Course Syllabus

Design for Reliability

ENME 695
Spring 2025

Course Description

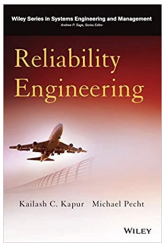
Reliability is the ability to perform as intended, without failure and within specified performance limits, for a specified time in its life-cycle conditions. Knowledge of reliability concepts and principles and risk assessment, mitigation, and management strategies prepare engineers to contribute effectively to product development, life-cycle management, and product safety. This course teaches the fundamental knowledge and skills of reliability concerning the design, manufacturing, and use of engineered products and systems. Specifically, students will learn how to:

- Apply design and analysis tools such as failure modes, mechanisms, and effects analysis, fault tree analysis, design of experiments, and reliability prediction to aid design for reliability.
- Implement derating as needed.
- Plan and implement product testing to assess reliability.
- Assess the suitability of the supply chain members to contribute to the development, manufacturing, distribution, and support of reliable products.
- Understand process capability and process control in manufacturing.
- Analyze degradation, failure, and warranty return data to estimate fundamental reliability parameters.
- Conduct root cause analysis.
- Implement prognostics and health monitoring to ensure system availability and safety.
- Address reliability issues associated with warranties, regulatory requirements, and liabilities.

This is an interdisciplinary course, and students in all science, engineering, and business areas are welcome. Students will learn the basic scientific foundations of reliability with real-life applications. In addition to the course instructors, experts from industry and academia will lecture in this course.

Required Resources

Course website: elms.umd.edu



Reliability Engineering:
Kailash C. Kapur and Michael G. Pecht
ISBN: 978-1-118-14067-3
First edition (2014).

Co-listed as ENRE 695

Prof. Michael Pecht
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Class Meets
Monday
09:30 am – 12:10 pm
J.M. Patterson Building
BLD #083, Room 2217

Teaching Assistant
TBD

Office Hours
TA – TBD
Dr. Das - Tu 11-12 on Zoom (Link will be shared through Google Calendar)
Please get in touch with the instructors to set up an appointment or communicate through the ELMS channels for other times.

Prerequisites
Undergraduate degree in engineering, science, or mathematics

Course Communication
Ask questions whenever they occur to you.

Use communication tools on the class web page.

Campus Policies

It is our shared responsibility to know and abide by the University of Maryland's policies that relate to all courses, which include:

- Academic integrity
- Student and instructor conduct
- Accessibility and accommodations
- Attendance and excused absences
- Grades and appeals
- Copyright and intellectual property

Papers and Research Documents

In addition to the book, articles, news information, and other documents will be assigned as required reading. The contents of these articles are part of the course and exam coverage.

Academic Integrity

The University of Maryland, College Park, has a nationally recognized Code of Academic Integrity administered by the Student Honor Council. This Code sets standards for academic integrity in Maryland for all undergraduate and graduate students. As a student, you are responsible for upholding these standards for this course. You need to be aware of the consequences of cheating, fabrication, facilitation, and plagiarism. For more information on the Code of Academic Integrity or the Student Honor Council, please visit the website through the link below: https://academiccatalog.umd.edu/undergraduate/registration-academic-requirements-regulations/academic-integrity-student-conduct-codes/.

Grades

All the on- and off-campus students are required to take two exams and do homework individually (and as a group when assigned). The breakdown of the grades is as follows:

- Midterm Exam: 25% of the total grade
- Final Exam: 35% of the total grade
- Homework: 40% of the total grade

All the on-campus (section 0101) students will take the midterm exam from 9:30 am to 10:45 am on Mar 10. The exam will be held in the classroom. The online students can take the exam in class with the on-campus.

All online students (Sections ER01 and RE01) must take the midterm between 9 pm on Sunday (Mar 09) and 9 pm on Tuesday (Mar 11). The exams will be sent to pre-approved proctors through a secure site or by email for examination administration.

The schedule for the final examination will be communicated once the University confirms the date.

