UNSW SYDNEY | Australia's Global University

Mechanical and Manufacturing Engineering

Course Outline

Term 1 2020

MANF4430

RELIABILITY AND MAINTENANCE ENGINEERING

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1. Staff contact details

Contact details and consultation times for course convenor

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Consultation concerning this course is available immediately after the classes. Direct consultation is preferred.

Please see the course Moodle.

2. Important links

- Moodle
- Lab Access
- Health and Safety
- Computing Facilities
- Student Resources
- Course Outlines
- Engineering Student Support Services Centre
- Makerspace
- UNSW Timetable
- UNSW Handbook
- UNSW Mechanical and Manufacturing Engineering

3. Course details

Credit points

This is a 6 unit-of-credit (UoC) course and involves 3 hours per week (h/w) of face-to-face contact.

The normal workload expectations of a student are approximately 25 hours per term for each UOC, including class contact hours, other learning activities, preparation and time spent on all assessable work.

You should aim to spend about 9 h/w on this course. The additional time should be spent in

making sure that you understand the lecture material, completing the set assignments, further reading, and revising for any examinations.

Contact hours

	Day	Time	Location
Lectures	Thursday	1000 – 1300	CivEng 101
Computer Quiz	Wednesday	1700 – 18:30 Week 3 and 6 only	Ainsworth 203 and 204

Please refer to your class timetable for the learning activities you are enrolled in and attend only those classes.

Summary and Aims of the course

The course will introduce statistics, mathematics and associated techniques for analysing an industrial process for the purpose of maintaining and improving it. Major disciplines covered include issue analysis, data collection, statistical data analysis, process modeling, decision-making and implementation. The course focuses on developing experimental techniques using statistical methods to test the performance of the processes in a manufacturing industry. It lays the foundations for testing products, components, machinery and processes. This is necessary for the development of quality products and processes. This leads to the development of quality assurance methods for products as well as the development and understanding of the reliability of the processes on the shop-floor. This is necessary to maintain maximum up-time and return-on-assets for a manufacturing facility.

This course aims to develop the concept of data gathering, analysis and modeling using statistical methods. In attempting to determine if the processes or products are meeting set criteria, the manufacturing engineer should carry out tests that will enable him or her to make a judgment with a certain level of confidence. The fundamental aim of the course is to present a comprehensive overview of methodologies and analyses in the fields of process improvement, process characterisation, reliability and maintenance engineering. Reliability and maintenance management are a collection of tools and methodologies to achieve machinery and process integrity and performance. One of the main foundations of reliability and maintenance engineering is that it is a top-down bottom-up driven strategy, regardless of the specific reliability and maintenance philosophies adopted. The aim is to provide students with a comprehensive overview of process improvement and maintenance strategies, methodologies and analytical foundations that form part of this important field. The challenge for process improvement and maintenance engineering is to develop the most effective and at the same time efficient strategy for managing the performance, capability and condition of plant & equipment so as to meet or exceed commercial and operational requirements.

Student learning outcomes

This course is designed to address the learning outcomes below and the corresponding Engineers Australia Stage 1 Competency Standards for Professional Engineers as shown. The full list of Stage 1 Competency Standards may be found in Appendix A.

After successfully completing this course, you should be able to:

Learning Outcome		**EA Stage 1 Competencies**
1.	Understand the different statistical methods available for analysis of different processes	PE1.1, PE1.2, PE1.3
2.	Understand the importance of the maintenance and process improvement functions within industry	PE2.1, PE2.2, PE2.3
3.	Understand the various methodologies used in industry to estimate the level of reliability and remaining life of a critical component and system at a certain point in time, using statistical and mathematical techniques where appropriate	PE1.2, PE2.1, PE2.2
4.	Be able to conduct a reliability study and to make recommendations with respect to the maintenance plan and ongoing reliability program	PE3.1, PE3.4, PE3.6

4. Teaching strategies

Lectures, demonstrations and assessments in the course are designed to cover the core knowledge areas in Engineering Management. They do not simply reiterate the texts, but build on the lecture topics using examples and cases taken directly from industry to show how the theory is applied in practice and the details of when, where and how it should be applied.

Lectures and demonstrations are designed to develop several graduate attributes by creating an environment where information sharing, discussions, teamwork, communication, task completion and project role playing will take place. Since each of you may have come from a different engineering stream, your experiences are drawn upon to illustrate various aspects of cases covered, and this helps to increase motivation and engagement.

