UNSW AUSTRALIA

Course Outline

Semester 2 2015

Never Stand Still | Engineering | Mechanical and Manufacturing Engineering

GSOE9840

Process Improvement & Maintenance Engineering

Contents

1. Staff Contact Details

Contact details and consultation times for course convenor

Dr Erik van Voorthuysen
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Consultation concerning this course is available immediately after the classes. Direct consultation requires prior booking via email.

Contact details and consultation times for additional lecturers/demonstrators/lab staff

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2. Course details

Credit Points:

This is a 6 unit-of-credit (UoC) course, and involves <insert hours> 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

Lectures	Day	Time	Location
Week 1 to 13	Wednesday	3pm – 6pm	OMB149

Summary 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.

Aims of the Course

This subject 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 has to 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 by definition 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 below learning outcomes 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 PE2.1
2.	Understand the steps involved in specifying equipment at the time of purchase and the importance of an ongoing reliability and condition-monitoring program to ensure that performance is maintained and both condition and risk are appropriately identified and managed.	PE2.1 PE2.2 PE2.4
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.	PE2.1 PE2.2 PE3.4
4.	Be able to conduct a reliability study and to make recommendations with respect to the maintenance plan and ongoing reliability program.	PE2.1 PE3.1 PE3.5

3. Teaching strategies

Lectures in the course are designed to cover the terminology and core concepts and theories in the design of ships and propulsion. They do not simply reiterate the texts, but build on the lecture topics using examples 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.

4. Course schedule

Topic	Date	Location	Lecture Content	Suggested Readings
Issue analysis framework	29/7/15	OMB149	Uncover the issue and establish hypothesis of a complex problem	Lecture notes available on Moodle
Basic reliability mathematics 1: Probability theory	5/8/15	OMB149	Basic laws of probability, Baye's theorem	Chapter 2.1 and 2.2 of the prescribed text
Basic reliability mathematics 2: Review of statistics	12/8/15	OMB149	Descriptive statistics, distribution theory	Chapter 2.3 – 2.6 of the prescribed text

Analysis of variance (ANOVA)	19/8/15	OMB149	Hypothesis testing, analysis of variance of engineering problems	Lecture notes available on Moodle
Test for independence & test for association	26/8/15	OMB149	Goodness-of-fit test, Chi-Square test	Chapter 2.7 of the prescribed text
Correlation and Regression	2/9/15	OMB149	Regression and correlation analysis	Chapter 2.8 of the prescribed text
Catch-up session, quiz 2 revision	9/9/15	OMB149	Catch-up session, Q/A for Quiz 2	-
Component reliability & Weibull analysis	16/9/15	OMB149	Reliability function, failure function, Weibull probability plot	Chapter 3.1 to 3.3 of the prescribed text
System reliability & condition monitoring	23/9/15	OMB149	Series system, parallel system, composite system	Chapter 4.1 of the prescribed text
Maintenance Theory	7/10/15	OMB149	Reliability centered maintenance, FMECA	Lecture notes available on Moodle
Process Identification, characterisation and modeling	14/10/15	OMB149	Bayesian network, partial least squares path modelling	Lecture notes available on Moodle
Process Improvement and Implementation	21/10/15	OMB149	Process improvement verification and validation	Lecture notes available on Moodle
Course summary and course evaluation	28/10/15	OMB149	CATEI evaluation, Q/A for Quiz 4	-

5. Assessment

Assessment task	Length	Weight	Learning outcomes assessed	Assessment criteria	Due date, time, and submission requirements
Quiz 1	80 minutes	15%	1 and 3	All course content from weeks 1-13	19/8/15, 4:30pm
Quiz 2	80 minutes	15%	1 and 3	All course content from weeks 1-13	9/9/15, 4:30pm
Quiz 3	80 minutes	15%	2 and 3	All course content from weeks 1-13	7/10/15, 4:30pm
Quiz 4	80 minutes	15%	2 and 3	All course content from weeks 1-13	28/10/15, 4:30pm
Group assignment 1	Approx. 3500 words	20%	1, 2, 3 and 4	Issue analysis, fact based data analysis and report writing skills	Midnight, Friday 11th September via Moodle
Group assignment 2	Approx. 3500 words	20%	1, 2, 3 and 4	Issue analysis, fact based data analysis and report writing skills	Midnight, Friday 30th October via Moodle

In order to achieve a PASS (PS) in this course, you need to achieve a composite mark of at least 50. Note that a 'double-pass' is not required for this course.

