Discipline Specific Elective (DSE) Courses

Discipline Specific Elective (DSE) Course 3a: Advanced Theory of Experimental Designs

Structure 1: PG Curricular Structure with only Course Work
Structure 2: PG Curricular Structure with Course Work + Research
Structure 3: PG Curricular Structure with Research only

Course Title & Code	Credits	Credit Distribution of the Course			Eligibility Criteria	Prerequisite of the course (if any)
		Lecture (45 Hours)	Tutorial (00 Hours)	Practical (30 Hours)		
DSE 3a: Advanced Theory of Experimental Designs	**4**	**03**	**00**	**01**	**NIL**	**Basic knowledge of Design of Experiments**

Course Objectives:

- To equip students with the ability to understand and apply experimental design techniques in real world problems and research.

Course Learning Outcomes: After the successful completion of this course, the student will be able to:

- Understand the design and analysis of Partially Balanced Incomplete Block Designs and apply them in situations where balanced designs are not available.
- Construct Hadamard matrices, symmetric and asymmetric orthogonal arrays. Orthogonal arrays are used in industrial setups like automobile industry, computer experiments, cryptography, and quality improvement.
- Understand the concepts in general theory of Fractional Factorial Experiments and Various optimality criteria to obtain optimal designs.
- Apply techniques of Response surface methodology, construct designs for first and second order models, and appreciate the concepts of orthogonality, rotatability and blocking.
- Construct and analyse designs for mixture experiments that are useful in our day-to-day life, food industry, chemical industry, pharmaceutical companies.
- Understand and apply Crossover designs in practical situations.
- Understand the Robust Parameter designs and their use in quality improvement.

Unit I (13 Hours)

Partially balanced incomplete block (PBIB) designs, Resolvable and affine resolvable designs, Lattice designs, Construction and analysis of PBIB (2) designs.

Unit II (10 Hours)

General theory of fractional factorial Plans, Optimal designs- Various optimality criteria.

Unit III (10 Hours)

Hadamard matrices, Orthogonal arrays- symmetric and asymmetric orthogonal arrays and their constructions.

Unit IV (12 Hours)

Response surface designs- first and second order models, concepts of orthogonality, rotatability and blocking. Mixture experiments–models and designs, Cross-Over designs, Robust Parameter designs.

Essential Readings:

1. Bose, M. and Dey, A. (2009). *Optimal Crossover Designs*, World Scientific.
2. Cornell, John A. (2011*). Experiments with Mixtures*, John Wiley & Sons.
3. Dey, A. and Mukerjee, R. (1999). *Fractional Factorial Plans*, John Wiley & Sons.
4. Hedayat, A.S., Sloane, N. J.A. and Stufken, J. (2012). *Orthogonal Arrays: Theory and Applications*, Springer Science & Business Media.
5. Myers, R. H. and Montgomery, D.C. (2016). *Response Surface Methodology: Process and Product Optimization using Designed Experiments*, John Wiley & Sons.
6. Raghavarao, D. (1970). *Construction and Combinatorial Problems in Design of Experiments*, John Wiley & Sons.

Suggested Readings:

1. Das, M.N. and Giri, N.C. (2015). *Design and Analysis of Experiments*, New Age International Publishers.
2. Dey, A. (1986). *Theory of Block Designs*, John Wiley & Sons.
3. Dey, A. (2010). *Incomplete block designs*. World Scientific.
4. Hinkelmann, K. and Kempthorne, O. (2005). *Design and Analysis of Experiments*, Vol. II: Advanced Experimental Design, John Wiley & Sons.

5. Jones, B. and Kenward, M.G. (2003). *Design and Analysis of Cross-over Trials*. Chapman & Hall/CRC Press.
6. Montgomery, D.C. (2007). *Design and Analysis of Experiments*, John Wiley & Sons.
7. Wu, C.F.J. and Hamada, M. (2000). *Experiments: Planning, Analysis and Parameter Design Optimization*, John Wiley & Sons.

List of Practicals:

1. PBIB (2) designs.
2. Construction of Hadamard matrices.
3. Orthogonal arrays.
4. Fractional factorial designs.
5. Construction of optimal design.
6. Response surface designs.
7. Mixture designs.
8. Cross-over designs.
9. Robust Parameter designs.