6. (a) What is meant by efficiency of a design? 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.

   (b) 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 for the 2^3 factorial experiment from these simple effects. (6,9)

7. Derive the analysis of variance for two-way classified data under fixed effect model stating clearly the mathematical model, the hypothesis to be tested, and the underlying assumptions. Also, write the ANOVA table. How would you test the hypothesis of equality of two specific class means? (15)

[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 5165 **J**

Unique Paper Code : 2374000008

Name of the Paper : Survey Sampling and Design of Experiments

Name of the Course : **GE**

Semester : VI (NEP-UGCF)

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 **five** questions in all.
3. **Q. 1** is compulsory.
4. Attempt **four** questions from sections A and B, selecting two questions from each section.
5. Use of **simple non-programmable calculator** is allowed.

1. (a) Fill in the blanks:

(i) In stratified sampling, the population of N units is sub-divided into k sub-populations called _____.

(ii) In _____, all the units of the universe have an equal chance of being included in the sample.

(iii) The expression n/N is known as _____.

(iv) The simplest and most flexible experimental design is known as the _____ .

(v) Each treatment occurs once in every block of a _____ design.

(vi) In two-way classification (one observation per cell) with p=3 and q=4, the total degrees of freedom are _____

condition under which variance of the estimated mean is minimum for fixed total size of the sample. (6,9)

Section B

5. (a) The entries in the following table were determined from data collected from a design. Complete the ANOVA table and identify the design used.

Source of Variations	Degree of Freedom	Sum of Squares	M.S.S.	F ratio
Blocks	4	26.8	--	--
Treatments	3	--	--	
Error	--	--	2.5	
Total	--	85.3		

(b) Prove that in an LSD the mean sum of square due to treatments is a biased estimator of the error variance. Under what condition does it become unbiased? Derive the expected value of the mean sum of squares due to errors. (6,9)

(b) Find the variance of the sample mean in case of SRSWR and obtain an estimate of the standard error of the population total. (6,9)

3. (a) Show that in SRSWOR, the probability of selecting a specified unit of the population at any given draw is equal to the probability of selecting it at the first draw.

(b) Describe the advantage of carrying out a sample survey in preference to a complete enumeration survey. Under what circumstances can complete enumeration be recommended in preference to a sample survey? (6,9)

4. (a) Describe the procedure of stratified random sampling. Under what conditions is stratified random sampling preferred over simple random sampling?

(b) Discuss the various methods of allocating a sample for different strata in stratified sampling. Find the

(b) State whether the following statements are True/False:

(i) Sampling can only be effectively conducted in a homogeneous population which is finite.

(ii) There is a least chance of sampling error in a heterogeneous population.

(iii) Stratification of the population generally results in a more efficient sampling plan.

(iv) In one way classification, the error degrees of freedom are n-1.

(v) A 3x3 LSD is more efficient than an RBD with 3 replications.

(vi) Two contrasts of k treatment means are said to be orthogonal if sum of the product of the corresponding coefficients is equal to unity.

(c) Attempt any six of the following:

(i) Define the terms: population, sampling unit, sampling frame.

(ii) Differentiate between simple random sampling with replacement and without replacement.

(iii) What do you understand by stratified random sampling? Write any two of its advantages.

(iv) Let $y_1, y_2, ..., y_{20}$ be a set of 20 observations. Arrange them in such a way so as to obtain the layout of the following designs:

(a) A CRD with three treatments A, B and C, The replication numbers being 4, 7 and 9.

(b) An RBD with four treatments and five blocks.

(v) What is meant by experimental error in Design of Experiments?

(vi) Name the basic principles of Design of experiments.

(vii) Suppose we have v treatments to be compared in v^2 plots. Name the design that you will carry out under each of the following situations:

(i) There is no fertility difference among the v plots,

(ii) The fertility changes along a particular direction, and

(iii) The fertility changes along two perpendicular directions. (6,6,18)

Section A

2. (a) Discuss briefly the basic principles of a sample survey.