

2125
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-I

1. (a) Define the term "designed experiment, randomization and blocking?
(b) Discuss the brief history of experimental Design?
2. (a) What is Karl Pearson's correlation AND coefficient of determination (R^2)?
(b) Explain the principles of test of means and EMS Rules.
3. (a) Define fractional factorial designs. Who first proposed the idea of fractional replications in large factorial experiments? Explain two differences between fractional factorial experiments and confounded designs.
(b) An experiment for 5 treatment factors, each with two levels, is designed such that only a single replicate of the 32 treatment combinations is run. Suggest a suitable method for analyzing such a design.
4. For an electronic device manufacturer, the charge cycles of a particular lithium-ion battery is of interest. Ten batteries are randomly selected and tested, and the following results are obtained

316	376
348	426
348	418
312	364
330	378

- (a) Demonstrate that the mean charge cycle exceeds 320 cycles. Setup an approximate hypothesis for investigating this claim.
- (b) Test these hypothesis using $\alpha = 0.01$. What are your conclusions?

SECTION-II

5. (a) Explain the t-distribution and chi-square distribution?
(b) The two cutting fluids A and B are tested on machining force (N).

Data:

A: 450, 470, 455, 460, 465

B: 490, 500, 485, 495, 505

Assume equal variances.

Perform two-sample t-test for difference in means.

(2)

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

(b) Explain clearly:

1. The linear model
2. F-tests

Q7. Fit a first-order regression model using the following RSM data:

Run	x_1	x_2	y
1	-1	-1	52
2	-1	+1	60
3	+1	-1	65
4	+1	+1	70

(a) Find Regression coefficients

(b) Estimated response at $x_1 = 0.5$, $x_2 = -0.5$

Q8. A 2^3 factorial experiment yielded the following responses:

Run	A	B	C	Y
1	-	-	-	30
2	+	-	-	50
3	-	+	-	40
4	+	+	-	70
5	-	-	+	35
6	+	-	+	55
7	-	+	+	45
8	+	+	+	75

Calculate:

- (a) All main effects A, B, C
- (b) All two-factor interactions AB, AC, BC
- (c) Three-factor interaction ABC

Interpret the results briefly.