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

N.B : (1) Attempt any **4 Questions**
(2) Figures to the right indicate full marks
(3) Assume suitable data wherever necessary and mention it clearly
(4) Use of statistical charts are permitted

Q.1 Explain <u>any four</u> of the following: **20**

i. What are Experimental Designs? Give its applications.
ii. What are the guidelines for designing experiments?
iii. Write short note on : Crossed Array Designs and S/N Ratios.
iv. Give the characteristics of Good and Bad Datasets.
v. Discuss on general 2^{k-p} Fractional Factorial Design

Q.2 Answer the following:

i . What are the critical factors involved in preparation of Yoghurt (Curd) in food industry? What are the response variables and how to measure it? **08**

ii. List potential sources of variability in Yoghurt preparation that would impact the response. **06**

iii. What is RSM? What is sequential nature of RSM? **06**

Q.3 Solve the following:

i. An oil company tested four different blends of Petrol for fuel efficiency according to a Latin square design in order to control for the variability of four different drivers and four different models of cars. Fuel efficiency was measured in kilometers per litre (Kmpl) after driving cars over a standard course. **15**

Fuel Efficiencies (kmpl) For 4 Blends of Petrol
(Latin Square Design: Blends Indicated by Letters A-D)

	Car Model			
Driver	**I**	**II**	**III**	**IV**
1	D (12)	B(12)	A(13)	C (15)
2	A (16)	C (15)	D (13)	B (14)
3	C (14)	A (15)	B (16)	D (15)
4	B (16)	D (14)	C (14)	A (16)

Analyze the data and draw your conclusions.

ii. Explain: Robust parameter Design with an example. **05**

Q.4 Solve the following:

i. A study was performed to measure the Surface Finish (Y) of a turned workpiece and its relationship to X1 = Feed, X2 = Speed and X3 = Depth of Cut. The following data were obtained as below:- **15**

Surface Finish (Y) microns	**Feed (X1)** mm/rev.	**Speed (X2)** rpm	**Depth of Cut (X3)** mm
2.8	0.2	1000	0.5
3.5	0.25	800	0.25
4.0	0.355	900	0.5

(i) Fit a multiple linear regression model to this data
(ii) Plot the residuals and comment on model adequacy.

ii. Write short notes on: Hypothesis testing in Multiple regression models **05**

Q.5 Answer the following: **20**

Inner Array		**Outer Array** 1	1	2	2	**X**
A	**B**	1	2	1	2	**Y**
1	1	15	14	17	16	
1	2	16	14	16	16	
1	3	17	16	14	15	
2	1	16	15	18	18	
2	2	14	13	17	17	
2	3	12	12	16	15	
3	1	19	18	20	21	
3	2	18	17	18	17	
3	3	17	15	17	16	

An experiment was conducted in measurement of Air Circulation using Ceiling Fan. There are two controllable variables viz. A (Fan Blades – 3/4/5 blades) and B(Distance from Ground – 3/4/5 metres) and two noise variables X (Air Humidity – 52% & 65%)and Y(Air Temperature 25 & 32 deg.C). The response variable is the reduction of temperature of hot body in 30 minutes time kept on ground below ceiling fan which is shown in table above.

(I) Calculate average response of factors
(II) Using robust design approach, find the optimal combination of factors.

Q.6 Answer the following:

i. Why do we work with coded variables? Explain with an example. **08**
ii. Give Differences between: Replication, Randomization and Blocking **06**
iii. Discuss on: Construction of Normal Probability Plot. **06**
