Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

ME SEMESTER– III (NEW) EXAMINATION – SUMMER 2017

Subject Code: 2735005 **Date: 02/05/2017**

Subject Name: Design and Analysis of Experiments

Time:02:30 pm to 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)** What is replication? Why do we need replication in an experiment? **07**

(b) Why are randomization and blocking important in an experiment? Explain. **07**

Q.2 **(a)** Clearly defined the following terms with reference to hypothesis testing. **07**
(1) P- value (2) Power of test (3) Type II error

(b) Show that $\bar{y}$ and S^2 are unbiased estimators of μ and σ^2. **07**

OR

(b) The time to repair an electronic instrument is a normally distributed random variable measured in hours. The repair times for 16 such instruments chosen at random are as follows: **07**

Hours			
159	280	101	212
224	379	179	264
222	362	168	250
149	260	485	170

(a) You wish to know if the mean repair time exceeds 225 hours. Set up appropriate hypotheses for investigation.
(b) Test these hypotheses using $\alpha = 0.05$. What are your conclusions?

Q.3 **(a)** Derive the following equation through decomposition of the "total sum of squares". **07**

$$SS_T = SS_{Treatments} + SS_E$$

(b) A product developer is investigating the tensile strength of a new synthetic fiber that will be used to make cloth for men's shirts. Strength is usually affected by the percentage of cotton used in the blend of materials for the fiber. The engineer conducts a completely randomized experiment with five levels of cotton content and replicates the experiment five times. The data are shown in the following table. **07**
Is there evidence to support the claim that cotton content affects the mean tensile strength?? Use $\alpha = 0.05$.

Cotton Weight Percent	Observations				
15	7	7	15	11	9
20	12	17	12	18	18
25	14	19	19	18	18
30	19	25	22	19	23
35	7	10	11	15	11

OR

Q.3 **(a)** Develop an ANOVA table for the Two-Factor Factorial, Fixed Effects Model. **07**

(b) Write a short note on "Randomized complete block design". **07**

Q.4 **(a)** Explain a case of 2^2 factorial design with suitable example. Also calculate main effects and interaction effects for that case. **07**

(b) The following output was obtained from a computer program that performed a two-factor ANOVA on a factorial experiment. **07**

Two-way ANOVA: y versus A, B

Source	DF	SS	MS	F
A	1	_____	0.0002	_____
B	___	180.378	_____	_____
Interaction	3	8.479	_____	_____
Error	8	158.797	_____	_____
Total	15	347.653	_____	_____

Fill in the blanks in the ANOVA table.

OR

Q.4 **(a)** Derive the following relation for least squares estimator of β, **07**

$$\hat{\beta}=(X'X)^{-1}X'y$$

(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. **07**

Strength	Percent Hardwood	Strength	Percent Hardwood
160	10	181	20
171	15	188	25
175	15	193	25
182	20	195	28
184	20	200	30

Fit a linear regression model to the data using equation derived in Q-4 (a).

Q.5 **(a)** Briefly explain "Response surface" and "Response surface methodology". **07**

(b) Discuss central limit theorem and its importance. **07**

OR

Q.5 **(a)** Write a short note on "Method of steepest ascent". **07**

(b) Explain "2^3 factorial design" with suitable example. **07**

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