Instructor: Dr. Manohar Aggarwal; Office: DH 386; Phone: 901-678-3756
Email: maggarwl@memphis.edu; Office Hours: MW 11 AM to 12 noon (or by appointment)


Course Description:

The techniques of experimental design are being used in the physical, chemical, biological, medical, social, psychological, economic, business, engineering and industrial sciences. Proper analysis of data and efficient planning of experiments is a part of every experimenter’s toolbox. This course lays down the foundations of good experimental design. The course covers the concepts and basic principles of experimental design, the difference between fixed and random effects models. The designs covered include completely randomized, randomized block, Latin squares, factorial, fractional factorial, response surface and robust parameter designs.

Course Goal:

Students will gain the ability to design statistically valid and efficient experiments and to correctly analyze data collected from any experiment.

Course objectives:

- Understand the basic principles of statistically designed experiments.
- Learn the classical experimental designs and their analysis.
- Become familiar with useful designs such as Balanced Incomplete Block designs, Factorial/ Fractional Factorial and Response Surface and Robust Parameter Designs.

Course topics:

- Introduction to Experimental Design (Chapter 1)
- Experiments with Single Factor (Chapter 3)
  - The Statistical Model and Parameter Estimation
  - Decomposition of Total Sum of Squares, Expected Mean Squares
  - Multiple Comparison Tests
  - Residual Diagnostics for Checking Model adequacy
  - Tests for Homogeneity of Variances
  - Random Effects Model
- Randomized Blocks, Latin Squares, and Related Designs (Chapter 4)
  - Statistical Analysis of the RCBD
  - Estimation of Model Parameters
  - Model Adequacy Checking
- The Latin Square Design
- The Graeco-Latin Square Design
- Balanced Incomplete Block Designs

• Introduction to Factorial Designs (Chapter 5)
  - Basic Definitions and principles
  - The Two-Factor Factorial Design
  - The General Factorial Designs
  - Blocking in Factorial Design

• The $2^k$ Factorial Design (Chapter 6)
  - $2^2$ and $2^3$ Factorial Design
  - The general $2^k$ Design

• Blocking and Confounding in the $2^k$ factorial Design (Chapter 7)
  - Blocking a replicated $2^k$ Factorial Design
  - Confounding in the $2^k$ Factorial Design
  - Confounding of $2^k$ Factorial design in two, four, … , and $2^p$ blocks

• Two- Level Fractional Factorial Designs (Chapter 8)
  - The One – Half Fraction of the $2^k$ Design
  - The One- Quarter Fraction of the $2^k$ Design
  - The general $2^{k-p}$ Fractional Factorial Design
  - Blocking of Fractional Factorial Design
  - Alias Structure in Fractional Factorial Design
  - Resolution III, IV, and V Designs
  - Plackett- Burman Designs

• Response Surface Methods and Designs (Chapter 11)
  - Introduction to Response Surface Methodology
  - Experimental Designs for Fitting Response Surfaces
  - Designs for Fitting the First- Order Model
  - Designs for Fitting the Second – Order Model
  - Blocking in Response Surface Designs

• Robust Parameter Design (Chapter 12)

Computing: We will be using the statistical software package SAS which is widely used in industry and academic research.

**Assessment:** The final grade will be determined in the following manner:
  - Home Work: 10 %
  - 2 Midterms: 40 %
  - Final: 50 %

**Examinations:** Exams will be closed book.

**Attendance:** Compulsory