de, cd, b, bce, a, ace, abde, abcd

(i) Identify the design and the defining relation for the design,

(ii) Find resolution of this design,

(iii) Write down the aliasing scheme for this design. (7,8)

[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 2937 **H**

Unique Paper Code : 32371601

Name of the Paper : Design of Experiments

Name of the Course : **B.Sc. (H), Statistics under CBCS (LOCF)**

Semester : VI

Duration : 3 Hours Maximum Marks : 75

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt **five** questions in all.
3. Question no. **1** is compulsory.
4. Attempt **four** questions from the remaining questions.
5. The use of non-programmable scientific calculators is allowed.

1. Attempt any **five** parts :

(a) Physics graduate student Laura Van Ertia has conducted a complete randomized design with different treatments, hoping to solve the mystery of the unified theory and complete her dissertation. The results of this experiment are summarized in the following ANOVA display :

Source	df	Sum of Squares	Mean squares	F
Treatment	--	--	14.18	--
Error	--	37.75	--	
Total	23	108.63		

Answer the following questions about this experiment :

(i) The sum of squares for the treatment is _____ .

(ii) The number of degrees of freedom for treatments in the experiment is _____ .

(iii) The number of degrees of freedom for error is _____ .

(iv) The value of the test statistic is _____ .

Replication I: 100, 202, 001, 211, 010, 112, 022, 220, 121

Replication II : 000, 101, 012

Identify all the confounded effects in each replication. Write down the contents of the remaining blocks. (9,6)

7. (a) What is meant by fractional factorial designs? Define the terms :

(i) Defining relation,

(ii) Resolution of a design

(iii) Principal fraction, and

(iv) Aliases

(b) Suppose a 2^5 experiment was to be run as a CRD, but the researcher could only run it with 8 experimental units. The following treatment combinations were chosen as a fraction to run the experiment :

5. (a) For a symmetric BIBD, let N be the incidence matrix. Prove that

$$(N')^{-1} = \frac{1}{r-\lambda}\left(N - \frac{\lambda}{r} E_{vv}\right),$$

where E_{vv} is a square matrix of order v whose elements are all unity.

(b) Explain Yates technique for calculating sum of squares due to main effects and interaction effects in case of a 2^3 factorial experiment with r replications. (9,6)

6. (a) What is confounding? Construct a completely confounded 2^3 factorial experiment in blocks of size 4 with 8 blocks, so that it completely confounds the second-order interaction. Give the complete composition of the blocks such that at least partial information about the 2- and 3- factor interaction components and complete information about all the main effects is recovered.

(b) The following are two blocks of a layout plan before randomization for a 3 factorial experiment with factors A, B, and C :

(b) The following is a layout plan before randomization for a 2^4 experiment with factors A, B, C and D arranged in 4 blocks of 4 plots each. The contents of one of the blocks are given as: ac, b, d and abcd. Identify the effect/(s) confounded.

(c) Can there exist a BIBD with the following parameters :

(i) $v = 17, \quad k = 3, \quad \lambda = 1$

(ii) $v = 16, \quad k = 10, \quad \lambda = 3$?

Justify your answer.

(d) Derive the expression to measure the efficiency of LSD over RBD when rows are taken as blocks, stating clearly the assumption used in the derivation.

(e) What is a treatment contrast? When are two contrasts said to be orthogonal?

(f) Consider a 3^2 factorial experiment in blocks of size 3. If we are equally interested in all the effects, we could use a basic design of 4 replicates. Give the ANOVA table, showing the breakdown of degrees of freedom. (3×5)

P.T.O.

2. In the Latin Square design,

A	B	C	D
B	A	D	C
C	D	A	B
D	C	B	A

Observation in the second row and the second column is missing. Obtain the estimate of the missing observation. Describe the analysis of this design. Also, obtain the expression for the standard error of the estimated treatment differences. (15)

3. (a) Explain the terms: experimental error, uniformity trials, and fertility contour map, along with their utility in the design of experiments.

(b) Let $y_1, y_2, \ldots y_{25}$ be 25 observations. Arrange the observations in such a way so as to obtain the layouts of the following designs :

(i) A CRD with 3 treatments A, B, and C. The replication numbers being 6, 9 and 10.

(ii) An RBD with 5 treatments and 5 blocks.

(iii) A 5×5 LSD.

Explain the method used for arranging the observations in a given layout. Which of the above designs is most suitable if the experimental material is heterogeneous? Justify your answer. (6,9)

4. (a) Define a derived, dual and complementary design. Consider the following system of blocks (within parenthesis) forming a BIBD :

(1,2,3),	(1,4,7),	(1,5,9),	(1,6,8),
(4,5,6)	(2,5,8),	(2,6,7),	(2,4,9),
(7,8,9),	(3,6,9),	(3,4,8),	(3,5,7).

Obtain its derived, dual and complementary designs along with their parameters.

(b) Derive the variance of the difference between two treatment estimates for (i) a BIBD with parameters (v, b, r, k, λ) and (ii) an RBD with r homogeneous blocks. Find the efficiency of BIBD with respect to RBD. (9,6)