ENRE 447
Fundamentals of Reliability Engineering
Spring 2016 – Monday 3:30-6:00 PM – 3 units
Classroom: TBD
Course Syllabus

Instructor: Prof. Mohammad Modarres
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Office hours: Monday 2:00pm – 3:00pm

TA: TBD
Grader: TBD

Course Description:
Reliability engineering is an engineering field that deals with the study of life performance of engineering structures, components and systems. Formally it determines the probability that a product or system will perform its intended function for a specified period of time under specified environmental conditions. The function of reliability engineering is to develop the reliability requirements for the product, establish an adequate reliability program, and perform appropriate analyses and tasks to ensure the product will meet its requirements. A reliability engineer, who usually holds an accredited engineering degree and has additional reliability-specific education and training, manages these tasks.

This course provides a general survey of the complete field of reliability engineering. The course is designed to give a thorough philosophical base for reliability engineering and mathematical techniques used along with frequent examples of application. Students completing this course will have a good understanding of the actions and goals of a state-of-the-art reliability program. Examples will cover a range of different applications with the objective of helping the student to appreciate the challenges in the varied components of development and production of complex products and systems. This course will discuss how things fail as well as how to estimate when a system will fail. Life-models for non-repairable items include the Weibull, Exponential, Lognormal, and Binomial distributions will be discussed. When analyzing the failure of systems, reliability block diagrams, fault trees, FMEA, and Markov models will be discussed which will be discussed in this course.


Grading:
Homework - 35%
Midterm Exam – April 4 (1.5-hour, open books and open notes) - 30%
Final Exam (2.0 hours, cumulative, open books and notes) - 35%

Assignment:
Seven homework assignments (one every two-weeks).
TOPICS COVERED

Reliability Engineering in Perspective (1 Week)
- Why Study Reliability?
- Failure Models
- Failure Mechanisms
- Performance Measures
- Formal Definition of Reliability

Basic Reliability Mathematics: Review of Probability and Statistics (~4 Weeks)
- Elements of Probability
  - Sets and Boolean Algebra
  - Basic Laws of Probability
  - Bayes’s Theorem
- Probability Distributions
- Random Variables
- Basic Characteristics
- Definition of Probability Distributions
- Definition of Probability Density Function
- Cumulative Distributions
- Multivariate Distributions
- Marginal Distributions
- Conditional Distributions
- Truncated Distributions
- Mean/Median/ Modes of Distributions
- Some Basic Discrete Distributions
- Some Basic Continuous Distributions
- Estimation and Hypothesis Testing
- Frequency Tables and Histograms
- Goodness-of-Fit Tests
- Regression Analysis

Component Reliability Analysis (~5 Weeks)
- Concept of Reliability
- Common Distributions in Component Reliability
- Elements of Reliability Data and Maximum Likelihood Estimation
- Sources and Forms of Reliability Data
- Reliability Model Selection and Estimation
- Probability Plotting with Application to Selected Distribution Function
- Classical Nonparametric Distribution Estimation
- Complete and Singly Censored Data
- Exponential Distribution Interval Estimation
- Lognormal Distribution
- Weibull Distribution
- Binomial Distribution

System Reliability Analysis (~3 Weeks)
- Reliability Block Diagram Method
- Fault Tree, Event Tree and Success Tree Methods
- Evaluation of Logic Trees
- Failure Mode and Effect Analysis
- Bayesian Estimation Procedures