More Details about Exams

- All students taking this course must take midterm and final exams.
    - Each student can bring **one sheet** of letter-sized paper with notes on both sides for the midterm exam and **two sheets** of letter-sized paper with notes on both sides for the final exam.
    - Notes can be handwritten or printed.
    - Students taking the exam should **not** use (bring in) any books, reference materials, computers, or **calculators**. Communication devices (e.g., phones, tablets, and smartphones) must be turned off.
- On-campus (section 0101) students are required to take exams in class.
- Online students (sections ER01 and RE01) need to take the tests as proctored exams unless they choose to take the exam in class. More details about proctoring can be found at https://mage.umd.edu/proctoring.

More Details about Homework

- Homework will be assigned each Monday and will be due the following class day before the class (09:29 am). Please see the Assignments section on ELMS for the due date and upload your HW on ELMS before the due date and time.
- Late work will not be accepted for credit.

All assessment scores will be posted on the course ELMS page. If you would like to review any of your grades (including the exams) or have questions about how something was scored, please email the instructors and TA to schedule a meeting time. We will be happy to discuss any of your grades, and if we make a mistake, we will immediately correct it. Any formal grade disputes must be submitted in writing within one week of receiving the grade.

Draft Course Schedule (ENME695 – Spring 2025) – Subject to Change

Class #	Date	Lecture Topics	Reading Materials (Textbook Chapters)	Instructor(s)
1	01/27	• Reliability engineering in the 21st century – what is important? • Reliability concepts	Chapter 1 Chapter 2	Prof. Pecht

2	02/03	• Probability and life distributions for reliability analysis and experiment –
		  • Continuous
		  • Discrete
			Chapter 3	Prof. Pecht
				Dr. Das

3	02/10	• Confidence interval concepts • Weibull++ (including "ALTA") Software tutorial and experiment	Chapter 13	Dr. Azarian Dr. Das
4	02/17	• Conclusion of software tutorial and discussion of HW queries • Parts selection and management • Change and change notification	Chapter 9	Dr. Das
5	02/24	• Product requirements, constraints, and specifications and how to meet reliability objectives • Life cycle conditions	Chapter 6 Chapter 7	Prof. Pecht
6	03/03	• System reliability modeling • Fault tree analysis • Software tutorial (BlockSim)	Chapter 17 Chapter 5	Dr. Das
7	03/10	• **Midterm exam** • Physics of failure-based reliability assessment	Chapters 5 and 13	Dr. Azarian
	03/17	• Spring break		

Class #	Date	Lecture Topics	Reading Materials (Textbook Chapters)	Instructor(s)
8	03/24	• Process control and process capability • Reliability capability and key reliability practices	Chapter 14 Chapter 8	Dr. Das Dr. Azarian
9	03/31	• Derating • Product screening and burn-in	Chapter 12 Chapter 15	Dr. Das
10	04/07	• Product qualification and accelerated testing	Chapter 13	Prof. Pecht
11	04/14	• Failure modes, mechanisms, and effects analysis • Analyzing product failures and root causes	Chapter 10 Chapter 16	Dr. Azarian
12	04/21	• Use of digital twins for reliability verification and validation • Does adherence to quality standards improve product reliability – a NASA case study		Andrew Vechart, Bell Textron, Inc. Dr. Bhanu Sood, GSFC, NASA
13	04/28	• Issues regarding warranty • Investigations involving advanced driver assistance systems – man, machine, or in between	Chapter 19	Peter Rundle, Rundle Law Corporation Robert L. Swaim, How It Broke (Retired NTSB)
14	05/05	• Life cycle costing based on reliability and maintainability principles Sustainment – logistics, spares, maintenance, and contracts		Prof. Peter Sandborn
	05/12	• Issues in battery safety • Battery failure mechanisms		Dr. Judy Jeevarajan, ULRI Sahithi Maddipatla, UMD
	TBD	Final Exam		

This is a tentative schedule and is subject to change as necessary – monitor the course ELMS page for current deadlines - adjustments to the course schedule, deadlines, and assignments may be made.