[This question paper contains 6 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 4516 **E**

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 a non-programmable scientific calculator is allowed.

P.T.O.

1. Attempt any **five** parts :

(a) Complete the following table for the analysis of variance of a fixed-effects Latin Square design :

Sources of Variation	d.f.	Sum of Squares	Mean Squares	F
Columns	-	-	36	-
Rows	-	72	-	2
Treatments	-	180	-	-
Errors	6	-	12	
Total	-	-		

(b) Calculate the minimum number of replications required so that an observed difference of 10% of the mean μ will be regarded as significant at 5% level of significance, given that the coefficient of variation of plot value is 12%.

(c) Show that for given v, k and λ, the parameters r and b given as follows must be integral :

$$r = \frac{\lambda(v-1)}{(k-1)} \qquad b = \frac{\lambda v(v-1)}{k(k-1)}$$

(d) Following is the principal block of a 2^4-factorial experiment :

(0000, 0101, 1010, 1111)

Identify the confounded factorial effects.

(e) Construct a 3^3 design in three blocks of nine runs each such that information on the highest order interaction is completely lost.

(f) Define Resolution IV and Resolution V designs giving an example of each. (3×5)

2. (a) Discuss the factors that affect the shape and size of plots and blocks in agricultural experiments.

(b) Show that in a Latin Square Design, the mean sum of squares due to treatments is a biased estimator of the error variance. Under what condition is it unbiased? Also, derive the expected value of the mean sum of squares due to errors.

(c) Derive the expression to measure the efficiency of RBD over CRD, stating clearly the assumptions used in the derivation. (6,6,3)

3. A randomized block experiment has been carried out in 4 blocks with 5 treatments A, B, C, D, and E. The reading for treatment D in block 2 appears to be missing. Give the complete statistical analysis of this design using the missing plot technique. Further, calculate the expression for the standard error of the difference between two estimated treatment means when one of them involves the missing observation. (15)

4. (a) Given a BIB design D, with parameters (v, b, r, k, λ). Let each block of this design be replaced by another block containing those treatments which are not included in the original block. What is the resulting design called? Derive the parameters (v*, b*, r*, k*, λ*) of this new design D*. Is it also a BIBD? Justify your answer.

(b) Define Resolvable and Affine Resolvable BIBDs. Identify the parameters of the following BIBD and show that it is both Resolvable and Affine Resolvable.

	Blocks											
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Treatments	1	4	7	1	2	3	1	2	3	1	2	3
	2	5	8	4	5	6	5	6	4	6	4	5
	3	6	9	7	8	9	9	7	8	8	9	7

(7,8)

5. (a) What is meant by factorial experiments? Write down the simple effects of a 2^3 factorial experiment. Derive the expressions for the main effects and interaction effects of 2^3-factorial experiment from these simple effects.

(b) An experiment for 5 treatment factors, each with two levels, is designed such that only a single replicate of the 32 treatment combinations is run. Suggest a suitable method for analyzing such a design. (9,6)

6. (a) Describe Yates' algorithm for computing the total effects and the sum of squares due to various effects for a 3^2 factorial experiment laid out in r randomized blocks.

(b) In a 3^3 factorial experiment confounded in 3 blocks, three elements of the key block are given to be 000, 011, 101. Write other elements of the key block and identify the confounded effects.

(c) A 2^5 design is to be arranged in 2^2 blocks of size 2^3 each. Suggest a suitable set of 3 degrees of freedom that you would like to confound such that information on main effects and first-order interactions is not at all lost and write down the treatment combinations of all the blocks.

(6,3,6)

7. (a) Define fractional factorial designs. Who first proposed the idea of fractional replications in large factorial experiments? Explain two differences between fractional factorial experiments and confounded designs.

(b) Construct a 2^{5-2} fractional factorial design with defining relations

$$I = ACD \text{ and } I = -BCE$$

Verify that each main effect is aliased with at least one two-factor interaction effect. What is the resolution of this design? How many alternate fractions can you generate for this design? Also, give their generating relationships. (6,9)