[This question paper contains 4 printed pages.]

Sr. No. of Question Paper : 1212 **E** **Your Roll No.....**

Unique Paper Code : 237602

Name of the Course : **B.Sc. (H) Statistics**

Name of the Paper : Design of Experiments (STH–602)

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, selecting **three** from **Section I** and **two** from **Section II.**
3. Attempt all parts of a question in continuation.

SECTION I

1. (a) Explain the terms experimental error, uniformity trial and fertility contour map along with their utility in Design of Experiments.

   (b) In a randomized block design there are only two blocks. Let k be the number of treatments and $\overline{y_1}$ and $\overline{y_2}$ be the average yields of two blocks. Show that the between blocks sum of squares can be expressed as $\frac{k}{2}\left(\overline{y_1}-\overline{y_2}\right)^2$.

   (c) Suppose we have v treatments to be compared in v^2 plots. How will you carry out the experiment under each of the following situations ?

      (i) there is no fertility difference among the v^2 plots,

      (ii) the fertility changes along a particular direction,

(iii) the fertility changes along two perpendicular directions.

Give appropriate analysis of variance table for each case (without derivation). (5,4,6)

2. (a) Show how to estimate a missing value in an L.S.D used to compare 6 varieties of paddy, when observation corresponding to 3rd treatment, 2nd row and 4th column is missing. Calculate the standard error of the difference between two treatment means, when (i) none of them involves missing observation (ii) one of them involves the missing observation.

(b) Identify the following designs and give reasons :

(i)

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

(iii)

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

(ii)

ε	δ	γ	β	α
δ	γ	β	α	ε
γ	β	α	ε	δ
β	α	ε	δ	γ
α	ε	δ	γ	β

(9,6)

3. (a) Show that an estimate of the missing values in randomized block design with r blocks and t treatments is given by $y = \frac{rB + tT - G}{(r-1)(t-1)}$, where B = the actual total of the block with the missing unit, T = the total of the yields of the treatment with the missing unit and G = the grand total. Show that by using the above missing value, the treatment sum of squares is over-estimated by $\frac{[B-(t-1)y]^2}{t(t-1)}$.

(b) Find the variance of the estimated elementary treatment contrast of a BIBD. Compare it with RBD. (9,6)

4. (a) For a BIBD with parameters v, b, r, k and λ, state the mathematical model and show that the adjusted treatment sum of squares is $\frac{k}{v\lambda}\sum_{i=1}^{v} Q_i^2$ where Q_i is the adjusted total for the ith treatment. Compute its degrees of freedom. Also show that sum of estimated treatment effects is zero.

(b) Define resolvable and affine resolvable BIBDs. Also, prove that for a resolvable BIBD, $b \geq v + r - 1$. (9,6)

SECTION II

5. (a) Explain Yates technique for calculating sum of squares due to main effects and interaction effects in case of a 3^2 factorial experiment with r replications. Also write down the ANOVA table.

(b) Construct a 2^{5-2} design with defining relations I = –ABE and I = BCDE. Write down the alias structure for this design. What is the resolution of the constructed design ?

(c) Construct one replication of a 2^5 confounded factorial experiment using blocks of size 2^3 such that no main effect and two factor interactions are confounded. (5,5,5)

6. (a) Construct one half fraction of the 2^4 design clearly explaining the terms generator, defining relation, aliases, alias structure, principal fraction and word.

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

Replication I: (1), *abc*, *abd*, *cd*
Replication II: (1), *abc*, *acd*, *bd*
Replication III: (1), *abd*, *acd*, *bc*

Find out the effect or effects confounded and construct the analysis of variance table for the design. (6,9)

P.T.O.

7. (a) 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. How the arrangement can be modified so as to recover at least partial information about the 2 and 3 factor interaction components and complete information about all the main effects ?

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

Replication I: $a,\ a^2c^2,\ c,\ a^2bc,\ b,\ abc^2,\ b^2c^2,\ a^2b^2,\ ab^2c$

Replication II: $(1),\ ac,\ bc^2$

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