Seat No.: _____ *Enrolment No._____*

GUJARAT TECHNOLOGICAL UNIVERSITY

M.E Sem-I Remedial Examination April 2010

Subject code: 710906 **Subject Name: Robust Design**

Date: 09 / 04 / 2010 **Time: 12.00 noon – 02.30 pm**

Total Marks: 60

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1 **(a)** A product development engineer is interested in investigating the tensile strength of a new fibre that will be used to make men's shirts. The engineer knows from previous experiences that the strength is affected by the weight percent of cotton used in the blend of materials used for the fibre. The experimental data collected by the engineer is given below. Check whether the weight percentage of cotton significantly affects the tensile strength of the fibre. $F_{0.05,4,20} = 2.87$ **06**

Weight percentage of cotton	Observed Tensile Strength				
	1	2	3	4	5
15	7	7	15	11	9
20	12	17	12	18	18
25	14	18	18	19	19
30	19	25	22	19	23
35	7	10	11	15	11

(b) Citing suitable example explain the terms "Randomization and blocking" in the context of design of experiments. **06**

Q.2 **(a)** With the help of a suitable example explain (a) Main effects (b) interaction **06**

(b) For the example given in Q1 (a), compare the pairs of treatment means using Tukey's test. **06**

OR

(b) For the. example given in Q1 (a), compare the pairs of treatment means using Least Significance difference(LSD) Method **06**

Q.3 **(a)** Explain how factorial design can provide more information compared to conventional experiments. Explain why experiments are replicated. **06**

(b) Write down the one half fraction of the 2^3 factorial design taking ABC as the generator. What you mean by aliases? Write down all the aliases of the 2^{3-1} fractional design. **06**

OR

Q.3 **(a)** Explain how do you identify and estimate the curvature effect associated with a model. Can blocking can be used to modify the linear model to a quadratic model? If yes, explain how, citing suitable example. **06**

(b) For an investigation in to the effect of the concentration of the reactant (Factor A: 15 to 25%) and the amount of catalyst (Factor B: 1 to 2 kg) on the yield in a chemical process the data is given below. **06**

Your task: Estimate the main effects of A &B as well as the interaction effect AB. Fit regression models for the same, both in terms of coded variables and natural variables.

Factor		Replicate		
A	B	I	II	III
-	-	28	25	27
+	-	36	32	32
-	+	18	19	23
+	+	31	30	29

Q.4 **(a)** With the help of suitable examples explain the following loss functions: (i) Nominal is the best (ii) lower is better (iii) higher is better **06**

(b) For an investigation in to the effect of the concentration of the reactant (Factor A: 15 to 25%) and the amount of catalyst (Factor B: 1 to 2 kg) on the yield in a chemical process the data is given below. $F_{0.05,1,8}$ =5.32. **06**

Your task: Calculate the sum of squares of A, B &AB and hence, develop the ANOVA table. Also list the factors and interaction(s) according to the order of significance.

Factor		Replicate		
A	B	I	II	III
-	-	28	25	27
+	-	36	32	32
-	+	18	19	23
+	+	31	30	29

OR

Q.4 **(a)** With the help of a suitable example explain the term "Taguchi Loss function" How significant is this concept in the context of ensuring quality of the product **06**

(b) Explain the terms (i) inner array (ii) outer array (iii) crossed array design (iv) signal-to-noise ratio. With the help of graphs explain the role of control X noise interaction in robust design **06**

Q.5 **(a)** In single replicate 2^2 design the raw material is available in two batches and each batch of raw material is only large enough for two treatment combinations to be tested. Explain how you will solve this problem without affecting the required result. **06**

(b) With the help of a suitable example explain the "Randomized Complete Block Design" **06**

OR

Q.5 **(a)** What do you mean by confounding? How it is useful in design of experiments? Explain with the help of a suitable example. **06**

(b) For the first order model $\hat{y} = 60 + 1.5x1 - 0.8x2 + 2.0x3$ **06**

Find the path of steepest ascent. The variables are coded as: $-1 \leq xi \leq 1$

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