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**STH 551**

**IV Semester M.Sc. Degree Examination, September/October 2022**

**STATISTICS**

**Design and Analysis of Experiments**

Time : 3 Hours

Max. Marks : 70

**Note :** Question No. 1 is **compulsory**. Answer **any four** questions from the remaining seven questions.

1. Answer **any six** sub-divisions. **(6×3=18)**
  - a) Obtain the least square estimator of  $\beta$  in the linear model. Is the least square estimator of  $\beta$  unbiased ?
  - b) When do you say that a linear parametric function is estimable ? Give an example for (i) an estimable parametric function (ii) non-estimable parametric function.
  - c) Describe the general block design.
  - d) Define the information matrix C. Prove that matrix C is symmetric.
  - e) Obtain the efficiency factor of a Balanced Incomplete Block Design (BIBD).
  - f) Describe Duncan's multiple comparison test.
  - g) In a Randomised Block Design (RBD) with single missing observation, obtain the variance of the estimated value.
  - h) Giving illustrations, distinguish between complete and partial confounding in factorial experiments.
2.
  - a) State and prove Gauss Markov theorem.
  - b) Define general linear model, by stating the assumptions. Derive the test procedure to test  $H_0 : K' \beta = m$ . **(6+7)**
3.
  - a) In a general block design, state and prove a necessary and sufficient conditions for a linear parametric function  $a'\theta$  to be estimable.
  - b) Write down the normal equations of a general block design and give a solution to it.
  - c) Prove that in a connected design, every treatment contrast is estimable. **(6+4+3)**

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4. a) Show that an RBD is connected and variance balanced.  
b) Show that, treatment contrasts and block contrasts are orthogonal in RBD.  
c) Describe Tukey's test for non-additivity. **(4+4+5)**
  5. a) State a BIBD model. Show that it is a variance balanced design.  
b) Obtain the intra block analysis of a BIBD. **(4+9)**
  6. a) State the one-way classification model with single covariate. Stating the assumptions, derive the likelihood ratio test procedure to test the significance of the treatment effects.  
b) Discuss the estimation of single missing value in an RBD and outline an approximate test to test the relevant hypothesis. **(8+5)**
  7. a) What are main effects and interaction effects in a  $2^3$  factorial experiment ?  
b) Describe Yates technique to compute the sum of squares due to the main effects and the interaction effects in a  $2^3$  factorial experiment.  
c) Briefly indicate the analysis in a  $2^3$  factorial experiment in which the effect AB is confounded in replicate I, AC in replicate II and BC in replicate III. **(4+4+5)**
  8. a) Describe Youden Square Design (YSD). Obtain the normal equations of YSD and hence derive the best estimator for the model parameters.  
b) Explain the importance of ANCOVA and derive the test procedure for ANCOVA with two-way classification. **(6+7)**
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