SL No of QP : **2248**
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. Use of non-programmable scientific calculator is allowed.

1. **(a)** Fill in the blanks:
- **(i)** CRD is not suitable for ---------- experimental material.
- **(ii)** In an RBD, blocks should be formed in ---------- direction to fertility gradient.
- **(iii)** If A and B are the two factors each at two levels, the simple effect of A at the first level of B is ----------.
- **(iv)** The error mean sum of squares always provides unbiased estimate of ----------.
- **(v)** In general, the efficiency of RBD relative to CRD is greater than or equal to -----.
- **(vi)** For a 5×5 LSD, the degrees of freedom for error is ----------. **(6)**

(b) What are uniformity trials? Discuss their utility in design of experiments. **(3)**
(c) Distinguish between complete and partial confounding. **(3)**
(d) Define BIBD. When a BIBD is called symmetric? **(3)**

2. **(a)** Discuss briefly the basic principles of design of experiments. Explain which of these principles are used for CRD, RBD and LSD.
(b) Derive the expected value of mean sum of squares due to errors and treatments in LSD. Also, show that under null hypothesis, the mean sum of squares due to treatments gives an unbiased estimate of error variance. **(7, 8)**

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	4	26.8	--	--
Treatments	3	--	--	--
Error	--	--	2.5	
Total	--	85.3		

Test the hypothesis that the treatment effects are equal to zero, showing all the steps in the general test procedure. (Given that $F_{0.05}(3, 12) = 3.49$ and $F_{0.05}(4, 12) = 3.26$)
(b) What is LSD? Determine the efficiency of this design relative to RBD with columns as blocks stating clearly the assumptions used in the derivation. **(9, 6)**

4. **(a)** For a BIBD with parameters v, $\mathbf{b}$, r, $\mathbf{k}$ and λ, prove that
$$rv = \mathbf{bk},\ \lambda(v-1) = r(\mathbf{k}-1) \text{ and } \mathbf{b} \geq v.$$

(b) Define resolvable BIBD. Show that, for a resolvable BIBD with parameters v, $\mathbf{b}$, r, $\mathbf{k}$ and λ,
$$\mathbf{b} \geq v + r - 1. \qquad \textbf{(9, 6)}$$

5. **(a)** Describe the Yates' algorithm for computing the total effects and sum of squares due to various effects for a 2^3 factorial experiment run in r randomised blocks.
(b) What is treatment contrast? When are two such contrasts said to be orthogonal? Derive the contrasts due to main effects and interaction effects in a 2^3 factorial experiment. **(6, 9)**

6. **(a)** What is meant by confounding in factorial experiments? Construct a 2^4 confounded factorial experiment into four blocks by confounding the effects ABC and BCD. Also list all the confounded effects.

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

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

7. Write short notes on any **Three** of the followings:
(i) Treatment and experimental error
(ii) Completely randomized design
(iii) Generator and aliases
(iv) Main and interaction effects

(5, 5, 5)