SE 411 **Introduction to RELIABILITY ENGINEERING** **Spring 2021**

Instructor: Prof. Girish Krishnan, e-mail: gkrishna@illinois.edu, all instructions will be virtual.

Course Website: Compass 2g

Course Objectives: After completing this course the student will be able to

- Use first-order second-moment 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 index
- Predict reliability as a function of time, based on failure rate models of early-life, useful-life and wearout life, or Weibull analysis of life-test data
- Find the reliability of series, parallel and more complicated systems based on component characteristics, system structure, dependency, redundancy, and other properties
- 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/or qualitatively apply: failure modes and effects analysis, fault tree analysis, quality control, reliability economics, risk and safety.

Prerequisites: IE 300 or equivalent with consent of instructor.

Textbooks and Materials:

- Required: Course notes by Prof. Hall and Prof. Krishnan
- Optional: (1). Nowak and Collins, *Reliability of Structures*, McGraw-Hill.
  (2) P. D. T. O'Connor, *Practical Reliability Engineering*, Wiley

Grading:

Homework (7):	30%
Midterm Tests (2):	40%
Final Exam:	20%
Project:	10%

Credit: 3h for seniors and graduate students.
4h credit for graduate students who complete a project.

SCHEDULE OF TOPICS

Weeks 1-2: **1.** Introduction and Review of Probability Concepts: Reliability vs. probability. Event probabilities and algebra, probability distributions. Functions of random variables, first-order approximations, and fundamental models.

Weeks 3-6: **2.** Component Reliability Analysis and Design: Models of load and resistance, single failure-mode analysis, limit state function, probability of failure, FOSM reliability index. Models of sums, products and extremes. Reliability-based design, safety factor relationships. AFOSM "design-point" methods. Normal plotting. Simulation methods.

Weeks 7-9: **3.** Reliability in the Time Domain: Time dependent loads and resistance. Failure rate concepts and the "bathtub" curve. Early life, useful life, wear-out reliability. Time-to-failure distributions. Influence of temperature and environment. Weibull analysis.

Weeks 9-12: **4.** System Reliability: System structures and features, redundancy, independence. Series and weakest-link systems. Non-independent systems. Active parallel, stand-by and ductile systems. Tri-state devices, availability. Minimal cut and tie sets. Simulation.

Weeks 13-15: **5.** Testing, Management and Safety: Life testing, parameter estimation, sample size and uncertainty, proof testing. Failure mode and effects analysis, fault tree analysis, quality control, gross error. Reliability economics, safety and risk.