

Department of Industrial Engineering
INEN 414 – Elective Course
Total Quality Engineering

CATALOG DESCRIPTION

Introduction to the principles of total quality engineering; total quality management philosophy, engineering approaches for designing quality into products and processes; off-line experimentation methods for the robust design; emphasis on teamwork and continuous quality improvement.

PREREQUISITE

INEN 314 or equivalent

COURSE OBJECTIVES

(1) Learn formulations, models, and analytical procedures for designing quality into products and processes; (2) Understand the connection between ISEN 414 to six-sigma program; (3) Learn fundamental principles of robust design and off-line experimentation techniques; (4) Be able to implement the robust design tools in industrial applications; (5) Improve team working skill, data-collecting, and experiment planning capability.

TEXTBOOK AND ADDITIONAL COURSE MATERIAL

Textbook: Myers, R.H. and Montgomery, D.C., 2002, *Response Surface Methodology: Process and Product Optimization Using Designed Experiments*, 2nd edition, John Wiley and Sons.

References: Montgomery, D.C, 2001, *Design and Analysis of Experiments*, 5th edition, John Wiley and Sons.

Software used in this course: MATLAB, Microsoft EXCEL

TOPICAL OUTLINE

Product development cycle; the philosophy of designing quality into products and processes; role of response surface methodology; three basic experimentation principles; data analysis procedure and decision making process; One-factor-at-a-time versus factorial design; 2-level factorial design; ANOVA table; Unreplicated design and half normal plot; fractional factorial design; center composite design (CCD); canonical analysis; concepts of robust design (Taguchi method); Taguchi quality loss function; uncontrollable noise factors vs. controllable factors; Cross-array method.

PROFESSIONAL COMPONENT

This course provides fundamental concepts, theory and procedures for the study of robust process/product design for production realization. Analytical procedures are developed to enhance the decision-making process in the design, improvement, and evaluation of quality control (QC) engineering techniques. The knowledge learned in this course will be practiced through ten lab sessions targeting different key QC concepts and techniques. This course is one of the two QC related courses that demonstrate how modern statistical technology will be applied to production and quality control. Together with INEN 314, the QC curriculum covers two pillar technologies in every Six Sigma training problem -- INEN 314 for Statistical Process Control and INEN 414 for Response Surface Methodology.

PROGRAM OUTCOMES

(A) To demonstrate that graduates have an ability to apply knowledge of mathematics, science, and engineering, students should be able to

- determine an appropriate probabilistic model for the data and identify interval, point estimates for key process parameters, and draw conclusions regarding whether point estimates are sufficiently accurate;
- given loosely stated objectives for drawing conclusions from the data, define and conduct appropriate statistical hypothesis tests;
- conduct data analyses to ascertain whether a process is in a state of statistical control.

(B) To demonstrate that graduates have an ability to design and conduct experiments as well as analyze and interpret data, students should be able to

- translate imprecise verbal experimental objectives regarding the nature of a process into an appropriate set of hypotheses to be tested;
- determine the factors, levels, and the associated optimal experimental plan;
- following the fundamental experimentation principles, convert an experiment design matrix into an actual experiment planning matrix;
- conduct a formal statistical hypothesis test and compile and communicate convincing evidence (in statistical, visual, and verbal form) regarding the truth of the hypotheses.

(D) To demonstrate that graduates have an ability to function on multidisciplinary teams, students should be able to

- coordinate with team members during lab sessions for conducting experiments;
- elaborate and interpret experiment results and physical phenomena based on team discussion.

(E) To demonstrate that graduates have an ability to identify, formulate, and solve engineering problems, students should be able to

- identify the potential key factors affecting product and process quality;
- design and conduct experiments, data collection processes, and statistical data analyses processes for understanding the statistical measures and their inherent uncertainty;
- quantify the impact on process variability of bringing a process into a state of statistical control.

(I) To demonstrate that graduates have a recognition of the need for, and an ability to engage in life-long learning.

Throughout the development of the class, a few factors are particularly emphasized as being relevant in the total quality engineering, including the importance of designing quality into product life cycle; the concept of designing robust processes that is insensitive to unexpected disturbances; the capability of identifying future factors influencing product/process quality; the benefit of connecting this course to a broad spectrum of continuous quality improvement. All these factors are dynamic in nature and allow the students to recognize the importance of being life-long learners, particularly since the factors are present in a number of open-end problems that must be addressed in real-life applications.

(K) to demonstrate that graduates have an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice, students should be able to

- all of the above bullets for outcomes (A), (B), and (D);
- use statistical software or toolbox (such as MATLAB or Excel) to facilitate data analyses.

Student's w/Disabilities:

The Americans with Disabilities Act (ADA) is a federal anti-discrimination statute that provides comprehensive civil rights protection for persons with disabilities. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you believe you have a disability requiring an accommodation, please contact Disability Services (visit <http://disability.tamu.edu>, call 845-1637, or go to Cain Hall Room B118).

Academic Integrity:

The Aggie Honor Code states that “An Aggie does not lie, cheat, or steal or tolerate those who do.” Upon accepting admission to Texas A&M University, a student immediately assumes a commitment to uphold the Honor Code, to accept responsibility for learning and to follow the philosophy and rules of the Honor System. Ignorance of the rules does not exclude any member of the Texas A&M University community from the requirements or the processes of the Honor System. For additional information, please visit: www.tamu.edu/aggiehonor.

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