Roll No. | | | | | | | | | | |

ANNA UNIVERSITY (UNIVERSITY DEPARTMENTS)

B.E. / B. Tech / B. Arch (Full Time) - END SEMESTER EXAMINATIONS, NOV/DEC 2024

INDUSTRIAL ENGINEERING
Semester VII
IE7751 & DESIGN OF EXPERIMENTS

(Regulation 2015)

Time: 3hrs Max.Marks: 100

PART- A (10 x 2 = 20 Marks)
(Answer all Questions)

Q. No	Question	Mark
1	What is type II error?	2
2	Define the term "Factor" in experimental design.	2
3	What is Fisher's LSD test used for?	2
4	Mention one advantage and one disadvantage of Completely Randomized Design (CRD).	2
5	What is an interaction effect in a factorial design?	2
6	How many experimental runs are required for a two-factor full factorial design with 3 levels each?	2
7	Name some commonly used designs in Response Surface Methods (RSM)	2
8	What is meant by partial confounding?	2
9	State the advantages of Taguchi Method.	2
10	Define Robust Design.	2

PART- B (5 x 13 = 65 Marks)
(Restrict to a maximum of 2 subdivisions)

Q. No	Question	Mark
11 (a)	The tensile strength (in MPa) of two different types of materials, Material X and Material Y, is measured as follows. The samples were selected randomly. Material X: 520, 530, 525, 540, 535, 510, 515, 520, 530, 525 Material Y: 510, 505, 512, 520, 525, 530, 525, 515, 540, 535 Assume that the tensile strength follows a normal distribution and has equal variances. Test the hypothesis that the mean tensile strength of the two materials is the same. Use $\alpha = 0.05$.	13
	(OR)	
11 (b) (i)	A study was conducted a year back which claims that the high school students spend on an average 11 hours per week on Internet. From a sample of 100 students studied recently found that they spend on average 9 hours per week on Internet with a standard deviation of 2.2 hours. (i) Test the hypotheses that the current students spend less than 11 hours on Internet. Use $\alpha = 0.05$. (ii) What is the p-value for the test? (iii) Determine the 95% confidence interval for the mean time.	13

12 (a)	A plant manager wants to evaluate the effect of temperature (three levels: 50°C, 60°C, 70°C) on the yield of a process. The experiment follows a Completely Randomized Design (CRD). The collected data is provided below. Analyze the data and draw conclusions. Use $\alpha = 5\%$.	13

Temperature (°C)	Observation				
	1	2	3	4	5
50	253	258	249	252	260
60	255	257	253	257	264
70	260	262	255	264	269

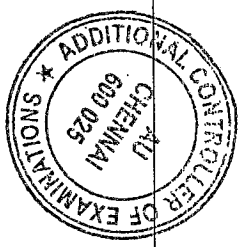
(OR)

12 (b)	An oil company wants to test the effect of four different blends of gasoline (A, B, C, D) on fuel efficiency. The company has used four cars for testing the four types of fuel. To control the variability due to the cars and the drivers, Latin square design has been used and the data collected are given in Table. Analyse the data from the experiment and draw conclusions. Use $\alpha = 0.05$.	13

Driver	Car			
	I	II	III	IV
1	D = 15.5	B = 33.9	C = 13.2	A = 29.1
2	B = 16.3	C = 26.6	A = 19.4	D = 22.8
3	C = 10.8	A = 31.1	D = 17.1	B = 30.3
4	A = 14.7	D = 34.0	B = 19.7	C = 21.6

13 (a)	A manufacturing engineer conducted a study to evaluate the effects of temperature (A), pressure (B), and material type (C) on the tensile strength of a component. Each factor was studied at two levels, and two replications of the experiments were carried out. Analyze using Yate's Algorithm.	13

Treatment Combination	Tensile Strength	
	R1	R2
(1)	140	135
a	160	155
b	148	152
ab	170	165
c	145	150
ac	175	170
bc	155	158
abc	180	185



(OR)

13 (b)	A two-factor factorial experiment was used to study the effect of two factors A (3 levels) and B (2 levels) on the output of a process. The data collected from the experiment is given below. Analyze the data and draw conclusions. Use α=5%.	13

B	A		
	1	2	3
1	54	106	84
	62	128	102
2	46	84	85
	29	93	95

14 (a)	A study was conducted to determine the effect of Speed (A), Feed (B) and Depth of Cut (C) on the milling process. Each factor was studied at two levels. As each batch of raw material was just enough to test four treatment combinations, each replicate of the 2^3 design was run in two blocks. The two replicates were run and ABC confounded in both replicates. The response total for each trial is given in table. Analyze the data.	13

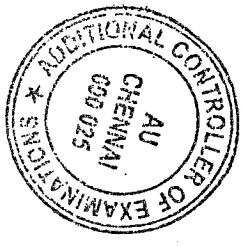
Treatment	(1)	a	b	ab	c	ac	bc	abc
R1	-17	-10	2	8	-9	-7	13	3
R2	-12	-11	3	8	-6	-9	9	5

(OR)

14 (b)	The surface finish of a machined component is being studied. Four factors, Speed (A), Feed (B), Depth of cut (C) and Type of coolant (D) are studied each at two levels. The coded data of the response (surface roughness) is given in following Table.	13

Treatment	Response
(1)	3.1
a	2.3
b	1.5
ab	2.4
c	7.2
ac	4.6
bc	6.4
abc	3.8

Suppose it was possible to run a one-half fraction of the 2^3 design. Analyze the data.



15 (a)	A study was conducted involving three factors A, B and C, each at three levels. The data is given in Table. Analyse using ANOVA and identify optimal levels for the factors. The objective is to minimize the response.	13

Ex. No	Factor			Result	
	A	B	C	R_1	R_2
1	1	1	1	7	5
2	1	2	2	5	6
3	1	3	3	4	3
4	2	1	2	4	2
5	2	2	3	4	3
6	2	3	1	3	2
7	3	1	3	6	5
8	3	2	1	4	3
9	3	3	2	3	5

(OR)

15 (b) The data to be minimized, obtained from an experimental study, are presented in the following table. **13**

Trial no.	Factor					Response	
	A	B	AB	C	AC	R1	R2
1	1	1	1	1	1	20	19
2	1	1	1	2	2	22	24
3	1	2	1	1	2	39	35
4	1	2	1	2	1	27	26
5	2	1	2	1	2	23	25
6	2	1	2	2	1	10	12
7	2	2	2	1	1	8	7
8	2	2	2	2	2	17	18

Calculate the S/N ratio and analyse the data using response graph method

PART- C (1 x 15 = 15 Marks)

(Q.No. 16 is Compulsory)

Q. No	Question	Mark
16	An experimenter wants to study the effect of five main factors A, B, C, and D, each at two levels, and the two-factor interactions AB, AC and AD. Design an Orthogonal Array (OA) experiment with procedure.	15