ASST8423

Reliability Engineering

Dr Kecheng Shen

School of Mechanical Engineering
Faculty of Engineering, Computing and Mathematics

UNIT OUTLINE

Trimester 3 2010
Version draft 0 @ 27/5/10
Version draft 1 @ 27/5/10
Version draft 2 @ 4/6/10
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ESSENTIAL ADMINISTRATIVE INFORMATION

Unit Title: Reliability Engineering
Unit Code: ASST8423
Unit Coordinator: Dr Kecheng Shen
School: Mechanical Engineering
Credit Value: 6
Additional requirements: Nil
Handbook Website: http://units.handbooks.uwa.edu.au/units/asst/asst8423
Unit Website: http://school.mech.uwa.edu.au/~mhodki/meam/eamProfDev.html
Faculty or School Website: http://www.mech.uwa.edu.au/
Contact Hours: 60 hrs in intensive mode. Block mode teaching dates: 1-3rd September & 22nd-24th September & 21st-22nd October. (see web page for details)

Important Notice
The Unit Outline (this document) gives the student important information about the unit, its aims, outcomes, materials, programme and assessment.

Note that important information relating to policies, examinations, expectations, copyright, referencing, academic misconduct assistance with communication skills is available on the Faculty website though http://www.ecm.uwa.edu.au/studentnet/exams.

You are required to be aware of and fulfil your responsibilities under the University’s rules, policies and procedures so it is important that you review the content of these in detail.

UNIT COORDINATOR

Every unit has a person who is responsible for the overall administration of that unit. This person is the Unit Coordinator.

<table>
<thead>
<tr>
<th>Unit Coordinator:</th>
<th>Dr Kecheng Shen</th>
</tr>
</thead>
<tbody>
<tr>
<td>Email:</td>
<td><a href="mailto:kshen@mech.uwa.edu.au">kshen@mech.uwa.edu.au</a></td>
</tr>
<tr>
<td>Phone:</td>
<td>08 6488 4748</td>
</tr>
<tr>
<td>Fax:</td>
<td>08 6488 1024</td>
</tr>
<tr>
<td>Building:</td>
<td>Mechanical Engineering</td>
</tr>
<tr>
<td>Room:</td>
<td>1.20A</td>
</tr>
<tr>
<td>Contact Hours:</td>
<td>By appointment (allow for a response time of 2 working days)</td>
</tr>
</tbody>
</table>
INTRODUCTION

Welcome to the Reliability Engineering (RE) unit. Reliability engineering is an interdisciplinary engineering field consisting of principles and practices to ensure that reliability, safety, quality and other organisational goals are achieved.

In this postgraduate unit we focus on building up a sound theoretical base regarding fundamental reliability terms and concepts, basic mathematics of probability and statistics, graphical tools for data analysis, failure mechanisms and failure mode and effect analysis. This is supplemented by selected tools and methods in reliability and availability modelling and maintenance strategies.

In the workshops presentation is combined with group work and class discussions. A substantial amount of time is spent working on examples and exercises to reinforce the topics. These face-to-face teaching and learning opportunities are reinforced by guided pre-reading and delivery of material, such as lecture notes, through Web support.

The academic staff includes Dr Kecheng Shen supplemented by Dr Melinda Hodkiewicz from the discipline group of Engineering Asset Management. Dr Hodkiewicz has extensive industrial experience in operation and maintenance of mining equipment and in asset management training, research and collaboration. Dr Shen spent many years working with the nuclear and train manufacturing industry regarding reliability and safety issues.

Beside the academic staff involved in the unit, the following people may also be engaged as guest lecturers:

- Subject matter experts drawn from other academic institutions
- Professionals and consultants engaged by the industry and asset owning organisations

Guest lecturers may be involved in the assessments associated with the material they have presented.

LEARNING OUTCOMES

On completion of this unit, you should be able to demonstrate the ability to:

1. Explain why and how things fail.
2. Describe the attributes of functions and failures of an asset.
3. Determine statistical failure distributions by analysing failure data.
4. Deploy processes and tools to predict the reliability performance of an asset system.
5. Develop appropriate maintenance strategies.

LEARNING ACTIVITIES

In this unit, the following approaches to teaching/learning are combined:

- The presentations focus on delivering the basic concepts and framework of the contents.
- The tutorials allow the student to apply the concepts from the lectures. This is done by the tutor presenting worked examples, the student doing exercises and participating in guided discussions.
- Periods between workshops are intended for the student’s self study, including doing pre-reading, listening to recorded lectures and working on assignments.

STUDENT FEEDBACK

We welcome your feedback as one way to keep improving this unit. Later this semester, you will be encouraged to give unit feedback through SURF, UWA’s online student feedback system. Recent changes to this unit in response to student feedback include:
• Sequence background material (eg laws of probability) with the reliability concept that uses it, rather than as a combined ‘background’ section at the start of the course.

