

**Instructor:** Prof. Girish Krishnan, e-mail: [gkrishna@illinois.edu](mailto:gkrishna@illinois.edu)

**Course Schedule:** Tuesdays and Thursdays 2 pm to 3.20 pm. 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:**

- Charles E. Ebeling, *An Introduction to Reliability and Maintainability Engineering*, Third Edition, Waveland Press Inc.
- 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

<b>Grading:</b>	Homework (7):	30%	Credit:	3h for seniors and graduate students.
	Midterm Tests (2):	40%		4h credit for graduate students who complete
	Final Exam:	20%		two graduate projects.
	Project:	10%		

**SCHEDULE OF TOPICS**

- Weeks 1-6: **1. 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. Multiple Failure-mode analysis, Simulation methods.
- Weeks 7-9: **2. 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 9-13: **3. 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 14-15: **4. 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.

Week/ Date		Course Topic	Notes on Assignments	
Week 1	1/21	Lec. 01: Course Introduction	HW-1 Assigned	
	1/23	Lec. 02: Definition of Reliability		
Week 2	1/28	Lec. 01: Distributions	HW-2 Assigned	HW-1 due
	1/30	Lec. 02: Reliability Index and Design		
Week 3	2/4	Lec. 01: AFOSM methods (Analytical)		
	2/6	Lec. 02: AFOSM methods (Computational)	HW-3 Assigned	HW-2 Due
Week 4	2/11	Lec. 01: AFOSM methods (Some Examples)		
	2/13	Lec. 02: AFOSM multiple failure modes		
Week 5	2/18	Lec. 01: Simulations		
	2/20	Lec. 02: Reliability Based Design Optimization		HW-3 Due
Week 6	2/25	Lec. 01: Reliability Based Design Optimization	Grad Project I assigned	
	2/27	<b>Exam-I</b>		
Week 7	3/4	Lec. 1: Time Dependent Reliability (Concepts)	HW-4 Assigned	
	3/6	Lec. 2: Time Dependent Reliability		
Week 8	3/11	Lec. 1: Time Dependent Reliability		
	3/13	Lec 2: Introduction to System Reliability		
Week 9	3/18	Spring Break (no class)		
	3/20			
Week 9	3/25	Lec. 1: System Reliability (series, parallel etc.)	HW-5 Assigned	HW-4 Due
	3/27	Lec. 2: System Reliability continued...		
Week 10	4/1	Lec. 1: Chains and Weakest links		
	4/3	Lec. 2: Review	Project II Assigned	HW - 5 due
Week 11	4/8	<b>Exam-II</b>		
	4/10	Lec. 1: Chains and Weakest links	HW-6 Assigned	
Week 12	4/15	Lec. 1: Repairability, Availability,		
	4/18	Lec. 2: Repairability, Availability,		
Week 13	4/23	Lec. 1: Fault Tree Continued, FMEA		
	4/25	Lec. 1: Fault Tree Continued, FMEA	HW-7 Assigned	HW-6 Due
Week 14	4/30	Lec. 2: Testing and Analysis		
	5/01	Lec. 3: Testing and Analysis		
Week 15	5/06	Summary & Final Exam Review		HW -7 due
	5/4	Ready Day (no class)		Grad Projects Due
5/6 - 5/13		<b>Final Exam</b> (Date TBD)		