

GUJARAT TECHNOLOGICAL UNIVERSITY
M. E. - SEMESTER – II • EXAMINATION – SUMMER • 2013

Subject code: 1725009**Date: 07-06-2013****Subject Name: Design and Analysis of Experiments****Time: 10.30 am – 01.00 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)** Explain three basic principles of Experimental Design; replication, randomization and blocking with suitable example. **07**
- (b)** State and Explain central limit theorem. What is its importance? **07**

- Q.2 (a)** Distinguish between the following: **07**
- (i) Null Hypothesis and Alternative Hypothesis
 - (ii) Type I error and Type II error during hypothesis testing
- (b)** The diameters of steel shafts produced by a certain manufacturing process should have a mean diameter of 0.255 inches. The diameter is known to have a standard deviation of $\sigma = 0.0001$ inch. A random sample of 10 shafts has an average diameter of 0.2545 inch. **07**
- (a) Set up appropriate hypotheses on the mean.
 - (b) Test these hypotheses using $\alpha = 0.05$.
 - (c) Find the P-value for this test.

OR

- (b)** The following are the burning times of chemical flares of two different formulations. **07**
- The design engineers are interested in both the mean and variance of the burning times.

Type 1		Type 2	
65	82	64	56
81	67	71	69
57	59	83	74
66	75	59	82
82	70	65	79

- (a) Test the hypothesis that the two variances are equal. Use $\alpha = 0.05$.
 - (b) Using the results of (a), test the hypothesis that the mean burning times are equal. Use $\alpha = 0.05$.
- Q.3 (a)** What is ANOVA? How is it different than t-test? Differentiate between fixed effect model and random effect model. **07**

- (b) A manufacturer of television sets is interested in the effect on tube conductivity of four different types of coating for color picture tubes. The following conductivity data are obtained: 07

Coating Type		Conductivity			
1	143	141	150	146	
2	152	149	137	143	
3	134	136	132	127	
4	129	127	132	129	

Is there a difference in conductivity due to coating type? Use $\alpha = 0.05$.

OR

- Q.3** (a) What do you mean by Single factor fixed effect model? Decompose Total Sum of Squares (SS_T) in to Sum of square due to treatments and Sum of square due to error for Single factor fixed effect model. 07
- (b) An experiment was run to determine whether four specific firing temperatures affect the density of a certain type of brick. The experiment led to the following data: 07

Temperature		Density			
100	21.8	21.9	21.7	21.6	21.7
125	21.7	21.4	21.5	21.4	
150	21.9	21.8	21.8	21.6	21.5
175	21.9	21.7	21.8	21.4	

Does the firing temperature affect the density of the bricks? Use $\alpha = 0.05$.

- Q.4** (a) Explain Randomized Complete Block Design (RCBD) with suitable example. 07
- (b) Three different washing solutions are being compared to study their effectiveness in retarding bacteria growth in 5-gallon milk containers. The analysis is done in a laboratory, and only three trials can be run on any day. Because days could represent a potential source of variability, the experimenter decides to use a randomized block design. Observations are taken for four days, and the data are shown here. Analyze the data from this experiment (use $\alpha = 0.05$) and draw conclusions. 07

Solution	Days			
	1	2	3	4
1	13	22	18	39
2	16	24	17	44
3	5	4	1	22

OR

- Q.4** (a) Define the term “Factorial Design”. Also explain terms “Main effect” and “Interaction effect” between the factors with suitable example. 07
- (b) Construct and explain the generalized ANOVA table for Two factor factorial design with fixed effect model. 07
- Q.5** (a) Explain the terms “Blocking” and “Confounding” with suitable example. 07

- (b) An engineer is interested in the effects of cutting speed (A), tool geometry (B), and cutting angle (C) on the life (in hours) of a machine tool. Two levels of each factor are chosen, and three replicates of a 2^3 factorial design are run. The results are as follow. Estimate the factor effects and identify the significant effects. 07

Treatment Combination	Replicate		
	I	II	III
(1)	22	31	25
<i>a</i>	32	43	29
<i>b</i>	35	34	50
<i>ab</i>	55	47	46
<i>c</i>	44	45	38
<i>ac</i>	40	37	36
<i>bc</i>	60	50	54
<i>abc</i>	39	41	47

OR

- Q.5 (a) Write a short note on “Method of Steepest Ascent”. 07
 (b) Differentiate between simple and multiple linear regression. 07
