Reliability Engineering I

ENM 565 / ISE 465

Instructor: Charles Ebeling
This course is an introduction to the concepts and methods of reliability engineering.

Topics covered include:

- reliability and hazard rate functions,
- reliability testing with and without censoring,
- theoretical and empirical failure & repair distributions,
- capacities and loads,
- redundancy,
- maintainability,
- availability,
- design concepts,
- and analysis of failure and repair data.

Both single component and multi-component systems are analyzed.
Prerequisites

An introductory course or courses in probability and statistic is recommended. (e.g. ENM 500 PROBABILITY & STATISTICS FOR ENGINEERING)

I really did enjoy that prob/stat stuff with all of those great numbers!
Course Objectives

At the completion of this course, each student should

• Understand the basic models and methods of reliability engineering,
• Be able to
  • collect and analyze failure and repair data,
  • derive an appropriate model,
  • and apply the model to solve reliability/ maintainability problems,
• Have a foundation for future study in reliability,
• Have access to the technical literature in reliability.
Course Requirements

1. Pass 3 quizzes covering Part 1 (Chapters 2 - 11) of the textbook
2. Complete 3 computer exercises
3. Pass a comprehensive final examination

You mean I may have to work in this class??
Grading

Quizzes 3 @ 20% each .................. 60%
(Chapters 2 - 11)
Computer exercises .................... 20%
Final Exam ................................ 20%

Grade Distribution
90 - 100  A
85 - 89   A-
80 - 84   B+
75 - 79   B
70 - 74   B-
60 - 69   C

These are some really good grade distributions.
Other Important Matters

Textbook

Software
• You will need to use the computer
  ✓ to solve some of the homework problems
  ✓ to take the quizzes
  ✓ to complete the reliability case studies.
• Minimum Software
  ✓ Excel and the Excel templates
  ✓ Reliability Analysis (comes with the book or can be downloaded free)
• May use commercial software
Course Overview

Part I Reliability Models
Wk 1-3 Failure Distributions
Wk 4-5 Systems Reliability
Wk 6 Physical Reliability Models
Wk 7 Design for Reliability
Wk 8-9 Maintainability / Design for Maintainability
Wk 10 Availability

Part II Analysis of Failure Data
Wk 11 Empirical Models
Wk 12-13 Identifying theoretical distributions
Wk 13-14 Goodness-of-Fit testing
Wk 14 Reliability Testing
Wk 15 Reliability Growth testing
Wk 15 FMECA/FTA
Wk 16 Final exam

What an exciting 16 week program.
## Important Dates

<table>
<thead>
<tr>
<th>Event</th>
<th>Tentative Dates (2011)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quiz #1</td>
<td>February 4</td>
</tr>
<tr>
<td>Quiz #2</td>
<td>February 27</td>
</tr>
<tr>
<td>Quiz #3</td>
<td>March 25</td>
</tr>
<tr>
<td>Exercises</td>
<td>See below</td>
</tr>
<tr>
<td>Final Exam</td>
<td>May 1</td>
</tr>
</tbody>
</table>

*Makeup exams taken after their scheduled date will include additional questions.

### Below:

<table>
<thead>
<tr>
<th>Mini-Case Study</th>
<th>Due Date (midnight)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exercise 1</td>
<td>April 3</td>
</tr>
<tr>
<td>Exercise 2</td>
<td>April 15</td>
</tr>
<tr>
<td>Exercise 3</td>
<td>April 22</td>
</tr>
</tbody>
</table>

*Fine print: Points will be deducted for late submissions.*
Computer Exercises

Computer Exercises are to be completed by the due dates provided. These exercises integrate the reliability modeling developed in Part 1 of the text with the analysis of failure and repair data discussed in Part 2 of the text. Your solution to these exercises will be submitted via the internet.
Computer Exercise Guidelines

• You must do your own work and submit your own solution although you may discuss the problem with your classmates.

