(3 Hours) **Total Marks: 80**

Note:

1. **Question No. 1 is compulsory**.
2. Attempt any **THREE** out of the remaining **FIVE** questions.
3. Assume suitable data if necessary.
4. **Use of Statistical table is allowed**

Q. 1. Write short notes on **any FOUR** questions. (20)

(a) Briefly explain the term "Replication".

(b) Randomized blocks

(c) Single Replicate of 2k Design

(d) F Test and its significance

(e) Explain Taguchi Loss Function

Q. 2. (a) Develop the Analysis of variance for a 3^2 Factorial design. (10)

(b) List the Various types of Shainin Tools. Explain any one of them in Details. (10)

Q. 3. (a) Define Experiment Give an example. (05)

(b) An Industrial Engineer has studied the effect of speed (B) feed (C) and Depth of Cut (A) on the surface finish of a machined component using a Three-factor factorial design. All the three factors were studied at two levels each. The surface roughness measurements (microns) from two Replications are given in Table 2. Analyze the data and draw conclusions Use $\alpha = 0.05$. (15)

Table 2

Depth of cut (A) mm	Speed (B) m/min			
	100		120	
	Feed(C) mm/rev		Feed(C)mm/rev	
	0.2	0.25	0.2	0.25
0.15	54	41	59	43
	52	58	61	55
0.2	86	62	82	65
	82	64	75	77

Q. 4. (a) List Guidelines for Designing Experiments and explain any one (10)

(b) Define mutually orthogonal contrasts with an example. (10)

Q. 5. (a) Write basic definitions and principles of factorial design (10)

(b) Explain in detail the procedure to test the hypothesis. (10)

Q. 6. Write short notes on: (20)

(a) Explain Signal to Noise ratio.

(b) Define the Population in DOE.

(c) When do we use ANOVA?

(d) How will you test Hypothesis using T-Test.

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