Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

M.Tech Degree S2 (R, S) / S2 PT (S, FE) Examination May 2024 (2022 Scheme)

Discipline: Mechanical Engineering

Course Code & Name: 222TME100 DESIGN OF EXPERIMENTS

Max. Marks: 60 Duration: 2.5 Hours

Use of statistical tables is permitted

PART A

Answer all questions. Each question carries 5 marks Marks

1 Illustrate central limit theorem with an example. (5)

2 The average life of 26 electric bulbs were found to be 1200 hours with a standard deviation of 150 hours. Test whether these bulbs could be considered as a random sample from a normal population with mean 1300 hours (Assume 5% level of significance). (5)

3 Discuss the following i) Randomization ii) Check for normality (5)

4 Explain Blocking and Confounding in the 2^k factorial design. (5)

5 Explain first order model and second order model design for response surface methodology (RSM). (5)

PART B

Answer any 5 questions. Each question carries 7 marks

6.a Among various ethnic groups, the standard deviation of heights is known to be approximately 3 inches. Construct a 95% confidence interval for the mean height of male Swedes. Forty-eight male Swedes are surveyed. The sample mean is 71 inches and the sample standard deviation is 2.8 inches. (4)

b. Explain the importance of Pareto chart. (3)

7 In the construction industry a study was undertaken to find out whether male workers are paid more than the female workers. From a sample of 25 male workers, it was found that their average wages were Rs 115.70 with a standard deviation of Rs 13.40. Whereas the average wages of female workers were Rs 106.00 with a standard deviation of Rs 10.20 from a sample of 20. Assume that the wages follow normal distribution with equal but unknown population (7)

standard deviations. Using 5% significance level, test whether the wages of male workers is same as that of female workers.

8 An agricultural officer wants to study the effect of the factor 'Quantity of Fertilizer (A)' with four levels, four different plots (B), and four different seasons (C) on the yield (in standard bags) of a specific crop. The data as per Latin square design are shown below. (7)

		Season (C) Block			
		1	2	3	4
Plot (B) Block	1	A1=40	A2=35	A3=22	A4=20
	2	A2=30	A3=22	A4=38	A1=33
	3	A3=19	A4=30	A1=25	A2=27
	4	A4=38	A1=25	A2=30	A3=18

(a) Write the corresponding model.

(b) Check whether each component of the model has effect on the yield of the crop at a significance level of 5%.

9 A company is keen in assessing the contribution of its employees in a 0–10 scale in terms of value addition to its business operations. In this connection, the UG qualification, sex, and work experience of the employees are considered to be the factors. The corresponding ratings of the employees are shown below. (7)

(a) Write the ANOVA model of this situation.

(b) Perform the relevant ANOVA using Yates' algorithm and state the inferences at the significance level of 5%.

Work Experience	U G Degree			
	Engineering		Commerce	
	Sex		Sex	
	Male	Female	Male	Female
Less than 5 years	9	3	5	3
	8	7	9	5
5 years and above	10	5	8	6
	10	10	9	7

10 An investigator is interested in analysing the effect of three factors on the surface finish of castings produced using the molten metal prepared in melting furnace. The factors are furnace temperature A, heating time B, and transfer time C. Each factor is kept at two levels, namely low and high levels. He conducted experiment based on principle half fraction and the corresponding data are shown in Table (7)

Furnace Temperature		Heating Time			
		Low		High	
		Transfer Time		Transfer Time	
		Low	High	Low	High
	Low		c=35	b=60	
	High	a =40			abc =50

(a) Give the alias structure of this design.

(b) Perform ANOVA at a significance level of 0.10.

11 Alpha engineering company wants to study the effect of operator as well as machines on the output per shift in terms of number of components turned. He designed a factorial experiment involving these two factors as shown below with two replications under each experimental combination. The operator is treated as factor A and the machine is treated as factor B. Perform ANOVA and check the significance of the components of the model of this problem at a significance level of 0.05. (7)

Operator (A)		Machine (B)			
		1	2	3	4
	1	100	120	115	140
		90	130	80	120
	2	120	160	130	70
		135	110	125	95

12 There are four different technological alternatives to manufacture a product. The R&D manager of a company feels that the type of technology may have some impact on the hourly output (in units) of the product. Because there might be variability from one plant to another plant, he decides to use the randomized complete block design. (7)

(a) Write the model

(b) Check whether each component of model has effect on the output of the product at a significance level of 5%.

Plant		Technology			
		T1	T2	T3	T4
	P1	73	68	74	71
	P2	73	57	75	52
	P3	45	38	68	40
	P4	73	41	75	75

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