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National Institute of Technology, Hamirpur (HP) Department of Mechanical Engineering

END-SEMESTER EXAMINATION, November. 2022

Branch: B. Tech. (Mechanical Engineering)	Semester: 7 th
Course Name: Design and Analysis of Experiments (Professional Elective)	Course Code: ME-433
Maximum Marks: 50	Maximum Time: 03 hrs

Note: All questions are compulsory. The marks are mentioned inside the bracket against the respective question.

Q-1.	Explain different types of Test Validity, Reliability, and Uncertainty	[4]
Q-2.	Define 3 Signal-to-Noise ratios of common interest for optimization of static problems <i>and</i> Write 8-steps in Taguchi methodology.	[2+4]
Q-3.	Explain experimental designs for fitting response surfaces <i>and</i> write the equation of response surface model for four factors X_1 , X_2 , X_3 and X_4	[3+2]
Q-4.	Explain 2 factors and 3 factors Central composite Design (CCD) and their types with suitable diagram	[5]

Q-5. An investigation into the effect of the concentration of the reactant and the amount of the catalyst on the conversion (yield) in a chemical process. The objective of the experiment was to determine if adjustments to either of these two factors would increase the yield. Let the reactant concentration be factor A and let the two levels of interest be 15 and 25 percent. The catalyst is factor B, with the high level denoting the use of 2 pounds of the catalyst and the low level denoting the use of only 1 pound. The experiment is replicated three times. The data obtained are as follows:

Factor A	ctor			Replicate	III	Total
	В	Combination	I	L II		
		A low, B low	28	25	27	80
+		A high, B low	36	32	32	100
	+	A low, B high	18	19	23	60
+	+	A high, B high	31	30	29	90

Calculate the main effects, Interaction effect and Total effects of the factors.

Q-6. A researcher wanted to study the relationship between data 1 (X) and data 2 (Y). The data is given below.

Participants	1	2	3	4	5	6	7	8	9	10
Data 1 (X)	3	2	4	4	3	2	2	3	5	2
Data 2 (X)	4	3	5	5	5	3	3	4	5	3

[5]

(146)

Q-7. In a study of 10 firms, the dependent variable was the total delivery time (Y) and the independent [10] variables were the distance covered (X_1) and the packaging time (X_2) . The delivery time data collected by the statistical analyst is given below. Fit a multiple linear regression model and calculate the coefficients of regression and coefficient of determination (\mathbb{R}^2) .

Time (y)	18	14	17	14	13	24	13	22	12	19
Distance (X1)	61	95	72	84	98	53	68	54	89	73
Packaging Time (X2)	30	25	30	25	10	35	15	40	30	20

Q-8. A researcher wanted to study the effect of anxiety and types of personality (Extroverts and Introverts) on the academic achievement of the undergraduate students. For the purpose, he has taken a sample of 20 undergraduates by using random method of sample selection. He administered related test and found following observations in relation to the academic achievement of the students. Set up an analysis of variance table for the results:

	Type of Personality									
Groups		E	xtrover	ts			Ir	ntrover	ts	
High anxiety	12	13	14	15	14	14	16	16	16	15
Low anxiety	14	14	13	15	15	11	10	12	12	16

[10]