2124
M.E. (Mechanical Engineering)
First Semester
MME-102: Design of Experiments

Time allowed: 3 Hours   **Max. Marks: 50**

NOTE: Attempt __five__ questions in all, selecting atleast two questions from each Section. All questions carry equal marks.

x-x-x

SECTION-A

1 (a) Define the term 'Experiment'? Differentiate between Research Design and Experimental design

(b) Describe the brief history of statistical design?

2 (a) Compare systematic sampling with simple random sampling along with their advantages and limitations.

(b) What are errors? Discuss about sampling and non-sampling errors?

3 (a) What is confounding? Construct a completely confounded 2^3 factorial experiment in blocks of size 4 with 8 blocks, so that it completely confounds the second order interaction

(b) Describe the model, uses and disadvantages of Latin Square Design.

Q4. From following information find the correlation coefficient between advertisement expenses and sales volume using Karl Pearson's coefficient of correlation method.

Firm	1	2	3	4	5	6	7	8	9	10
Advertisement Exp. (Rs. In Lakhs)	11	13	14	16	16	15	15	14	13	13
Sales Volume (Rs. In Lakhs)	50	50	55	60	65	65	65	60	60	50

SECTION-B

5. The following data shows the results of a study on the impact of value education lessons as a % of the curriculum and the happiness quotient of a group of primary school students.

	1	2	3	4	5	6
Value education %	2	3	5	7	8	9
Happiness quotient	3.5	3.7	4.4	4.6	4.8	4.9

Find the regression equation between percentage of value education and the happiness quotient.

6 (a) What are the three main disadvantages of the conventional design of experiments approach as compared with Taguchi's method?

(b) What are orthogonal arrays? How many orthogonal arrays are possible for three factors and three level design? Write any one of them.

7   An engineer is interested in observing the effect of cutting speed (A), tool geometry (B), and cutting angle (C) on the life (in hours) of a machine tool. Two levels of each factor are chosen, and three replicates of a 2^3 factorial design are run. The results follow:

A	B	C	Treatment Combination	Replicate		
				I	II	III
-	-	-	(1)	22	31	25
+	-	-	a	32	43	29
-	+	-	b	35	34	50
+	+	-	ab	55	47	46
-	-	+	c	44	45	38
+	-	+	ac	40	37	36
-	+	+	bc	60	50	54
+	+	+	abc	39	41	47

Estimate the factor effects. Which effects appear to be large? Use the analysis of variance to confirm your conclusions.

8.   A researcher is interested in determining the optimum level of process parameters on an end mill machine to minimize surface roughness. He considers three process parameters each at three levels, as given below.

Symbol	Machining parameters	Unit	Level-1	Level-2	Level-3
A	Cutting speed	(rev/min)	2000	3000	4000
B	Feed rate	(mm/min)	1000	1250	1500
C	Depth of Cut	(mm)	0.05	0.10	0.15

The researcher performs nine experiments according to the Taguchi L9 orthogonal array and measures the surface roughness. The data for roughness are given below:

Experiment Number	A	B	C	Surface roughness
1	1	1	1	3.40
2	1	2	2	3.43
3	1	3	3	3.53
4	2	1	3	2.801
5	2	2	1	3.265
6	2	3	2	3.151
7	3	1	2	0.458
8	3	2	3	0.747
9	3	3	1	1.196

Determine the S/N ratio, perform mean analysis and analysis of variance (ANOVA) to obtain optimum level of the machining parameters.

x-x-x