• Allow more time for complex topics.

• Remove topics which are covered in other units.

TEXT BOOK & RESOURCES

Recommended Texts

You do not have to purchase the following textbooks but we suggest you refer to them.


Technical Requirements

The University only permits the use of calculators in examinations when the calculator has an approved sticker. If the student does not have an approved sticker on their calculator, they will not be permitted to use the calculator. Since this is a University wide policy it is not possible for unit coordinator to grant on the spot exemptions.

Software Requirements

You will need access to a web-linked PC, be able to use word processing, PowerPoint and Excel software, know how to access recommended reading and other materials on the web and from the University Library system, access WebCT, and have an active email address. There are no specialist software requirements. A laptop computer is required in the class.
ASSESSMENT DETAILS

Assessment Mechanism
The assessment for this unit consists of the following items.

<table>
<thead>
<tr>
<th>Assessment Tasks</th>
<th>Worth</th>
<th>Due</th>
<th>Unit Learning Outcome Assessed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Online quizzes</td>
<td>-</td>
<td>At the end of the day</td>
<td>Daily/workshop topics</td>
</tr>
<tr>
<td>Assignment 1</td>
<td>20%</td>
<td>13/9</td>
<td>Topics in workshop 1</td>
</tr>
<tr>
<td>Mid-workshop test</td>
<td>15%</td>
<td>19/9</td>
<td>Topics in workshop 1</td>
</tr>
<tr>
<td>Exam</td>
<td>35%</td>
<td>21/10</td>
<td>All</td>
</tr>
<tr>
<td>Assignment 2</td>
<td>30%</td>
<td>28/10</td>
<td>Topics in workshops 1 &amp; 2</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>100%</strong></td>
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</table>

Online quizzes
At the end of each day in Workshop 1 and 2, the participant may complete an online quiz on WebCT or use paper if required. These quizzes are not assessed.

Assignment 1 – Report

**Worth: 20%**

**Due: 13/9**

Assignment 1 is about Functions, Failures and FMEA for an asset. It assesses your ability to:
- Explain what functions and failures of an asset are and how they are related to each other.
- Apply FMEA methodology to an asset.
- Identify risks and recommend controls/actions.
- Document the work process and results, reflect on the learning outcomes and discuss advantages/limitations of the FMEA methodology.

This individual assignment assumes that you have been asked to perform an FMEA on an asset of your choice. Use processes cited in course materials and from your reading. Ensure that your material is substantiated with evidence.

Assignment 2 – Report

**Worth: 30%**

**Due: 28/10**

The first part of Assignment 2 is to analyse equipment failure data and determine confidence limits. The second part is about construction and analysis of system reliability block diagrams involving the equipment. This assignment assesses your ability to:
- Perform ranking of data.
Manage suspended data.

Use Weibull plots to determine distribution types and estimate distribution parameters.

Determine confidence limits for distribution parameters.

Construct RBD considering system function logic and the relevant failure modes of the components.

Calculate component reliability.

Evaluate system reliability.

Discuss the results and draw conclusions.

The results will be documented in a report. This assignment is individual.

**Submission Details for assignments**

You will document the work and submit a report. Make sure you use the assignment cover sheet from WebCT. The header or footer of the report should include your name or student number. If you use an Excel spreadsheet, make sure the pages are formatted and ready for print.

Submission of the assignment can be made (a) electronically by e-mail to the lecturer (b) on a memory stick or on paper to the lecturer's office or the school reception. Late submission will cause a deduction of 10% per day.

**Referencing Style**

Students should use the Harvard referencing style when preparing assignments. More information can be found on this style from the Library web site:

http://libguides.library.uwa.edu.au/referencing_uwa

**Assignment Marking**

The assignment marking will be expected to take about a week.

**Final exam**

Final exam will be in open book format and in three hours with 10 minutes reading time.

**Academic Conduct**

**Academic Conduct Essentials**

It is a University requirement that all newly enrolled students complete a short compulsory online unit called Academic Conduct Essentials (ACE) within the first 10 weeks of semester. ACE can be accessed via WebCT (http://webct.uwa.edu.au/webct/entryPageIns.dowebct).

To find out more about Academic Integrity, look at these great resources:

- Student Services, who run workshops on Academic Integrity http://www.studentservices.uwa.edu.au/ss/learning
- http://www.ryerson.ca/academicintegrity/index.html, a series of flash videos from a Canadian University exploring Academic Integrity
- http://www.lc.unsw.edu.au/onlib/plag.html which takes you to an on-line quiz where you test your understanding of plagiarism, and where there are links to other universities’ academic integrity pages.

