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Subject Code:- AMTME0102

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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 (2022 - 2023)

Subject: Design of Experiments

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. Process-design problems involve the revision of _____ and the development of _____ (CO1) 1
- (a) New processes, new processes
(b) Existing processes, new processes
(c) Existing processes, existing processes
(d) New processes, existing processes
- 1-b. ANOVA is a statistical method of comparing the _____ of several populations (CO2) 1
- (a) Mode
(b) Means
(c) Standard deviations
(d) Median
- 1-c. There are 30 students in each experimental condition in a 5x4 between-groups design, how many participants would be needed in total?(CO3) 1

- (a) 200
- (b) 600
- (c) 20
- (d) 400

- 1-d. Which of these does not come into the general model of a process? (CO4) 1
- (a) output factor
 - (b) Input
 - (c) Controllable input factors
 - (d) Uncontrollable inputs factors
- 1-e. Assertion (A): Taguchi approach is a simplified version of partial factor designs; and it requires analyse of variance. Reason (R): We need not really run the full factorial experiment, and would still be able to come up with reasonably good inference (CO5) 1
- (a) Both A and B are False.
 - (b) Both A and R are true, and A is the followed by R
 - (c) Both A and R are true, but A is not followed by R
 - (d) A is true, But R is false

2. Attempt all parts:-

- 2.a. What do you understand by the term "Design"? (CO1) 2
- 2.b. Explain the concept of fractional factorial design with relevant example. (CO2) 2
- 2.c. What is the roll of confounding? (CO3) 2
- 2.d. Discuss about multi-response data analysis with suitable example. (CO4) 2
- 2.e. What are the advantages of the signal to noise ratio analysis? (CO5) 2

SECTION B

20

3. Answer any five of the following:-

- 3-a. Describe the ways of reducing the variation in production sample. (CO1) 4
- 3-b. How should the test coupons be assigned to the quenching solutions, and in what order should the data be collected? (CO1) 4
- 3-c. An experimenter has conducted a single-factor experiment with six levels of the factor, and each factor level has been replicated three times. The computed value of the F-statistic is $F_{0.5,81}$. Find bounds on the P-value. (CO2) 4
- 3-d. Write a short note on Kruskal-Wallis Test. (CO2) 4
- 3.e. Explain the degree of freedom in ANOVA. (CO3) 4

- 3.f. Is it possible to use taguchi method, if the dependent variable or measured variable is negative ? (CO4) 4
- 3.g. Discuss the difference between Static and Dynamic S/N Ratios. (CO5) 4

SECTION C

35

4. Answer any one of the following:-

- 4-a. Almost everyone is concerned about the rising price of gasoline. Construct a cause and effect diagram identifying the factors that potentially influence the gasoline mileage that you get in your car. How would you go about conducting an experiment to determine any of these factors actually affect your gasoline mileage? (CO1) 7
- 4-b. The breaking strength of a fiber is required to be at least 150 psi. Past experience has indicated that the standard deviation of breaking strength is 3 psi. A random sample of four specimens is tested, and the results are $y_1 = 145, y_2 = 153, y_3 = 150$, and $y_4 = 147$. State the hypotheses that you think should be tested in this experiment. (CO1) 7

5. Answer any one of the following:-

- 5-a. The viscosity of a liquid detergent is supposed to average 800 centistokes at 25°C. A random sample of 16 batches of detergent is collected, and the average viscosity is 812. Suppose we know that the standard deviation of viscosity is 25 centistokes. State the hypotheses that should be tested. (CO2) 7
- 5-b. construct an experimental model for milling operation. What are the different noises of the process. (CO2) 7

6. Answer any one of the following:-

- 6-a. what is the significance of Blocking in a factorial design. (CO3) 7
- 6-b. Explain Scheffé's Method for comparing all contrasts. (CO3) 7

7. Answer any one of the following:-

- 7-a. Can we use Taguchi method on non-numerical values, such as types of materials, as one of the parameters in DOE? Discuss. (CO4) 7
- 7-b. Explain the different properties of orthogonal arrays. (CO4) 7

8. Answer any one of the following:-

- 8-a. 16-run fractional factorial experiment in nine factors was conducted by Chrysler Motors Engineering and described in the article "Sheet Molded Compound Process Improvement," by P. I. Hsieh and D. E. Goodwin (Fourth Symposium on Taguchi Methods, American Supplier Institute, Dearborn, MI, 1986, pp. 13-21). The purpose was to reduce the number of defects in the finish of sheet-molded grill opening panels. The design, and the resulting number of defects, c , observed on each run, is shown in Table . This is a resolution III fraction with generators $E = BD$, $F = BCD$, $G = AC$, $H = ACD$, and $J = AB$. Plot the residuals from this model versus the predicted number of defects. Also, prepare a normal probability plot of the residuals. Comment on the adequacy of these plots. (CO5) 7

Run	A	B	C	D	E	F	G	H	J	c	$\sqrt{c}$	F&T's Modification
1	-	-	-	-	+	-	+	-	+	56	7.48	7.52
2	+	-	-	-	+	-	-	+	-	17	4.12	4.18
3	-	+	-	-	-	+	+	-	-	2	1.41	1.57
4	+	+	-	-	-	+	-	+	+	4	2.00	2.12
5	-	-	+	-	+	+	-	+	+	3	1.73	1.87
6	+	-	+	-	+	+	+	-	-	4	2.00	2.12
7	-	+	+	-	-	-	-	+	-	50	7.07	7.12
8	+	+	+	-	-	-	+	-	+	2	1.41	1.57
9	-	-	-	+	-	+	+	+	+	1	1.00	1.21
10	+	-	-	+	-	+	-	-	-	0	0.00	0.50
11	-	+	-	+	+	-	+	+	-	3	1.73	1.87
12	+	+	-	+	+	-	-	-	+	12	3.46	3.54
13	-	-	+	+	-	-	-	-	+	3	1.73	1.87
14	+	-	+	+	-	-	+	+	-	4	2.00	2.12
15	-	+	+	+	+	+	-	-	-	0	0.00	0.50
16	+	+	+	+	+	+	+	+	+	0	0.00	0.50

8-b. Consider the following experiment compute. What is the resolution of this design? (CO5) 7

Run	Treatment Combination
1	d
2	ae
3	b
4	abde
5	cde
6	ac
7	bce
8	abcd