ENG ME 308 Statistics and Quality Engineering

2008-2009 Catalog Data:
ENG ME 308 Statistics and Quality Engineering Prereq: CAS MA 225. Four main concepts of quality engineering—Acceptance, Sampling, Real Time Quality Control, and the Taguchi method for product quality improvement—are introduced as applications of key concepts in probability and statistics. Principles of probability and statistics including events, Bayes theorem, random variables, functions of random variables, sampling distributions, and parameter estimation are also covered. May not be taken for credit in addition to ENG ME 500 or ENG EC 381 or ENG BE 200. 4 cr., either sem.

Class/Lab Schedule: 4 lecture hours per week

Status in the Curriculum: Required in Manufacturing Program

Textbook(s) and/or Other Required Material: W. W. Hines and D. C. Montgomery, D. M. Goldsman, C. M. Borror *Probability and Statistics in Engineering*, (4th edition) Wiley, 2003

Coordinator: Michael Caramanis, Professor, Mechanical Engineering

Prerequisites by topic:
1. Calculus at the level of MA 225 Multivariate Calculus with particular emphasis on graphing inequalities, setting and evaluating multiple integrals.
2. Sequences and series including geometric progressions and their limits.
3. Introductory Discrete Mathematics notions on propositional logic, set theory, relations, and combinatorics (reviewed)
4. Fundamentals of Mathematical analysis including continuity, sets, linear transformation properties, single valued functions and inverse functions.
5. Basic understanding of manufacturing processes, measurement, and calibration as covered in engineering courses such as ENG EK 156 Design and Manufacture.

Goals:
Provide undergraduate students with the fundamentals of axiomatic probability theory and an introduction to statistics including sampling distributions and hypothesis testing. Quality control concepts and applications are introduced throughout the course by means of systematically selected examples focusing on control limit design, acceptance sampling, estimation, hypothesis testing, sampling design and response surface characterization.

Course Learning Outcomes:

Students completing this course will:
i. Acquire basic skills of probability, statistics, and statistical quality control
ii. Develop an appreciation of the fact that lack of exact/deterministic knowledge about the state of a system does not mean lack of knowledge altogether. In fact, a probabilistic model that captures the available information is possible.

iii. Learn how to build probabilistic models that describe imperfect system state information. Moreover, learn how to update these models so that they incorporate additional information that may become available over time in an incremental manner.
iv. Develop problem solving approaches to learning or acquiring information of interest through sampling, and more generally through selecting trial configurations (designs) whose performance is to be observed or sampled.
v. Understand how redundancy of functional components of a system or the interconnection architecture of system components affect system reliability.
vi. Learn how to use available information in the form of measurements related to the unpredictable output of a process to construct a systematic description/knowledge of the process' variability.
vii. Are able to design diagnostic procedures for real time determination of the likely state of a manufacturing process.

Course Learning Outcomes mapped to Program Outcomes:

Program:	A	B	C	D	E	F	G	H	I	J	K	L	M	N
Course:	ii-vii	ii-vii	v-vi		ii-vii			ii,iii	iii	ii, iii	i- vii	iv,vi	ii, iii	ii-vii
Emphasis:	5	5	2	2	4	2	2	3	2	3	4	3	2	4

Topics (time spent in weeks):

1. Axioms of Probability Theory, sets, events, classes of events, measure theory concepts. (1.5)
2. Conditional probability and independence, Bayes theorem, probability models as a means to quantify available and obtainable information about non-deterministic quantities. (2.5)
3. Discrete mathematics and complex random experiments. Repeated trials, binomial distribution and its relationship to the Normal and Poisson distributions. Relationship of Poisson and exponential processes and the memoryless property. (2)
4. Random variables, density and distribution functions, expectation, conditional expectation, non-linear and linear regression. (2)
5. Functions of random variables and derived distributions. Order statistics and reliability engineering fundamentals. (2)
6. Monte Carlo simulation, random samples, statistics as estimators. (1.5)
7. Sampling distributions and hypothesis testing. Design of Quality Control Charts for on line SPC. (1)
8. Introduction to Design of Experiments concepts and ANOVA. Introduction to six sigma goals and philosophy. (1)

Contribution of Course to Meeting the Professional Component:
Engineering topics: 90%, Mathematics: 10%

Status of Continuous Improvement Review of this Course:
Prepared by: Professor Michael Caramanis **Date:** 4/10/2009