep3
1		1	1	1	1	24	21	20
2		1	2	2	2	20	22	21
3		1	3	3	3	22	21	20
4		2	1	2	3	21	20	22
5		2	2	3	1	17	19	18
6		2	3	1	2	16	18	17
7		3	1	3	2	14	12	13
8		3	2	2	3	18	19	17
9		3	3	1	1	20	17	19

Identify the significant effects using Response graph method.

(OR)

b) Analyze the data by computing S/N ratios and identify the optimal levels for the factors.