ESI 5247 – Engineering Experiments
Spring 2014

Course Information
Class Meeting Time: Monday, Wednesday 3:45pm -5:00pm
Class Meeting Place: COE – A125.

Contact Information
Instructor: Dr. Arda Vanli
Office: COE A252 **Tel:** 410-6354 **Email:** oavanli@eng.fsu.edu
Office Hours: Tuesday, Thursday 1:30pm-3:00pm, or by appointment

Course Objectives and Outcomes
The objective of the course is to provide an understanding of the methods for designing experiments and analyzing data. The course deals with the types of experiments that are frequently conducted in engineering and industrial systems to improve performance. The goal is for you to learn how to plan and conduct experiments effectively and learn how to analyze the resulting data to obtain statistically valid conclusions. At the end of the course the students will be able to design and analyze multifactor experiments for improving performance of engineering systems using statistical software.

Textbook
Design and Analysis of Experiments (8^{th} edition), by D.C. Montgomery, John Wiley & Sons, New York (2012), ISBN-13: 978-1118146927

Course Prerequisites
1. EGN 3443: Statistical Topics in Industrial Engineering. Equivalent courses on statistical methods only with approval of the instructor.
2. A mathematics course involving matrix and vector algebra.

Blackboard Web Site
Students must check the course's Blackboard site (accessible through campus.fsu.edu) regularly for assignments, announcements as well as other important timely information.

Grading Policy:
Your course grade is based on two midterms, one final exam, homework assignments and project. The weights of these components in your final grade will be as follows:
- Midterm Exam I : 20%
- Midterm Exam II : 25%
- Final Exam : 25%
- Homework : 15%
- Project : 15%

Grading Scale:
The grades will be based on the following scale:
- 90 – 100 : A
- 80 – 89 : B
- 70 – 79 : C
- 60 – 69 : D
- 0 - 59 : F

Midterm Exam and Final Exam
Three in-class exams will be given. The exams will be closed-books and closed-notes but you will be allowed to bring one page typed or hand written (both sides) formula sheet to the exam. The topic coverage of the exams will be announced during the semester. Tentative dates of the exams are as follows:

- Midterm I : **Feb 3, 2014**
- Midterm II : **Mar 5, 2014**
- Final : **April 16, 2014**

Homework
Homework problems will be assigned from the textbook or other texts. Use of statistical software and computer programming may be required to complete assignments. Homework is to be done individually (group work is not acceptable). Homework assignments are due at the start of the class on the assigned date. No late submissions will be accepted.

Project
A project that consists of planning, conducting and analyzing an experiment using design of experiments techniques will be assigned. You will submit a typed report (8 pages maximum) summarizing your objectives, experiments, analyses and main results.

Software Use
Use of statistical computer packages Minitab, Design Expert and MATLAB programming language is encouraged for statistical analyses in homework assignments and project. A 45-day free trial version of Design Expert is available for download at www.statease.com. These software packages are also available in the COE computer labs.

Topics

- Basic statistical concepts (Ch 2)
- Experiments with a single factor (Ch 3)
- Randomized block and Latin square designs (Ch 4)
- Introduction to Factorial Experiments (Ch 5)
- 2^k factorial designs (Ch 6)
- Blocking and Confounding in the 2^k factorial design (Ch 7)
- 2^{k-p} fractional factorial designs(Ch 8)
- Response surface methods (Ch 11)
- Experiments with random factors (Ch 13)
- Nested and Split-Plot designs (Ch 14)

Make-up Exam Policy:
Make-up, late or early exams will be given only if the student obtains **prior** approval from the instructor. Approvals for make-up exams will only be granted for medical and family emergencies. If a make-up examination is not granted, you will receive a **score of zero (0)** for the exam that you missed.

Academic Honor Code:
Students are expected to uphold the Academic Honor Code published in The Florida State University Bulletin and the Student Handbook. The Academic Honor System of The Florida State University is based on the premise that each student has the responsibility (1) to uphold the highest standards of academic integrity in the student's own work, (2) to refuse to tolerate violations of academic integrity in the university community, and (3) to foster a high sense of integrity and social responsibility on the part of the university community.

Americans with Disabilities Act:
Students with disabilities needing academic accommodation should:

1. Register with and provide documentation to the appropriate university office. For FAMU students this is the Center for Disability Access and Resources (CeDAR). For FSU students this is the Student Disability Resource Center (SDRC); and
2. Bring a letter to the instructor indicating the need for accommodation and what type. This should be done during the first week of class.