The dates for the assignments will be communicated to you in class and provided on Moodle as the course progresses. You will be given approximately 5 weeks to complete each assignment.

Assignments

Group forming

By Friday of Week 2, at 5pm, you will need to self-enroll into a group on Moodle. Each group is set to consist of two to four members. Instruction to the self-enroll system can be found on Moodle by Week 1. Please note that any students who are not enrolled in a group by Friday of Week 2, at 5pm, they will be automatically assigned to a new group.

Presentation

All submissions should have a standard School cover sheet which is available from this subject's Moodle page.

All submissions are expected to be neat, and clearly set out. Your results are the pinnacle of all your hard work. Presenting them 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. Where an assessment task is worth less than 20% of the total course mark and you have a compelling reason for being unable to submit your work on time, you must seek approval for an extension from the course convenor ***before the due date***. Special consideration for assessment tasks of 20% or greater must be processed through https://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.

Assessment Criteria

The following criteria will be used to grade assignments:

- Analysis and evaluation of assignments by integrating knowledge gathered in lectures, demonstrations 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, were appropriate, to support or illustrate the calculations.
- Use of tables, where appropriate, to support or shorten the calculations.
- Neatness.

Examinations

You must be available for all tests and examinations. There are 4 quizzes that count toward 60% of the course. There is no final examination in this course.

For further information on exams, please see Administrative Matters.

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 https://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 Administrative Matters, available on the School website and on Moodle, and the information on UNSW's Special Consideration page.

6. Expected Resources for students

Prescribed textbook

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.

The prescribed textbook is available for purchase at the UNSW bookshop, and a number of copies can be borrowed from the UNSW library: www.library.unsw.edu.au/servicesfor/index.html

Each of you will be assigned to two major assignments with set of questions listed. These cases are published by the Harvard Business School. The case is copyrighted therefore you need to download it at a reasonable cost (around AUD $8.00) from their website.

Reference books:

1. Moubray J, Reliability-centered Maintenance, 2nd edition, 1997, Butterworth Heineman (two copies are held in the library, one in open reserve)
2. J L Devore, Probability and Statistics for Engineering and the Sciences, Duxbury
3. C Chatfield, Statistics for Technology, Chapman and Hall, 1983
4. C Lipson and N J Sheth, Statistical Design and Analysis of Engineering Experiments, McGraw Hill, 1973.
5. D C Montgomery, Design and Analysis of Experiments, John Wiley, 2001.
6. D H Besterfield, Quality Control, Prentice Hall, 5th Edition 1998
7. Moubray J, Reliability-centered Maintenance, 2nd edition, 1997, Butterworth Heineman (two copies are held in the library, one in open reserve)

8. C. Ebeling, An Introduction to Reliability and Maintainability Engineering, International Edition, 1997, McGraw-Hill, Singapore
9. Tribology Handbook (2nd Edition), Edited by: Neale, Michael J. © 1995 Elsevier (UNSW Library, on-line access)

Additional materials provided in UNSW Moodle

This course uses UNSW Moodle which list of assignments, answers to the numerical questions, suggested answers to case studies and assignments.

Logging on to UNSW Moodle using the following Web address: https://moodle.telt.unsw.edu.au/login/index.php

7. Course evaluation and development

Feedback on the course is gathered periodically using various means, including the Course and Teaching Evaluation and Improvement (CATEI) 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 introduction of using statistical software package – Minitab 17 to assist in data analysis.

8. 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: https://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 presented in a School handout, Administrative Matters, available on the School website.

9. Administrative Matters

You are expected to have read and be familiar with *Administrative Matters*, available on the School website: www.engineering.unsw.edu.au/mechanical-engineering/sites/mech/files/u41/S2-2015-Administrative-Matters_20150721.pdf

This document contains important information on student responsibilities and support, including special consideration, assessment, health and safety, and student equity and diversity.

Erik van Voorthuysen
Ronald Chan
July 2015

Appendix A: Engineers Australia (EA) Professional Engineer Competency Standards

	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