Course Syllabus

Design for Reliability

ENME 695
Spring 2027

Course Description

Reliability is the ability to perform as intended, without failure and within specified performance limits, for a specified time in its lifecycle conditions. It is a fundamental pillar of engineering that transcends mere functionality; it is the promise of consistent performance, safety, and trust over a product's entire lifecycle. From preventing catastrophic failures in aircraft and medical devices to ensuring the daily dependability of a car or smartphone, reliability has a direct impact on user safety, brand reputation, financial viability, and environmental sustainability. This class on reliability provides a systematic methodology for building quality in from the start, moving beyond simply fixing failures when they occur. It equips engineers with rigorous tools, including failure modes, mechanisms, and effects analysis, accelerated life testing, statistical modeling, and robust design principles, to proactively predict, prevent, and mitigate failures. The goal is to transform reliability into a quantifiable, manageable, and engineered characteristic, ultimately saving lives, protecting resources, and building the foundation for long-term success in an increasingly complex technological world. Knowledge of reliability concepts and principles, as well as risk assessment, mitigation, and management strategies, prepares engineers to contribute effectively to product development, lifecycle management, and product safety. Specifically, students will learn how to:

- Apply design and analysis tools, such as failure modes, mechanisms, and effects analysis, fault tree analysis, and reliability prediction, to aid in 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 fundamental scientific principles of reliability and their real-life applications. In addition to the course instructors, experts from industry and academia will lecture in this course.

Co-listed as ENRE 695

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

Office Hours
Dr. Das - Tu 11-12 on Zoom (Link will be shared through Google Calendar)
Please contact the instructors to arrange an appointment or communicate through the ELMS channels.

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.

Required Resources

Course website: elms.umd.edu

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

Books at the STEM library reserve

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 on- and off-campus students are required to take the exams. The breakdown of the grades is as follows:

- Midterm Exam: 35% of the total grade
- Final Exam: 65% of the total grade

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

Online students are encouraged to take the exam in class with on-campus students. All other online students (Sections ER01 and RE01) must take the midterm on either March 8 or 9. No exceptions can be made to this requirement outside of the University-approved excused absence policy. The exams will be sent to pre-approved proctors through a secure site or by email for examination administration. The final examination schedule will be communicated once the University confirms the date.

More Details about Exams

- All students enrolled in this course are required to take the 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) are required to take the tests as proctored exams, unless they choose to take the exam in class. For more details about proctoring, please visit **https://mage.umd.edu/proctoring.**

More Details about Homework

There will be no graded homework. However, problems will be provided and posted on the course ELMS page to give students a sense of what should be learned and what types of questions might appear on the exam.

Course Schedule – Subject to Updates

Class #	Date	Lecture Topics	Reading Materials (Textbook Chapters)	Instructor(s)
1	02/01	• Reliability engineering in the 21st century – what is important? • Reliability concepts	Chapter 1 Chapter 2	Prof. Pecht

2	02/08	• Probability and life distributions for reliability analysis and experiment –
		  • Discrete
		  • Continuous
		• Confidence interval concepts
			Chapter 3	Dr Azarian

3	02/15	• Weibull++ (including "ALTA") Software tutorial and experiment		Dr. Das
4	02/22	• Product requirements, constraints, and specifications, and how to meet reliability objectives • Life cycle conditions	Chapter 6 Chapter 7	Prof. Pecht
5	03/01	• Parts selection and management • Change and change notification	Chapter 9	Dr. Das
6	03/08	• **Midterm exam** • System reliability modeling	Chapter 17	Dr. Das

Class #	Date	Lecture Topics	Reading Materials (Textbook Chapters)	Instructor(s)
	03/15	• Spring break		
7	03/22	• Fault tree analysis • Software tutorial (BlockSim)	Chapter 17	Dr. Das
8	03/29	• Reliability capability and key reliability practices • Failure modes, mechanisms, and effects analysis: Physics of failure	Chapter 8 Chapters 5, 13, 15, and 16	Dr. Azarian
9	04/05	• Process control and process capability	Chapter 14	Dr. Das
10	04/12	• Product qualification and accelerated testing	Chapter 13	Prof. Pecht
11	04/19	• Product screening and burn-in • Derating	Chapter 15 Chapter 12	Dr. Das
12	4/26	• Analyzing product failures and root causes	Chapter 19	Dr. Azarian
14	05/03	• TBD		TDB
15	05/10	• Life cycle costing based on reliability and maintainability principles • Sustainment – logistics, spares, maintenance, and contracts		Prof. Peter Sandborn
	TBD	Final Examination		

This tentative schedule is subject to change as necessary. Please monitor the course ELMS page for current deadlines, as the schedule, deadlines, and assignments may change.