For more information about services available to students with disabilities:

FAMU students should contact:
Center for Disability Access and Resources
Phone: (850)599-3180
E-mail: cedar@famu.edu

FSU students should contact:
Student Disability Resource Center
Phone: (850) 644-9566
E-mail: sdrc@fsu.edu

This syllabus and other class materials are available in alternative format upon request.

Syllabus Change Policy:
Except for changes that substantially affect implementation of the grading policy or grading scale, this syllabus is a guide for the course and subject to change with advance notice.

ESI 5247 - Engineering Experiments - Outline - Spring 2014

Class	Date	Topic	Reading	Learning Objectives	Assignment Due
1	6-Jan	Introduction to DOE.	1.1-1.3	- Basic Principles and applications for designing experiments	
2	8-Jan	Simple Comparative Experiments	2.1, 2.2, 2.3	- Use of probability distributions and expectation and variance operators - Random sampling and sampling distributons: Normal, t, Chi2, F	
3	13-Jan	Simple Comparative Experiments	2.4.1, 2.4.2, 2.5	- Hypothesis testing and confidence intervals to make inference on differences in means - Paired comparison problem	
4	15-Jan	Experiments with a single factor	3.1, 3.2, 3.3	- Fixed effects model for single factor experiments - ANOVA to compare treatments of the factor	HW 1 - Ch 2
5	20-Jan	Martin Luther King, Jr. Day. No Classes.			
6	22-Jan	Experiments with a single factor	3.4, 3.5, 3.7	- Checking adequacy of model assumptions - Comparing pairs of treatment means: contrasts, Fisher LSD method	
7	27-Jan	Randomized Blocks, Latin Squares	4.1.1, 4.1.2, 4.1.4, 4.2	- Use of blocking to eliminate effects of a nuisance factor - Statistical analysis of the RCBD - Use of Latin square designs to block against two nuisance factors	
8	29-Jan	Exam Review			HW 2 - Ch 3,4
9	3-Feb	Midterm Exam I			
10	5-Feb	Introduction to factorial design.	5.1,5.2, 5.3.1,5.3.2	- Analysis of multiple factor experiments - Understand the concept of interaction between factors	

11	10-Feb	Introduction to factorial design.	5.3.3,5.3.6, 5.3.7, 5.4	- Model with no interaction and single replicate - Modeling three or more factors	
12	12-Feb	2^k factorial designs	6.1., 6.2	- Use of two-level experimental designs for factor screening - Two factor designs	
13	17-Feb	2^k factorial designs	6.3, 6.4, 6.5	- Three factor designs - General 2^k design for four or more factors - Experiments with single replicate	
14	19-Feb	2^k factorial designs	6.6., 6.8, 6.9	- Examples usign Design Expert - Add center points to assess curvature - Importance of coded design variables	HW 3- Ch 5, 6
15	24-Feb	Response surface Methods	11.1,11.2	- Response surface models. - Process optimization with steepest ascent	
16	26-Feb	Response surface Methods	11.3,11.4	- Analysis of second order models. - Experimental designs for response surfaces	
17	3-Mar	Exam Review			HW 4 - Ch 11
18	5-Mar	Midterm Exam II			
19	10-Mar	Spring break			
20	12-Mar	Spring break			
21	17-Mar	Blocking and Confounding in 2^k factorial	7.1-7.7	- Blocking in replicated factorial design - Confounding when blocking is used for unreplicated design - Confounding with four or more blocks	

22	19-Mar	2^k-p fractional factorial designs	8.1,8.2	- Use of fractionated designs for large number of variables. Definition of design resolution. Analysis of one-half fraction design	
23	24-Mar	2^k-p fractional factorial designs	8.3, 8.4	- General fractional factorials. Generalized interaction	
24	26-Mar	2^k-p fractional factorial designs	8.6, 8.7	- Resolution III designs, fold over designs, Resolution IV and V designs	
25	31-Mar	Experiments with random factors	13.1, 13.2		HW 5 - Ch 7,8
26	2-Apr	Experiments with random factors	13.3, 13.4, 13.5		
27	7-Apr	Nested and Split-Plot Designs	14.1, 14.2, 14.3		
28	9-Apr	Nested and Split-Plot Designs	14.4, 14.5		HW 6- Ch 13, 14
29	14-Apr	Exam Review			
30	16-Apr	Final Exam			
31	21-Apr	Project Presentations			
32	23-Apr	Project Presentations			Presentation files. Report.