UNSW SYDNEY | Australia's Global University

Mechanical and Manufacturing Engineering

Course Outline

Semester 2 2017

MANF4430

Process Improvement & Maintenance Engineering

Contents

1. Staff contact details

Contact details and consultation times for course convenor

Name: Dr Ron Chan
Office Location: Room ME507, Ainsworth Building
Tel: (02) 9385 1535
Email: r.chan@unsw.edu.au

Name: Dr Erik van Voorthuysen
Office Location: ME507, Ainsworth Building
Tel: (02) 9385 4147
Email: erikv@unsw.edu.au

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

Please see the course Moodle.

2. Important links

- Moodle
- UNSW Mechanical and Manufacturing Engineering
- Course Outlines
- Student intranet
- UNSW Mechanical and Manufacturing Engineering Facebook
- UNSW Handbook

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 UNSW website states “The normal workload expectations of a student are approximately 25 hours per semester for each UoC, including class contact hours, other learning activities, preparation and time spent on all assessable work. Thus, for a full-time enrolled student, the normal workload, averaged across the 16 weeks of teaching, study and examination periods, is about 37.5 hours per week.”

This means that 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	Friday	12:00 – 15:00	Ainsworth 202
Demonstrations	Friday	15:00 – 16:00	Ainsworth 202

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 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 completions and project role playing will take place. Since each of you may have come from a different engineering stream, your experiences are drawn on to illustrate various aspects of cases covered, and this helps to increase motivation and engagement.

5. Course schedule

Date	Lecture Content (Ainsworth 202) 12:00 – 14:00	Suggested Readings	Demonstration (Ainsworth 202) 14:00 – 15:00
Week 1 Fri 28/07/17	Issue analysis and data visualisation	Lecture notes only	Using graphing tools in Minitab17 (computer lab)
Week 2 Fri 04/08/17	Summary statistics and distribution theory	Textbook 1 – Chapter 3,4 and 5 and Lecture notes	Questions on distribution theory (Ainsworth G02)

Week 3 Fri 11/08/17	Hypothesis testing – Student's t-test	Textbook 1 – Chapter 7,8 and 9 and Lecture notes	Hypothesis testing in Minitab 17
Week 4 Fri 18/08/17	Analysis of variance (ANOVA)	Textbook 1 – Chapter 12 and Lecture notes	ANOVA in Minitab 17
Week 5 Fri 25/08/17	Analysis of variance (ANOVA) Part II	Textbook 1 – Chapter 12 and Lecture notes	Advanced ANOVA in Minitab 17
Week 6 Fri 01/09/17	Simple and multiple linear regression	Textbook 1 – Chapter 14 and Lecture notes	Linear regression in Minitab17
Week 7 Fri 08/09/17	Wrap-up session and support on assignment 1	Lecture notes only	Wrap-up session and support on assignment 1
Week 8 Fri 15/09/17	Component reliability and Weibull analysis	Textbook 1 – Chapter 1, Textbook 2 – Chapter 1and 2 and Lecture notes	Questions on basic reliability analysis
Week 9 Fri 22/09/17	System reliability and condition mentoring	Textbook 2 – Chapter 6 and 7 and Lecture notes	Questions on advanced reliability analysis
Week 10 Fri 29/09/17	Maintenance Theory	Textbook 2 – Chapter 8 and Lecture notes	Industry case study and discussion
Week 11 Fri 06/10/17	Process identification, characterization and modelling	Lecture notes only	Industry case study and discussion
Week 12 Fri 13/10/17	Wrap-up session and support on assignment 2	Lecture notes only	Wrap-up session and support on assignment 2
Week 13 Fri 20/10/17	TBA	TBA	TBA