• You may use any textbook as a reference, and you may use any computer application; however, the reliability software that accompanies the text along with MS Excel is sufficient to work the problems.
The exercises are currently in development and will be available soon. Every effort is being made to insure that these exercises are worthy of your academic efforts.

Happiness is a Reliability Problem to be solved
### More, Important Dates

<table>
<thead>
<tr>
<th>Date</th>
<th>what happens then...</th>
</tr>
</thead>
<tbody>
<tr>
<td>January 14</td>
<td>first class meets</td>
</tr>
<tr>
<td>January 21</td>
<td>No class</td>
</tr>
<tr>
<td>April 24</td>
<td>Last class before final exams</td>
</tr>
<tr>
<td>April 29</td>
<td>Final Exam</td>
</tr>
</tbody>
</table>

I would rather be studying reliability

A not so important date
This will be my best course ever! What else should I know?

Ye Olde Web Site:
http://academic.udayton.edu/CharlesEbeling/ENM_565/Syllabus.htm

- bulletin board
- contact form on the Welcome page
- reading assignments and presentations for download
- homework assignments and solutions
- download software
- case studies

Can we go visit the site?
Look here for special notices, posted meeting times with the instructor, course changes and updates, and other relevant information pertaining to the Reliability Engineering I (ENM/MSC 565) course.

Helpful hint: Use your refresh button on the tool bar to insure that you are viewing the most recent version of these Web pages.

Welcome to the spring 2012 offering of the Reliability Engineering I course. This promises to be the best semester ever! Please review this Website prior to the first class meeting in order to become familiar with the course and its content. Bring your questions to the first class meeting or contact your instructor prior to class.
Contact Information – distant learning students
Please enter and submit the requested information (information can be updated by resubmitting):

Last Name:               First Name:               Student ID:
email address:

Primary phone number:   Alternate phone number (optional):
Fax number (optional):

your location:  City:               State:
<table>
<thead>
<tr>
<th>Week</th>
<th>Date</th>
<th>what happens then...</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Mon. Jan 14</td>
<td>Course Introduction / Chapter 1</td>
</tr>
<tr>
<td></td>
<td>Wed. Jan 16</td>
<td>Failure Distributions / Chapter 2</td>
</tr>
<tr>
<td>2</td>
<td>Mon. Jan 21</td>
<td>No class</td>
</tr>
<tr>
<td></td>
<td>Wed. Jan. 23</td>
<td>CFR model Chapter 3</td>
</tr>
<tr>
<td>3</td>
<td>Mon. Jan. 28</td>
<td>Weibull Chapter 4</td>
</tr>
<tr>
<td></td>
<td>Wed. Jan. 30</td>
<td>Normal/ Lognormal/Gamma Chapter 4</td>
</tr>
<tr>
<td>4</td>
<td>Mon. Feb. 4</td>
<td>Quiz #1 Exam Chapters 2-4</td>
</tr>
<tr>
<td></td>
<td>Wed. Feb. 6</td>
<td>Systems Reliability Chapter 5 – Part I</td>
</tr>
</tbody>
</table>
# Homework Assignments

<table>
<thead>
<tr>
<th>Week of</th>
<th>Topic</th>
<th>Text</th>
<th>Homework Problems</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Part 1 Basic Reliability Models</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Course Introduction/ Failure Distributions</td>
<td>Chapter 1 &amp; 2</td>
<td>2.1-2.5, 2.10, 2.14</td>
</tr>
<tr>
<td></td>
<td>Failure Distributions, CFR model</td>
<td>Chapter 3 except 3.3</td>
<td>3.1, 3.2, 3.4, 3.8, 3.11, 3.12, 3.13</td>
</tr>
<tr>
<td></td>
<td>Weibull, Normal, Lognormal</td>
<td>Chapter 4.1 - 4.3</td>
<td>4.1, 4.2, 4.6, 4.8, 4.9, 4.10, 4.13, 4.15, 4.20</td>
</tr>
</tbody>
</table>
This has been an exciting overview of the ENM 565 course

Let’s begin our studies into things reliable ....