

5. (a) Obtain the least squares estimates of the unknown parameters of a second-order response surface model. Also, obtain their variances and covariances.
- (b) Construct a BBD for three factors and 6 centre points, and list all design points. Discuss the rotatability of this design. (9,9)
6. (a) List the component proportions comprising the blends in a two-component $\{2,4\}$ simplex-lattice. List the 20 blends that comprise a $\{4,3\}$ simplex-lattice.
- (b) What is the number of distinct points in a q -component simplex-centroid design? Express the parameters of the associated polynomial as a linear function of the expected responses at the points of the simplex centroid design with $q = 3$. Hence, or otherwise, obtain a general formula for the model parameters. (9,9)

[This question paper contains 4 printed pages.]

Your Roll No.....

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Unique Paper Code : 2373010016

Name of the Paper : DSE 5b- Advanced Design
of Experiments

Name of the Course : **B.Sc. (Hons.) Statistics under
NEP-UGCF**

Semester : VII

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. All questions carry equal marks.
3. Attempt any **five** questions.
4. Use of a non-programmable calculator is allowed.

1. (a) Three chemists analysed two varieties of coal, and the ash content of each was recorded. Both the varieties and the chemists were randomly selected from large populations. Fill in the missing entries in the ANOVA table obtained :

Sources of Variations	DF	SS	MS	E(MS)	F-ratio
A					
B			6		
Interaction AB		8			
Error					
Total		30			

Also, estimate the variance components σ^2_A , σ^2_B , σ^2_{AB} .

- (b) A dietician is studying how exercise intensity and diet type affect weight loss, and has carried out an experiment with a sample size layout as follows:

Exercise intensity Diet	High	Low
Diet I	2	8
Diet II	5	15

Why is this a non-orthogonal design? What are its statistical implications? (9,9)

2. (a) Prove that, $k \sum_{i=1}^v \frac{Q_i^2}{\lambda v}$ is the adjusted sum of squares for treatments in a BIBD.

- (b) Derive an appropriate test for the significant difference between any two treatment means in a BIBD. (9,9)

3. (a) Define a Latin square. When are two Latin squares said to be orthogonal? Generate the elements of GF(8) and give the complete set of MOLS of order 8.

- (b) With the help of orthogonal Latin squares of size 5, construct the BIBD with

$$v = b = s^2 + s + 1, \quad r = k = s + 1, \quad \lambda = 1 \quad (9,9)$$

4. (a) Let $v = b = 11$, $r = k = 5$. Construct a BIBD with these parameters using the method of differences. Derive a residual BIBD for the resultant BIBD and write its parameters.

- (b) Construct a BIBD with parameters $v = 9$, $b = 12$, $k = 3$, $r = 4$, $\lambda = 1$. Also, write its incidence matrix. (9,9)