**Plagiarism Monitoring - (include this section if it applies)**

Some (or all) assessments in this unit will be monitored for plagiarism using Turnitin plagiarism detection service (see http://turnitin.com). Students who do not want assignments retained in the Turnitin database, must lodge a special request prior to the submission date.
STUDENTS’ RIGHTS AND RESPONSIBILITIES

It is the responsibility of every student to be aware of all relevant legislation, policies and procedures relating to their rights and responsibilities as a student. These include:

- the Student Charter,
- the University’s Guiding Ethical Principles,
- the University’s policy and statements on plagiarism and academic integrity,
- copyright principles and responsibilities,
- the University’s policies on appropriate use of software and computer facilities,
- the use of calculators in exams,
- students’ responsibility to check enrolment,
- deadlines, appeals, and grievance resolution,
- student feedback,
- other policies and procedures, and
- electronic communication with students.


The Student Guild employs a number of Education Officers who provide information, support and advocacy with a range of academic matters [http://www.guild.uwa.edu.au/home/student_assistance/academic_help](http://www.guild.uwa.edu.au/home/student_assistance/academic_help).

**Guild Student Centre**

- Opening Hours: 8.30am - 5.00pm, Monday to Friday
- Location: Ground floor, Guild Village, near Bankwest ATM machine.
- Mailing Address: M300, 35 Stirling Highway, Crawley Western Australia 6009
- Phone: +61 8 6488 2295
- Fax: +61 8 6488 1200
- Email (general): enquiries@guild.uwa.edu.au
- Email (confidential): education@guild.uwa.edu.au

ADDITIONAL INFORMATION

**Telephone Contacts:**

If you have a query relating to administrative matters such as:

- requests for deferment of study,
- difficulties with accessing online study materials, or
- obtaining assessment results,

please contact your Unit Coordinator.

If you have a query relating to other matters such as:

- missed assessments,
- missing part of Semester,
- being considered for special consideration,

please contact the Faculty Reception:

6488 3061
enquiries-ecm@admin.uwa.edu.au

Location: 2nd Floor, Electrical Engineering Building, Fairway Entrance No 3; Carpark No 15 (see: [http://www.uwa.edu.au/campus_map?id=1891](http://www.uwa.edu.au/campus_map?id=1891) for a Google interactive map)
Note: The intended schedule for this unit is shown in the table below. The schedule is to be used as a guide and is subject to change.

**Trimester 3 2010**

<table>
<thead>
<tr>
<th>WEEK</th>
<th>DATE</th>
<th>MODULE/CHAPTER/TOPIC:</th>
<th>ASSESSMENT</th>
<th>DUE DATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>35</td>
<td>Wed 1/9</td>
<td>Unit introduction</td>
<td>Quiz 1</td>
<td>1/9</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Reliability engineering &amp; asset life cycle</td>
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<td>Concepts</td>
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<td>Functions and functional failures</td>
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<td>FMEA/FMECA process</td>
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<td>Thu 2/9</td>
<td>Random variables &amp; common distributions</td>
<td>Quiz 2</td>
<td>2/9</td>
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<td></td>
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<td>Weibull distribution</td>
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<td></td>
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<td>Conditional probability</td>
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<td></td>
<td>Fri 3/9</td>
<td>Reliability and hazard model</td>
<td>Quiz 3</td>
<td>3/9</td>
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<tr>
<td></td>
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<td>Weibull analysis &amp; probability plotting</td>
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<td></td>
</tr>
<tr>
<td>36-37</td>
<td>6-21/9</td>
<td>Study time between Workshop 1 and 2</td>
<td>Assignment 1 Test</td>
<td>13/9 19/9</td>
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<tr>
<td></td>
<td>Wed 22/9</td>
<td>Mid-workshop test</td>
<td>Quiz 4</td>
<td>22/9</td>
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<td>Data analysis and normal distribution</td>
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<td>Point estimation of reliability parameters</td>
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<td>Confidence limits</td>
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<td>Hypothesis testing and goodness-of-fit</td>
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<td>38</td>
<td>Thu 23/9</td>
<td>Laws of probability</td>
<td>Quiz 5</td>
<td>23/9</td>
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<tr>
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<td>System reliability modelling using RBDs</td>
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<td></td>
<td>Fri 24/9</td>
<td>Availability models</td>
<td>Quiz 6</td>
<td>24/9</td>
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<tr>
<td></td>
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<td>Maintenance strategies &amp; RCM</td>
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<tr>
<td>39-41</td>
<td>27/9-19/10</td>
<td>Study time between Workshop 2 and 3</td>
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</tr>
<tr>
<td>42</td>
<td>Wed 20/10</td>
<td>Unit review – 1st workshop material</td>
<td>Final exam</td>
<td>21/10 28/10</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Unit review – 2nd workshop material</td>
<td>Assignment 2</td>
<td></td>
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<tr>
<td></td>
<td>Thu 21/10</td>
<td>Final exam</td>
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<td></td>
<td>Work on Assignment 2</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Unit feedback</td>
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