(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.

Q,1 **Solve any Four out of Five** 20

A Define the Alternate Hypothesis in DOE.

B Define the Null Hypothesis in DOE.

C Write Guidelines for Designing Experiments

D Define the Population in DOE.

E What is replication? Why do we need replication in an experiment?

Q.2 A List Guidelines for Designing Experiments and explain any one 10

B Table presents the effective life (in hours) observed in the battery design example. Do the Analysis of Variance for Battery Life Data and find Sum of Square, Degrees of Freedom, and fill it in table given. 10

Material type	Temperature (^{0}F)					
	15		70		125	
1	130	155	34	40	20	70
	74	180	80	75	82	58
2	150	188	136	122	25	70
	159	126	106	115	58	45
3	138	110	174	120	96	104
	168	160	150	139	82	60

The Analysis of Variance Table for the Two-Factor Factorial, Fixed Effects Model

Source of Variation	**Sum of Squares**	**Degrees of Freedom**	**Mean Square**	**F_0**
A treatment				
B treatment				
Interaction				
Error				
Total				

Q.3 A Write basic definitions and principles of factorial design 10

B Explain with example “The Two-Factor Factorial Design” 10

Q.4 A Write Features of a desirable design while selecting the response surface design. 10

B The tensile strength of a paper product is related to the amount of hardwood in the pulp. Ten samples are produced in the pilot plant, and the data obtained are shown in the following table. 10

strength	Precent hard wood	strength	Precent hard wood
160	10	181	20
171	15	188	25
175	15	193	25
182	20	195	28
184	20	200	30

Find

1. Mean square value of block in this experiment
2. Degree of freedom the block in this experiment
3. Mean square value of treatment in this experiment
4. Degree of freedom the treatment in this experiment

Mean square value of residual in this experiment

Q.5 A Explain in detail Basic Principles of Randomization 10

B What are the potential risks of a single large, comprehensive experiment in contrast to a sequential approach? 10

Q.6 **Write** 20

A Define the Sample in DOE.

B Define the Degrees of Freedom in DOE

C When to use Design of Experiments?

D Write a note on Latin Square Design with example.
