LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

M.Sc. DEGREE EXAMINATION – **STATISTICS**

FOURTH SEMESTER – **APRIL 2022**

PST 4501 – APPLIED EXPERIMENTAL DESIGNS

Date: 15-06-2022 Dept. No. Max. : 100 Marks

Time: 01:00 PM - 04:00 PM

PART – A

Answer ALL the Questions **(10x2=20 Marks)**

1. Define contrast and provide an example.
2. What is interaction effect? And provide the expression to determine the interaction effect between A and B in a 2^2 Factorial design.
3. Provide an example where two way blocking is required.
4. Provide any one advantage and disadvantage of a fractional factorial design.
5. Explain the term "Generator" and "aliases" in factorial experiments.
6. Define Balanced Incomplete Block Design.
7. Provide second order response surface model and state its uses.
8. Define Orthogonal Latin Square Design and state its uses.
9. Define Partially Balanced Incomplete Balanced Design.
10. Define Split Plot design with an example.

PART – B

Answer any FIVE Questions **(5x8=40 Marks)**

11. Explain the following basic principles of Experimental designs with example:
    a) Randomization b) Replication and c) Local control.
12. Explain the statistical model of a Randomized Block Design and derive the various sum of squares along with the layout of ANOVA table.
13. Explain the analysis of variance for a 2^3 Factorial design.
14. Construct a 2^3 design layout such that AB is confounded in replicate 1, AC is confounded in replicate 2, BC is confounded in replicate 3, and ABC is confounded in replicate 4 by using the table of algebraic signs
15. Construct a design for 2^5 factorial experiments in 2^3 plots per block confounding interaction ABD and ACE using modulus sum method
16. If $N = (n_{ij})$ is the incidence matrix of a BIBD with parameters (v,b,r,k,λ) then show that i) $NN' = (r-\lambda) I + \lambda J$ ii) $|NN'| = rk(r-\lambda)^{v-1}$ where I is the unit matrix of order v and J is a v x v matrix all of whose elements are unity
17. Discuss analysis of covariance(ANCOVA) in detail
18. The fitted second order response surface design is given by
    $Yield = 79.94 + 0.99X_1 + 0.52X_2 - 1.38X_1^2 - X_2^2 + 0.25X_1X_2$
    Where $X_1 = (\delta_1 - 85)/5$ and $X_2 = (\delta_2 - 175)/5$
    Identify the point of stationarity and estimate the fitted response value at the point of stationarity

PART – C

Answer any TWO Questions **(2x20=40 Marks)**

19. a) Derive the main effects and interaction effects for a 2^2 design using dummy coding procedure and effect coding procedure and explain the advantage of effect coding procedure over dummy coding procedure in modeling factorial experiments.
    b) Show that 2^2 design is D-optimal

20. a) State and prove the necessary parametric relations for the existence of a BIBD **(16)**
    c) What is resolvable BIBD? give an example **(4)**

21. Fit a first order response surface design for the following data and identify the path of steepest ascent

X_1	30	30	40	40	35	35	35	35	35
X_2	150	160	150	160	155	155	155	155	155
Y	39.3	40	40.9	41.5	40.3	40.5	40.7	40.2	40.6

22. a) Explain the following design types associated with second order response surface **(8)**
    i) Circumscribed ii) Face Centered iii) Inscribed
    b) Discuss Resolution III, IV and V designs with an example for each design **(8)**
    c) Discussion the use of resolution design IV and V in screening process **(4)**

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