SE 411 – Reliability Engineering

Spring 2022

CRN: 66938 (U) or 66939 (G)
Time: TR 2:00 - 3:20
Room: TB-203
Course Website: https://canvas.illinois.edu/courses/18183

Course Introduction: This introductory course will provide the concepts of reliability engineering, practical issues and methodology in reliability modeling and analysis, reliability data analysis, testing, and reliability-based design optimization. Students will learn the foundation of reliability engineering through lectures and directed classroom discussion. Course objectives include:

- Provide students with an understanding of the fundamental concepts of reliability engineering.
- Develop an understanding of the role of reliability in system design.
- Provide an understanding of the processes by which real-life problems are analyzed through reliability engineering principles.

Instructor and TA Information:

- Instructor: Dr. Pingfeng Wang
  Email: pingfeng@illinois.edu
  Office: 310 Transportation Building
  Office hours: 3:30pm to 4:30pm on Tuesday, or by appointment

- Teaching Assistant: Ms. Yanwen Xu
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  Office: 18 Transportation Building
  Office hours: 3:30 pm to 4:30pm on Thursday, or by appointment

Textbook References:

- An Introduction to Reliability and Maintainability Engineering, 3rd Edition, Charles, E. Ebeling, 2019;
- Lecture notes and handouts from the class (Dr. W. Brent Hall).
- Engineering Design under Uncertainty and Health Prognostics, Hu, C., Youn, B., and Wang, P., 2019 (online available).

Learning Objectives: After completing this course, students can

- Use first order and advanced methods to estimate the reliability of components and systems that can be modeled by failure theories or performance functions.
- Determine a design safety factor, or other parameter, to be used in a design equation to achieve a target reliability.
- Find the reliability of series, parallel and more complicated systems based on component characteristics, system structure, dependency, redundancy, and other properties.
- Predict reliability as a function of time, based on failure rate models of early life, useful-life and wear-out life, or Weibull analysis of test data.

- Estimate parameters from strength- or life-test results, and account for the effects of sample test uncertainty on a reliability estimate.
- Describe basic features and qualitatively apply techniques of: failure modes and effects analysis, fault tree analysis, quality control and reliability economics.

Prerequisite: IE 300, Analysis of Data; or per the instructor's approval.

Evaluation: Students are expected to complete their homework/exams on their own. In addition, one term project will be evaluated based on the project report. Graduate students will have the second term project to account for one additional credit hour. The evaluation of students' work is the instructor's professional judgment and is **not subject to negotiation.** Incomplete "**I**" will not be given out, unless there are very special circumstances.

Grading: The overall grade of the course will be assembled based on

Quizzes (10%); Homework (20%); Term Projects (20%); Exams (50%)

A+: 97 – 100%	A: 93 – 96%	A-: 90 – 92%
B+: 87 – 89%	B: 83 – 86%	B-: 80 – 82%
C+: 77 – 79%	C: 73 – 76%	C-: 70 – 72%
D+: 67 – 69%	D: 63 – 66%	D-: 60 – 62%

Academic Integrity: We will follow university regulations for academic integrity: (http://admin.illinois.edu/policy/code/). Students who violate academic integrity will receive a "0" on that exam or assignment and may receive an "F" grade in the course. Discussing a homework assignment in a group is encouraged as long as each student writes the answer in his/her own words. Plagiarism is considered a serious violation of academic integrity and will be dealt with utmost severity.

Tentative Class Content

1. Failure Modeling and Reliability Engineering in Perspective
2. Basic Reliability Mathematics- Review of Probability and Statistics
3. Reliability Engineering
   - Failure Time Distributions
   - Failure Rate Models and Reliability
   - System Reliability
   - Reliability and Redundancy Allocation
   - Fault Tree Analysis
4. Probability of Failure Analysis and Design
   - Sampling Methods
   - First-Order Reliability Methods (FORM)
   - Other Reliability Analysis Methods
   - Reliability-based Design Optimization
5. Accelerated Life Testing (ALT)
6. Reliability Data Analysis
7. Maintainability Analysis
8. Other Selective Topics