

King Fahd University of Petroleum & Minerals
MECHANICAL ENGINEERING DEPARTMENT

ME 462: Products and Systems Reliability

(Formerly known as “Reliability for Mechanical Engineers”)

Catalogue Description: (3-0-3)

Fundamentals of probability theory, Reliability in Design- Probabilistic models of load (stress) and resistance (strength) variables, Stress-strength interference models in probabilistic design, Monte Carlo simulation, Hazard functions and reliability models for random and wear-out failures, Hazard plotting and reliability estimation, System reliability – series, parallel, and n out of k and series parallel systems, Failure rate endurance testing and failure data analysis, Accelerated life testing, Reliability in systems operation: availability, spare parts computation and maintenance strategies, Use of Excel and other reliability software in reliability analysis and predictions.

Status in Curriculum: Elective

Prerequisites: ME307

Prerequisites by Topics:

1. Introduction to basic statistics.
2. Fundamentals of design of machine elements.
3. Working knowledge of a spreadsheet, such as Excel.

Textbook: Elmer E. Lewis, Introduction to Reliability Engineering, 2nd Edition, John Wiley & Sons, Inc., 1996

References: J. E. Shigley and C. R. Mischke, Mechanical Engineering Design, 5th edition, McGraw-Hill, 1989

Instructor: Dr. Syed Sohail Akhtar, Assistant Professor of Mechanical Engineering

Goals:(general objectives)

This senior level course is designed to give the students basic ideas about theory and practice of reliability engineering. Reliability data analysis using spreadsheets, such as Excel will be introduced. Applications of reliability in design, systems analysis and maintenance will be the focus of the course.

Course Outline (Lecture Topics):

1. A review of basic concepts in probability theory: probability of events and random variables; discrete distributions: Poisson and Binomial (6 Lectures)
2. Continuous distributions: Exponential, Weibull, normal and lognormal distributions. Distribution of model fitting (8 Lectures)
3. Reliability and rates of failure: reliability characterization and failure rates, Bath Tub curves. Constant failure rate models (exponential model). Conditional probability of survival of a device (3 Lectures)
4. Time-dependent failures rate models: Weibull, normal and lognormal reliability model
5. Reliability testing and data analysis: non-parametric methods; grouped and ungrouped data. Ungrouped and grouped censored data (2 Lectures)
6. Reliability data analysis: parametric methods. Parameters estimation using linear regression of transformed data; exponential, Weibull normal and lognormal distributions. Accelerated life testing, interval estimates, probability plotting (9 Lectures)
7. System reliability: series, parallel, standby redundant and —out-of—systems; static and dynamic reliability models (5 Lectures)
8. Preventive maintenance and corrective maintenance (maintainability and availability) (6 Lectures)
9. Probabilistic models of load (stress) and capacity (strength) variables, load-capacity analysis (Stress-Strength Interference Theory) (3 Lectures)

Design Activities/Projects:

Reliability and availability data analysis and interpretation of results, determining the configuration of components of a system to meet specific system reliability objectives, determining a maintenance strategy to meet specific system reliability target.

Computer Usage:

Most of the data analysis topics and related homework and assignments will require the use of any of the well-known spreadsheet software, such as Excel.

Assessment Tools:

- i- Mid-term Examinations

- ii- Homework/Project Assignments
- iii- Quizzes
- iv- Final Exam

Course Learning Outcomes:

- I- Understand the terminology of reliability and will gain the knowledge of probability and statistics in theory and practice of reliability engineering.
- II- Apply the knowledge of probability and statistics by recognizing, formulating and solving reliability problems.
- III- Perform data analysis using spreadsheets, such as Excel, and interpret the data and results by the used of statistics.
- IV- Learn about systems and sub-systems reliability and their interrelations, estimate system reliability, and design a system to meet a reliability target.
- V- Perform system maintenance analysis.
- VI- Work and write reports and term papers together as team members and communicate more efficiently, through oral/poster presentations.
- VII- Use the techniques, skills, and modern engineering tools necessary for engineering practice, through the use of library, internet, computer programs and word processors
- VIII- Understand professional responsibility through data collection procedures, review of reliability issues, and public relations and contemporary issues associated with them.

Course Learning Outcomes mapped to Student Outcomes:

Student Outcomes	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>	<i>g</i>	<i>h</i>	<i>i</i>	<i>j</i>	<i>k</i>
Course-to-Student outcome mapping	I, II, IV, V		IV,	VI	II, IV, V		VI			VIII	III, VIII
Emphasis*	S		S		S		M			L	S

*L: Little/None

M: Moderate

S: Strong

Status of Continuous Improvement review of this Course:

Date reviewed: March 8st, 2015

Reviewed by: Dr. Anwar K. Sheikh

Prepared by: Dr. Syed Sohail Akhtar

Date prepared: March 1st, 2015