Seat No.: _____ *Enrolment No._____*

GUJARAT TECHNOLOGICAL UNIVERSITY

M. E. - SEMESTER – I • EXAMINATION – SUMMER • 2014

Subject code: 710906N **Date: 24 -06-2014**

Subject Name: Robust Design

Time: 02:30 pm - 05:00 pm **Total Marks: 70**

Instructions:

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

Q.1 **(a)** With the help of suitable examples explain the meaning and significance of Randomization, and blocking. **07**

(b) With a suitable example explain the term óRobust Designô. **07**

Q.2 **(a)** A product development engineer is interested in investigating the tensile strength of a new fibre that will be used to make menôs 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 eight percentage of cotton significantly affects the tensile strength of the fibre. F0.05,4,20 = 2.87 **07**

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) Suppose, a response is functionally represented as y = f (A, B), where both A & B are variables with two levels. Design a suitable experiment. If, the responses are represented by y_i, where, i=1 ton and n = total number of experiments. Estimate the factor effects and their interactions in terms of y_i. The experiments are not replicated. Explain the reasons for replicating experiments. **07**

OR

(b) What do you understand by confounding? Explain its importance in design of experiments with the help of a appropriate example. **07**

Q.3 **(a)** Explain, giving suitable example, how will you construct the one-quarter fraction of the 2^k design. **07**

(b) Explain the concept of Robust Response Surface Design and Analysis. **07**

OR

Q.3 **(a)** Explain split-plot design and nested design giving one appropriate example. **07**

(b) With help of suitable sketches explain (i) CCD, (ii) Rotatability (iii) the Spherical CCD. **07**

Q.4 **(a)** An industrial engineer is investigating the effect of four assembly methods (A,B,C,D) on the assembly time for a colour television component. Four operators are selected for the study. Furthermore, the engineer knows that each assembly produces such fatigue that the time required for the last assembly may be greater than the time required for the first, regardless of the method. To account these sources of variability, the engineer uses the Latin square design shown below. Analyse the data for Ŭ = 0.05 and draw conclusions. $F_{0.05,3,6}$ = 4.76; $F_{0.05,3,7}$ =4.35 **07**

Order of Assembly	Operator			
	1	2	3	4
1	C=10	D=14	A=7	B=8
2	B=7	C=18	D=11	A=8
3	A=5	B=10	C=11	D=9
4	D=10	A=10	B=12	C=14

(b) Explain briefly the concepts: parametric and tolerance design. Citing a suitable example explain how robustness can be attained in a product. **07**

OR

Q.4 **(a)** What do you mean by ANOVA? How it is useful in design of experiments? **07**

(b) An experiment was performed to improve the yield of a chemical process. Four factors were selected, and a completely randomized experiment was run. The results are shown below **07**

Treatment Combination	Response	Treatment Combination	Response
(1)	90	d	98
a	74	ad	72
b	81	bd	87
ab	83	abd	85
c	77	cd	99
ac	81	acd	79
bc	88	bcd	87
abc	73	abcd	80

Suppose that in the chemical process development experiment, it was only possible to run a one-half fraction of the 2_4 design. Construct the design. Carry out ANOVA and identify the significant factors. $F_{.05,1,3}$ = 10.13

Q.5 **(a)** Explain the meaning and significance of the ñThe Method of steepest Ascentò **07**

(b) Explain the concept of Design for Six Sigma. **07**

OR

Q.5 **(a)** Compare the following quality loss functions, giving suitable examples: step and quadratic functions. Suppose, the functional limit for a colour television is m ± 7 and the repair cost of a television set in the field is Rs. 980. Calculate the quality loss associated with each m ± 4 set. **07**

(b) Discuss the issues for the Implementation of Six Sigma. **07**

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