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Total No. of Pages : 03

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**B.Tech. (Ind. Engg. & Mgt.) (Spl. in TQM) PT (Sem.-7)****ADVANCED QUALITY TOOLS**

Subject Code : IEM-751

M.Code : 71698

Time : 3 Hrs.

Max. Marks : 40

**INSTRUCTIONS TO CANDIDATES :**

1. Attempt EIGHT out of TEN questions from SECTION-A carrying TWO marks each.
2. Attempt any FOUR out of SIX questions from SECTION-B carrying SIX marks each.

**SECTION-A****1. Answer briefly :**

- a. Describe the use of affinity diagrams.
- b. Write advantages of arrow diagram.
- c. Discuss various steps in tests of significance.
- d. Describe planning phase of Design of experiments.
- e. What do you mean by Taguchi method? Explain.
- f. Enlist controllable factors in robust design.
- g. Write various types of statistical functions that can be performed by using MINITAB.
- h. What is two way ANOVA? Discuss.
- i. Describe the situation where relations diagram can be used.
- j. Write significance of F-test.

### SECTION-B

2. Three adhesives are being analyzed for their impact on the bounding strength of paper in a pulp and paper mill. The adhesives are each randomly applied to four batches. The data is shown in table. Here, the three treatments are the adhesive ( $p = 3$ ), and the number of replications for each treatment is 4 ( $r = 4$ ). The completely randomized design is a balanced one. Find a 95% confidence interval for the difference in the mean bonding strengths of adhesive 1 and 3. Is there a difference in the means of these two adhesives?

Adhesive type	Bonding Strength (kg)				Sum	Mean
Adhesive 1	10.2	11.8	9.6	12.4	44.0	11.000
Adhesive 2	12.8	14.7	13.3	15.4	56.2	14.050
Adhesive 3	7.2	9.8	8.7	9.2	34.9	8.725
					135.1	11.258

3. In the furniture industry the quality of surface finish of graded lumber is an important characteristic. Three factors are to be tested, each at two levels, for their impact on the surface finish. Factor A is the type of wood: oak (level-1) or pine (level 1). Factor B is the rate of feed: 2m/min (level -1) or 4m/min (level 1). Factor C is the depth of cut: 1mm (level-1) or 3mm (level 1). For each treatment combination three replications are carried out using a completely randomized design. Table 2 shows the surface finish for the eight treatments. The larger the value, the rougher the surface finish. Find the sum of squares for each of the main effects and interaction effects.

Treatment	Surface Finish			Sum
1	6	8	9	23
a	10	16	15	41
b	18	12	15	45
ab	12	9	10	31
c	20	26	19	75
ac	34	28	32	94
bc	36	44	46	126
abc	25	22	24	71

4. The following table gives the number of refrigerators sold 4 salesmen in three months May, June and July.

Month	Salesman			
	A	B	C	D
May	50	40	48	39
June	46	48	50	45
July	39	44	40	39

Is there a significant difference in the sales made during different months?

5. Explain in detail the difference between various types of matrix diagrams.
6. Suppose for a solid propellant experiment, the thrust force develops (coded data) from each formulation (A, B, C and D) is as follows :

Batch of raw material	Operators			
	1	2	3	4
1	A=14	D=6	C=10	B=8
2	B=4	C=14	B=10	A=19
3	C=18	B=11	A=22	D=7
4	B=14	A=20	D=5	C=16

Test whether the type of formulation has significant effect on thrust force (Take  $F_{0.05, 3, 6} = 4.46$ )

7. An experiment was conducted with seven main factors (A, B, C, D, E, F and G) using  $L_8$  OA and the following data was collected (Table below). Assuming Larger-the better type quality characteristic, compute S/N ratios and identify optimal levels for the factors. The results (response) from two replications are given in Table below:

Trial No.	Factors/Columns							Results		
	A	B	C	D	E	F	G	R <sub>1</sub>	R <sub>2</sub>	R <sub>3</sub>
	1	2	3	4	5	6	7			
1	1	1	1	1	1	1	1	11	4	11
2	1	1	1	2	2	2	2	4	4	4
3	1	2	2	1	1	2	2	4	1	14
4	1	2	2	2	2	1	1	4	0	8
5	2	1	2	1	2	1	2	9	8	4
6	2	1	2	2	1	2	1	4	1	1
7	2	2	1	1	2	2	1	1	4	4
8	2	2	1	2	1	1	2	14	4	8

Determine the average response for each factor level and identify the significant effects.

**NOTE : Disclosure of Identity by writing Mobile No. or Making of passing request on any page of Answer Sheet will lead to UMC against the Student.**