6. Assessment

Assessment overview

Assessment	Length	Weight	Learning outcomes assessed	Assessment criteria	Due date and submission requirements	Deadline for absolute fail	Marks returned
Online Quiz x 4	Multiple choice and short answer questions	40%	1, 2, 3 and 4	Lecture and demonstration material	Beginning of Week 4, 7, 10 and 13	End of Week 5, 9 and 13	Immediately after the quiz is closed
Group assignment 1	2000 words per team	30%	1, 2, 3 and 4	See below	Friday Week 7 08/09/17 5pm on Moodle	1 week after the due date	2 weeks after submission
Group assignment 2	2000 words per team	30%	1, 2, 3 and 4	See below	Friday Week 13 20/10/17 5pm on Moodle	1 week after the due date	Upon release of final results

Assignments

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

The following criteria will be used to grade assignments:

Written reports

- Analysis and evaluation of assignments by integrating knowledge gathered in lectures, demonstration sessions and textbook
- Sentences in clear and plain English—this includes correct grammar, spelling and punctuation
- Correct referencing in accordance with the prescribed citation and style guide
- Appropriateness of analytical techniques used
- Accuracy of numerical answers
- All working shown
- Use of diagrams, where appropriate, to support or illustrate the calculations
- Use of graphs, where appropriate, to support or illustrate the calculations
- Use of tables, where appropriate, to support or shorten the calculations
- Neatness

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

Late submissions will be penalised 5 marks per calendar day (including weekends). An extension may only be granted in exceptional circumstances. Special consideration for assessment tasks must be processed through student.unsw.edu.au/special-consideration.

It is always worth submitting late assessment tasks when possible. Completion of the work, even late, may be taken into account in cases of special consideration.

Where there is no special consideration granted, the ‘deadline for absolute fail’ in the table above indicates the time after which a submitted assignment will not be marked, and will achieve a score of zero for the purpose of determining overall grade in the course.

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

There is no final exam for this course.

Online Quiz

Four quizzes (quiz 1, 2, 3 and 4) will be conducted online via Moodle. The format of the quiz is like those that are done on paper, which consists of multiple choice questions, calculations and short answer questions. The link to the quiz will be available on Monday of the quiz week; the link will remain open until 5pm, Friday of the same week. Each student gets ONE attempt to complete the quiz within a set time limit. The feedback of the quiz will be provided after the quiz is closed. Note that the quiz questions are randomly drawn from a question bank with similar theme and difficulty, numerical questions may appear with random input numbers, so students will not expect to get the exact same question. Students are expected to complete the quiz individually.

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 shown 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 School Office or the Engineering Student Centre prior to the examination. Calculators not bearing an "Approved" sticker will not be allowed into the examination room.

Special consideration and supplementary assessment

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

7. Attendance

You are required to attend a minimum of 80% of all classes, including lectures, labs and seminars. It is possible to fail the course if your total absences equal to more than 20% of the required attendance. Please see the School intranet and the UNSW attendance page for more information.

8. Expected resources for students

The prescribed textbook for this course is:

- Modarres, Kaminsky and Krivtsov, Reliability Engineering and Risk Analysis – A practical guide, Macmillan, ISBN 978-0-8493-9247-4.
- Montgomery D, Introduction to Statistical Quality Control, 5th ed, Wiley

You can purchase the textbook from UNSW bookshop.

There also are two eBooks available for free at the UNSW library website site that supports the weekly lecture:

- *Textbook 1* – Statistics and Probability for Engineering Applications. Burlington: Elsevier, DeCoursey, W., & Ebooks Corporation, 2003
- *Textbook 2* – Barlow, R., Engineering reliability, American Statistical Association, & Society for Industrial Applied Mathematics, 1998

You can find a limited number of the prescribed textbook from the UNSW library.

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

9. 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 introducing a peer evaluation system that aims to provide peer feedback support and ensure fair workload distribution.

10. 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: 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

Further information on School policy and procedures in the event of plagiarism is available on the intranet.

11. Administrative matters and links

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

- Attendance, Participation and Class Etiquette
- UNSW Email Address
- Computing Facilities
- Assessment Matters (including guidelines for assignments, exams and special consideration)
- Academic Honesty and Plagiarism
- Student Equity and Disabilities Unit
- Health and Safety
- Student Support 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