[This question paper contains 2 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 532 **K**

Unique Paper Code : 2372573501

Name of the Paper : DSC: Introduction to Design of Experiments

Name of the Course : **B.A. / B.Sc. (P) under NEP-UGCF**

Semester : V

Duration : 3 Hours Maximum Marks : 90

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt **Six** questions in all.
3. Question no. **1** is compulsory. Attempt **Five** questions from the remaining questions.
4. Attempt all parts of question in continuation.
5. Use of a non-programmable scientific calculator is allowed.

1. **(a)** Fill in the blanks:

(i) In an RBD with v treatments and r blocks, the degrees of freedom for error is .....

(ii) The LSD is more efficient than RBD, if the efficiency >.....

(iii) The error mean squares always provide an unbiased estimate of .....

(iv) If A and B are the two factors each at two levels, the simple effect of A at the second level of B is .....

(v) For a 4×4 LSD, the degrees of freedom for error is .....

(vi) A resolvable design is said to be Affine resolvable if ..... **(6)**

(b) What do you understand by experimental error? What are its main sources? **(3)**

(c) What are the advantages and disadvantages of RBD? **(3)**

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

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

(ii) $v = 9, b = 12, r = 4, k = 3, \lambda = 1$?

Justify your answer. **(3)**

2. **(a)** Explain the principles of replication, randomization, and local control in experimental design. How are these principles used in RBD and LSD?

(b) Prove that in LSD, under the truth of null hypothesis, each of the mean sum of squares due to rows, columns and treatments gives an unbiased estimate of error variance. **(6, 9)**

P.T.O.

3. **(a)** Complete the following ANOVA table for RBD:

Source of Variation	Degrees of freedom	Sum of Squares	Mean sum of squares	Variance ratio (F)
Blocks	3	--	--	--
Treatments	2	34.67	--	--
Error	--	--	1.22	
Total	--	46.67		

Test the hypothesis that the treatment effects are equal to zero, showing all the steps in the general test procedure. (Given that $F_{0.05}(3, 6) = 4.76$ and $F_{0.05}(2, 6) = 5.14$)

(b) Derive the expression to measure the efficiency of LSD over RBD using columns as blocks, stating clearly the assumptions used in the derivation. **(9, 6)**

4. **(a)** Define a BIBD with parameters v, b, r, k, and λ. State and prove the three basic relationships among its parameters.

(b) Derive a necessary condition for the existence of a symmetric BIBD with even number of treatments. **(10, 5)**

5. **(a)** What is a treatment contrast? When are two such contrasts said to be orthogonal? Show that in 2^3 factorial experiment, the main effects and interactions are mutually orthogonal.

(b) An experiment for 4 factors, each with two levels, is designed such that only a single replicate of the 16 treatment combinations is run. Suggest a suitable method for analyzing such a design. **(7, 8)**

6. **(a)** What is meant by confounding in factorial experiments? Construct a 2^4 partially confounded factorial experiment into 4 blocks by confounding the effects AB and CD in the first replication and ABC and BCD in the second replication.

(b) The following are two key blocks of a layout plan before randomization for a 2^4 factorial experiment with factors A, B, C, and D:

Replication I: (1), abd, acd, bc

Replication II: (1), a, abc, acd

Identify all the confounded effects. **(9, 6)**

7. **(a)** Define fractional factorial designs. Explain the terms: Generator and aliases.

(b) Construct a 2^{4-1} design with defining relation I = ABCD. Write down the alias structure of the design. What is the resolution of this design? **(6, 9)**