IHE 7050 - Design and Analysis of Engineering Experiments

Course Description
Introduction to planning and analysis of engineering experiments. Topics include basic statistics review, linear models, regression, analysis of variance, experiment designs, response surface methods, and engineering applications.

Offered both face-to-face and online
Graduate level – 3 credit hours

Course Learning Objectives
Students enrolled in this course will learn to:

- Understand how to design experiments, carry them out, and analyze the data they yield.
- Understand the process of designing an experiment, including appropriately defining factors and responses.
- Understand the essential assumptions for statistical techniques and how to verify them.
- Be able to effectively utilize factorial and fractional factorial designs.
- Use factorial designs for cost reduction,   increasing efficiency of experimentation, and revealing the essential nature of a process.
- Investigate the logic of hypothesis testing, including analysis of variance and the detailed analysis of experimental data.
- Learn the technique of regression analysis, and how it compares and contrasts with other techniques studied in the course.
- Understand the role of response surface methodology and its basic underpinnings.
- Understand how to analyze experimental design data using the most common software packages and be able to draw appropriate conclusions in an engineering context.

Course Learning Outcomes
Upon successful completion of this course, a student will:

- Understand how to design experiments, carry them out, and analyze the data they yield.
- Understand the process of designing an experiment, including appropriately defining factors and responses.
- Understand the essential assumptions for statistical techniques and how to verify them.
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Tentative Weekly Schedule

Week 1   Introduction
         Probability Concept Review: Random Variables
Week 2   Review: Statistical Inference for a Single System
         Review: Statistical Inference for Comparison of Systems
Week 3   Analysis of Variance: Single Factor Experiments
         Analysis of Variance: Statistical Significance, Residual Analysis
Week 4   Analysis of Variance: Transformations to Improve Model Adequacy
         Analysis of Variance: Comparison of Means
Week 5   Pre- Exam Review
         EXAM 1
Week 6   Post-Exam Solutions Review
         Randomized Complete Block Design
Week 7   Latin Square Designs
         Balanced Incomplete Block Designs
Week 8   Factorial Designs: 2 Factors, Multiple Factors
          2^k Factorial Designs
Week 9   Factorial Designs: Single Replicate of the 2^k Design
         Factorial Designs: Blocks and Confounding the 2^k Design
Week 10 Pre-Exam Review
         EXAM II
Week 11 Post-Exam Solutions Review
         Fitting Regression Models to Experimental Data
Week 12 Fitting Regression Models to Experimental Data
         Center Point in the 2^K Design
Week 13 Factorial Designs: Fractions of the 2^k Design

Factorial Designs: Resolution in Fractional Designs
Week 14 Interpreting Regression & Coded Variables in JMP
Response Surface Methods
Week 15 Final Exam