

Course Code	Course Name	Credits
MEDLO5012	Design of Experiments	03

Objectives: -

1. To obtain clear understanding of use of statistics in experimentation
2. To obtain clear understanding of scheme of experimentation and its effect on accuracy of experimentation
3. To obtain knowledge of how to analyze results from such investigations to obtain conclusions
4. To become familiar with methodologies that can be used in conjunction with experimental designs for robustness and optimization

Outcomes: Learner will be able to...

1. Plan, design, and conduct experimental investigations efficiently and effectively;
2. Understand strategy in planning and conducting experiments;
3. Choose an appropriate experimentation scheme to evaluate a new product design or process improvement through experimentation strategy, data analysis, and interpretation of experimental results.

Module	Details	Hrs
1	Introduction, Background and Overview: A brief history of DOE-When to use DOE- Basic principles of DOE & Some typical applications. Overview of basic statistical concepts, Simple Comparative Experiments, Single Factor experiments, Randomized Blocks, Latin Square Designs and extensions. Testing of Hypothesis ('T' & 'F' test), Introduction to Factorial Designs, 2^k Designs.	06
2	Full Factorial Design: The basics of "full factorials", ANOVA, Factorial effects including interaction effects and plots	06
3	Two & Three Level Fractional Factorial Design: Objective, The one-half fraction and one-quarter of the 2^k design, 2^{k-p} fractional factorial design, 3-level & Mixed-level Factorials & Fractional Factorials.	08
4	The Robust Design: Basics of robust designs, Loss Function, Taguchi designs, Orthogonal Arrays, Linear Graphs and Interaction effects, Signal to Noise Ratio, Parameter Design, Tolerance Design, Robust design example.	08
5	Response Surface Methodology: First & second order experiments, Analysis of second-order response surfaces, Central composite designs, Plackett-Burman designs, process optimization & reliability improving experiments	06
6	Experiment Design According to Shainin, Multi-variate charts, components search, paired comparisons	06

Assessment:

Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
3. **Remaining questions will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only **Four questions need to be solved.**

Text/Reference Books:

1. Statistics for Experimenters, Box, GEP, Hunter, WG, and Hunter, JS, 1978, Wiley.
2. Empirical Model-Building and Response Surfaces, Box, GEP and Draper, NR 1987, Wiley.
3. Experimental Designs, Cochran, WG and Cox, GM, 1957, Wiley.
4. The Design of Experiments, 8th Ed., Fisher, RA, 1966, Hafner.
5. Design and Analysis of Experiments (Vol I), Hinkelmann, K and Kempthorne, O, 1994, Wiley.
6. Optimal Design of Experiments, Pukelsheim, F, 1993, Wiley.
7. Statistical Principles in Experimental Design, 2nd Ed., Winer, BJ, 1962, McGraw-Hill.
8. Engineering Methods for Robust Product Design: Using Taguchi Methods in Technology and Product Development, Fowlkes WY, Creveling CM, 1995, Addison-Wesley Publishing Company
9. Design and Analysis of Experiments, 5th edition, by D.C. Montgomery, John Wiley & Sons, New York, 2001
10. Total Quality Management, 4th Ed, Besterfield D.H., Carol Besterfield M, Mary Besterfield Sacre, Besterfield G.H., Urdhwarsh H, Urdhwarsh R, 2015, Pearson

Links for online NPTEL/SWAYAM courses:

<https://nptel.ac.in/courses/110/105/110105087/> - Design and Analysis of Experiments, IIT Kharagpur

<https://nptel.ac.in/courses/111/104/111104075/> - Analysis of Variance and Design of Experiments-I, IIT Kanpur

<https://nptel.ac.in/courses/111/104/111104078/> - Analysis of Variance and Design of Experiments-II, IIT Kanpur