School of Systems and Enterprises
Stevens Institute of Technology
Castle Point on Hudson
Hoboken, NJ 07030

Syllabus August 2008

SDOE 655 Robust Engineering Design

PURPOSE: This memorandum provides each student the administrative details and guidance necessary to successfully complete SDOE 655.

TEXT: **Robust Engineering: Learn How to Boost Quality While Reducing Costs & Time to Market,** Genichi Taguchi, Subir Chowdhury, Shin Taguchi, 1999.
Engineering Methods for Robust Product Design, William Y. Fowlkes & Clyde M Creveling, Addison-Wesley, 1995.
Invention by Design: How Engineers Get from Thought to Thing by Henry Petroski (ISBN:0674463676, Publisher:Harvard University Press, 1996)
21st Century Jet: The Making and Marketing of the Boeing 777 by Karl Sabbagh (ISBN**:** 0684807211, Publisher: Scribner 1996)

SOFTWARE: Excel

COURSE DESCRIPTION:
This course is designed to enable engineers, scientists, and analysts from all disciplines to recognize potential benefits resulting from the application of robust engineering design methods within a systems engineering context. By focusing on links between sub-system requirements and hardware/software product development, robust engineering design methods can be used to improve product quality and systems architecting. Topics such as Design and Development Process and Methodology, Need Analysis and Requirements Definition, Quality Engineering, Taguchi Methods, Design of Experiments, Introduction to Response Surface Methods, and Statistical Analysis of Data will be presented.

COURSE PREREQUISITES: none

COURSE OBJECTIVES: This purpose of this course is to provide the students with the following capabilities:
Objective 1: To apply modern software packages to conduct analysis of real world data.
Objective 2: To understand the technical underpinning of robust engineering design.
Objective 3: The ability to apply the appropriate analytical techniques to a wide variety of real world problems and data sets.
Objective 4: To summarize and present the analysis results in a clear and coherent manner.

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STUDENT PERFORMANCE ASSESSMENT:

Graded Events	% of Course
Class Homework Portfolio	15
Class Discussions	30
Term Papers	20
Team Project	35
Course Total	100

Projects and Homework

Projects and homework are scheduled for submission on the dates shown on the "Lesson Schedule." Prior approval must be received for late submissions.

Re-grading

If you would like to submit a homework assignment, exam, or project for re-grading, please do not write anything on your paper before you resubmit it. Instead, simply attach a sheet of paper listing the problem numbers you would like to be regarded and what your issues are with the grading. **You must submit your concerns in writing in order for a problem or project to be re-graded.**

GRADING AND CRITERIA FOR PASSING:

(1) Turn in all written material (see Lesson Schedule).
(2) Final grades will be awarded in accordance with the following scale:

Grade	Percentage
A	90 - 100
B	80 - 89
C	70 - 79
F	<70

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Schedule for SDOE 655 Robust Engineering Design

Class No.	Topic	Reading	Assignments
1	Overview of Class and Team Project Introduction to Quality Engineering	*FuzzySet.pdf* and *QFDMatrix.pdf*	
2	Deterministic and Probabilistic Models I o Basic Concepts o Terms and Definitions o Descriptive Statistics o Basic Probability Concepts o Random Variables o Probability Distributions o Probability Plots o Pareto Concept	Chapter 1 of RE Class Slides	F & C, Chapter 1: Q 1,2 and 12.
3	Deterministic and Probabilistic Models II o Statistical Inference o Point and Interval Estimates of Parameters o Confidence Intervals o Hypothesis Testing o Characteristics of Estimators	Chapter 2 of RE Class Slides	F & C, Chapter 1: Q 1, 2 and 12.
4	Deterministic and Probabilistic Models III o Design of Experiments o Introduction o Sample Size Determination o Randomization o Analysis of Variance (ANOVA) o Correlation and Regression Analysis	Chapter 3 of RE Class Slides	Portfolio Problem 3
5	Quality Loss Function o Introduction o Tolerance Limits o Quadratic Quality Loss Function o Alternative Quality Loss Functions o Smaller-the-better o Larger-the-better o Asymmetric Loss Function o Average Quality Loss	Chapter 4 of RE Class Slides	F & C, Chapter 3: Q 4, 7 and 10.
7	Dynamic Problems o Zero-point Proportional o Reference-point Proportional o Non-linear Dynamic Problems o Double-dynamic o Continuous-Digital o Digital-Continuous o Digital-Digital o Double Signals o Classified Attributes o S/N Ratio with Complex Numbers o Incomplete Data	Chapter 6 of RE Class Slides	F & C, Chapter 6: Q 1, 5 and 9.

Class No.	Topic	Reading	Assignments
8	Orthogonal Arrays o Introduction o Degrees of Freedom o Selecting a Standard Orthogonal Array o Dummy Level Technique o The Compound Factor Method o Linear Graphs and Interaction Assignment o Confounding of Interactions with Factor Effects o Interaction Table o Linear Graphs o Interaction for 3-level Factors o Modification of Linear Graphs o Strategy for Constructing an Orthogonal Array o Beginner Strategy o Intermediate Strategy o Advanced Strategy o Comparison of Robust Design with Classical Statistical Experimental Design. o Differences in Problem Formulation o Differences in Experimental Layout o Differences in Data Analysis	Chapter 7 of RE Class Slides	F & C, Chapter 7: Q 1,7 and 12.
10	Performing Data Analysis o Introduction o Determining Optimum Levels o Predicting Optimum Performance o Verifying Optimum Performance o Examples of Parameter Design	Chapter 9 of RE Class Slides	F & C, Chapter 11: Q 1. Chapter 12: Q 1, 7, 10.
11	Design Of Experiments, ANOVA o Introduction o Build-Test-Fix Experiments o One Factor-at-a-Time Experiments o Full Factorial Experiments o Completely Randomized Design o Randomized Block Design o Latin Square Design o Fractional Factorial (Orthogonal Array) Experiments o Analysis of Means o Degrees of Freedom o Other Experimental Designs	Chapter 10 of RE Class Slides	F & C, Chapter 17: Q 1, 8 and 9. Term Paper II, based on IBD.
12	Advanced Topics o Interactions o Relationship between RD and other Quality Processes o Robust Testing	Class Slides	Team Project
13	Summary and Course Review o Summary o Graded Requirements	Class Slides	Team Project