5. Course schedule

Date	Lecture Content	Suggested Readings
Week 1	Issue analysis and data visualisation techniques	Sahay, Data visualization. Volume 1, recent trends and applications using conventional and big data, 1st ed, Chapter 1 to 6
Week 2	Statistical Hypothesis testing	Montgomery, Design and analysis of experiments, 8th ed, Chapter 2
Week 3	Linear Regression Analysis Part 1	Montgomery, Introduction to linear regression analysis, 5th ed, Chapter 2, 3 and 4
Week 4	Linear Regression Analysis Part 2	Montgomery, Introduction to linear regression analysis, 5th ed, Chapter 5 and 6
Week 5	Introduction to Probability theory	Ogunnaike, Random phenomena: fundamentals of probability and statistics for engineers, Chapter 3
Week 6	Component reliability and Weibull analysis	Modarres, Reliability engineering and risk analysis : a practical guide, Chapter 1, 2 and 3
Week 7	System reliability	Modarres, Reliability engineering and risk analysis : a practical guide, Chapter 4
Week 8	Condition Monitoring and Physical Degradation Models	Lecture notes
Week 9	Maintenance Theory	Lecture notes
Week 10	Technical Process Identification, Characterisation and Modeling	Lecture notes

6. Assessment

Assessment overview

Assessment	Group Project? (# Students per group)	Length	Weight	Learning outcomes assessed	Assessment criteria	Due date and submission requirements	Deadline for absolute fail	Marks returned
Quiz x 4	No	Multiple choice and short answer questions	40% (10% each)	1, 2 and 3	Lecture and demonstration contents	Week 3, 6, 8 and 10	N/A	1 week after the quiz is closed
Assignment x 2	Yes (4)	1000 words + 20 minutes viva for assignment 1 3000 words for assignment 2	50% (25% each)	1, 2, 3 and 4	See Assignment Section	Week 6 and 10	1 week after the due date	2 weeks after submission

This course will include the following hurdle requirements that are closely linked to a set of learning outcomes which demonstrate that you have acquired the required skills and competencies within this discipline:

- Students must demonstrate understanding of the theory of reliability, both at the component as well as the system level. A minimum mark of 45% must be obtained for the combined marks of all 4 quizzes in order to pass this subject. Failure to achieve this minimum mark will result in an unsatisfactory fail (UF) grade, regardless of the performance in the rest of the course.

Assignments

The assignment instructions will be posted on Moodle or handed out in class, and a reminder announcement will be made about due date for the assignments. The assignments support the learning outcomes by incorporating an appropriate mix of activities such as issue analysis and fact-based data analysis that support the design of appropriate solutions and strategies. The assignments also support collaborative teamwork and integration of different ideas and components into an overall coherent quality management strategy.

The following criteria will be used to grade assignments:

Viva

The assignment will be assessed in person and feedback given as part of an oral examination or 'viva'. Each team member must be present during this formal examination in weeks 5 and 10. A system will be implemented on Moodle for booking a time with your lecturers. The team will still need to prepare appropriate documentation and material as preparation for this assessment.

Executive Summary

In addition to the Viva examination, each team is to provide a 1-page executive summary (excluding diagrams), outlining the key findings of the assignment.

Presentation

All submissions are expected to be neat and clearly set out. Your results are the pinnacle of all your hard work and should be treated with due respect. Presenting results clearly gives the marker the best chance of understanding your method; even if the numerical results are incorrect.

Submission

Work submitted late without an approved extension by the course coordinator or delegated authority is subject to a late penalty of 20 percent (20%) of the maximum mark possible for that assessment item, per calendar day.

The late penalty is applied per calendar day (including weekends and public holidays) that the assessment is overdue. There is no pro-rata of the late penalty for submissions made part way through a day.

Work submitted after the 'deadline for absolute fail' is not accepted and a mark of zero will be awarded for that assessment item.

For some assessment items, a late penalty may not be appropriate. These are clearly indicated in the course outline, and such assessments receive a mark of zero if not completed by the specified date. Examples include:

a. Weekly online tests or laboratory work worth a small proportion of the subject mark, or
b. Online quizzes where answers are released to students on completion, or
c. Professional assessment tasks, where the intention is to create an authentic assessment that has an absolute submission date, or
d. Pass/Fail assessment tasks.

Marking

Marking guidelines for assignment submissions will be provided at the same time as assignment details to assist with meeting assessable requirements. Submissions will be marked according to the marking guidelines provided.

Examinations

You must be available for all quizzes, tests and examinations.

Final examinations for each course are held during the University examination periods: February for Summer Term, May for T1, August for T2, and November/December for T3.

Please visit myUNSW for Provisional Examination timetable publish dates.

For further information on exams, please see the Exams webpage.

Calculators

You will need to provide your own calculator of a make and model approved by UNSW for the examinations. The list of approved calculators is available at student.unsw.edu.au/exam-approved-calculators-and-computers

It is your responsibility to ensure that your calculator is of an approved make and model, and to obtain an "Approved" sticker for it from the Engineering Student Supper Services Centre prior to the examination. Calculators not bearing an "Approved" sticker will not be allowed into the examination room.

Special consideration and supplementary assessment

If you have experienced an illness or misadventure beyond your control that will interfere with your assessment performance, you are eligible to apply for Special Consideration prior to submitting an assessment or sitting an exam.

