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NOIDA INSTITUTE OF ENGINEERING AND TECHNOLOGY, GREATER NOIDA
(An Autonomous Institute Affiliated to AKTU, Lucknow)

M.Tech

SEM: I - THEORY EXAMINATION (2025 - 2026)

Subject: Design of Experiment

Time: 3 Hours

Max. Marks: 70

General Instructions:

IMP: Verify that you have received the question paper with the correct course, code, branch etc.

1. This Question paper comprises of **three Sections -A, B, & C**. It consists of Multiple Choice Questions (MCQ's) & Subjective type questions.

2. Maximum marks for each question are indicated on right -hand side of each question.

3. Illustrate your answers with neat sketches wherever necessary.

4. Assume suitable data if necessary.

5. Preferably, write the answers in sequential order.

6. No sheet should be left blank. Any written material after a blank sheet will not be evaluated/checked.

SECTION-A

15

1. Attempt all parts:-

1-a. Blocking in experimental design helps to (CO1,K1)

1

- (a) Increase randomness
- (b) Eliminate replication
- (c) Increase observations
- (d) Reduce experimental error

1-b. ANOVA is a statistical method of comparing the _____ of several populations (CO2,K1)

1

- (a) Mode
- (b) Means
- (c) Standard deviations
- (d) Median

1-c. In regression analysis, a mathematical model derived from experimental data is used to (CO3,K1)

1

- (a) Fractional factorial design
- (b) Classify data
- (c) Eliminate variability
- (d) Rank experimental results

1-d. An L9 Orthogonal Array has how many experimental runs? (CO4,K2)

1

- (a) 3
- (b) 6
- (c) 9
- (d) 12

- 1-e. Signal -to-Noise Ratio (SNR) is expressed in units of: (CO5,K1) 1
- (a) Decibels (dB)
 - (b) Hertz (Hz)
 - (c) Watts (W)
 - (d) None of the above

2. Attempt all parts:-

- 2.a. What are Measures of Variability? Why are they important? (CO1,K2) 2
- 2.b. What is randomization? (CO2,K2) 2
- 2.c. What is T- Test? (CO3,K3) 2
- 2.d. Discuss about multi-response data analysis with suitable example. (CO4,K2) 2
- 2.e. What is meant by quality characteristic? (CO5,K1) 2

SECTION-B

20

3. Attempt all parts:-

3.a. Answer any one of the following:-

- 3.a.(i) A population has mean 75 and standard deviation 12. Random samples of size 121 are taken. Find the mean and standard deviation of the sample mean. How would the answers to part (a) change if the size of the samples were 400 instead of 121 ? (CO1,K3) 4

3.a.(ii) Explain the Concept of Confidence Level. (CO1,K3) 4

3.b. Answer any one of the following:-

3.b.(i) Write short notes on Confounding in experimental designs. (CO2,K3) 4

3.b.(ii) Draw the design matrix for 3-factors each at 2-levels. (CO2,K3) 4

3.c. Answer any one of the following:-

3.c.(i) How an factorial experiment be represented? Explain in detail the concept of two-factor factorial design.(CO3,K3) 4

3.c.(ii) Explain YATE's algorithm for ANOVA in brief. (CO3,K3) 4

3.d. Answer any one of the following:-

3.d.(i) Discuss the comparison of Classical and Taguchi's approach with an suitable example.(CO4,K2) 4

3.d.(ii) Draw and explain L9 orthogonal array in brief.(CO4,K3) 4

3.e. Answer any one of the following:-

3.e.(i) What is the significance of tolerance design strategy.(CO5,K2) 4

3.e.(ii) Calculate the S/NLB ratio for this data from inner array trial:
{23, 25, 21, 20, 23, 19} (CO5,K3) 4

SECTION-C

35

4. Answer any one of the following:-

4-a. Why is randomization important in an experiment? Explain it with suitable example.(CO1,K3) 7

4-b. Explain the concept of Concept of confidence level. (CO1,K3) 7

5. Answer any one of the following:-

- 5-a. Define and differentiate between factors and levels in the context of factorial experiments. How are interactions between factors identified, and why are they essential to understanding the experimental outcomes? (CO2,K2) 7
- 5-b. A study was conducted using a 2^2 factorial design with factors A, B and C. The data obtained are given in a below table 7

TABLE 6.10 Data for Problem 6.1

<i>Treatment combination</i>	<i>Response</i>	
	<i>R₁</i>	<i>R₂</i>
(1)	15	12
<i>a</i>	17	23
<i>b</i>	34	29
<i>ab</i>	22	32
<i>c</i>	18	25
<i>ac</i>	5	6
<i>bc</i>	3	2
<i>abc</i>	12	18

Analyse the data assuming that each replicate (R_1 and R_2) as a block of one day. (CO2,K3)

6. Answer any one of the following:-

- 6-a. What is quality loss function? Explain its types. (CO3,K3) 7
- 6-b. Draw and explain L9 (3^4) OA in detail. (CO3,K3) 7

7. Answer any one of the following:-

- 7-a. Describe Taguchi's method in detail.(CO4,K2) 7
- 7-b. Explain the concept of Orthogonal Arrays (OAs) in Taguchi's method. How do OAs help in reducing the number of experiments? (CO4,K3) 7

8. Answer any one of the following:-

- 8-a. An engineer wants to study the effect of the control factors A, B, C, D and E including the interactions AB and AC affecting the hardness of a metal component. The objective is to maximize the hardness. Design an OA experiment. (CO5,K3) 7
- 8-b. How the variability due to noise can be controlled in robust design process?(CO5,K2) 7