Please note that UNSW now has a Fit to Sit / Submit rule, which means that if you sit an exam or submit a piece of assessment, you are declaring yourself fit enough to do so and cannot later apply for Special Consideration.

For details of applying for Special Consideration and conditions for the award of supplementary assessment, please see the information on UNSW's Special Consideration page.

7. Expected resources for students

The prescribed textbook for this course is:

- Babatunde A. Ogunnaike, Random phenomena : fundamentals of probability and statistics for engineers, CRC Press, 9950845363701731
- Douglas C. Montgomery, Design and analysis of experiments, 8th ed, Hoboken, N.J.: John Wiley & Sons, Inc., 1118146921
- Douglas C. Montgomery, Introduction to linear regression analysis, 5th ed, Hoboken, N.J.: John Wiley & Sons, Inc., 9781118627365
- Mohammad. Modarres, Reliability engineering and risk analysis : a practical guide, 2nd ed, Hoboken, CRC Press, 9950728008301731
- Sahay Amar, Data visualization. Volume 1, Recent trends and applications using conventional and big data, 1st ed, Business Expert Press, 9950811769301731

You can find a free e-copy of the textbook from the UNSW library.

UNSW Library website: https://www.library.unsw.edu.au/
Moodle: https://moodle.telt.unsw.edu.au/login/index.php

8. Course evaluation and development

Feedback on the course is gathered periodically using various means, including the UNSW myExperience process, informal discussion in the final class for the course, and the School's Student/Staff meetings. Your feedback is taken seriously, and continual improvements are made to the course based, in part, on such feedback.

In this course, recent improvements resulting from student feedback include the continuous use of VIVA assessment as it received positive feedback when the course was revised in 2019.

9. Academic honesty and plagiarism

UNSW has an ongoing commitment to fostering a culture of learning informed by academic integrity. All UNSW students have a responsibility to adhere to this principle of academic integrity. Plagiarism undermines academic integrity and is not tolerated at UNSW. *Plagiarism at UNSW is defined as using the words or ideas of others and passing them off as your own.*

Plagiarism is a type of intellectual theft. It can take many forms, from deliberate cheating to accidentally copying from a source without acknowledgement. UNSW has produced a website with a wealth of resources to support students to understand and avoid plagiarism, visit: student.unsw.edu.au/plagiarism. The Learning Centre assists students with understanding academic integrity and how not to plagiarise. They also hold workshops and can help students one-on-one.

You are also reminded that careful time management is an important part of study and one of the identified causes of plagiarism is poor time management. Students should allow sufficient time for research, drafting and the proper referencing of sources in preparing all assessment tasks.

If plagiarism is found in your work when you are in first year, your lecturer will offer you assistance to improve your academic skills. They may ask you to look at some online resources, attend the Learning Centre, or sometimes resubmit your work with the problem fixed. However more serious instances in first year, such as stealing another student's work or paying someone to do your work, may be investigated under the Student Misconduct Procedures.

Repeated plagiarism (even in first year), plagiarism after first year, or serious instances, may also be investigated under the Student Misconduct Procedures. The penalties under the procedures can include a reduction in marks, failing a course or for the most serious matters (like plagiarism in an honours thesis) even suspension from the university. The Student Misconduct Procedures are available here:
www.gs.unsw.edu.au/policy/documents/studentmisconductprocedures.pdf

10. Administrative matters and links

All students are expected to read and be familiar with UNSW guidelines and polices. In particular, students should be familiar with the following:

- Attendance
- UNSW Email Address
- Special Consideration
- Exams
- Approved Calculators
- Academic Honesty and Plagiarism
- Equitable Learning Services

Appendix A: Engineers Australia (EA) Competencies

Stage 1 Competencies for Professional Engineers

	Program Intended Learning Outcomes
PE1: Knowledge and Skill Base	PE1.1 Comprehensive, theory-based understanding of underpinning fundamentals
	PE1.2 Conceptual understanding of underpinning maths, analysis, statistics, computing
	PE1.3 In-depth understanding of specialist bodies of knowledge
	PE1.4 Discernment of knowledge development and research directions
	PE1.5 Knowledge of engineering design practice
	PE1.6 Understanding of scope, principles, norms, accountabilities of sustainable engineering practice
PE2: Engineering Application Ability	PE2.1 Application of established engineering methods to complex problem solving
	PE2.2 Fluent application of engineering techniques, tools and resources
	PE2.3 Application of systematic engineering synthesis and design processes
	PE2.4 Application of systematic approaches to the conduct and management of engineering projects
PE3: Professional and Personal Attributes	PE3.1 Ethical conduct and professional accountability
	PE3.2 Effective oral and written communication (professional and lay domains)
	PE3.3 Creative, innovative and pro-active demeanour
	PE3.4 Professional use and management of information
	PE3.5 Orderly management of self, and professional conduct
	PE3.6 Effective team membership and team leadership