UNSW Course Outline

MANF4430 Reliability and Maintenance Engineering - 2024

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General Course Information

Course Code : MANF4430
Year : 2024
Term : Term 1
Teaching Period : T1
Is a multi-term course? : No
Faculty : Faculty of Engineering
Academic Unit : School of Mechanical and Manufacturing Engineering
Delivery Mode : Multimodal
Delivery Format : Standard
Delivery Location : Kensington
Campus : Sydney
Study Level : Postgraduate, Undergraduate
Units of Credit : 6

Useful Links

Handbook Class Timetable

Course Details & Outcomes

Course Description

The course will introduce statistics, mathematics and associated techniques for analyzing an industrial process for the purpose of maintaining and improving it. Major disciplines covered include data collection, data analysis including statistical process control, 6-sigma analysis and

decision-making. 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. 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.

Course Aims

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 and reliability / 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.

Course Learning Outcomes

Course Learning Outcomes
CLO1 : Analyse industrial processes using different statistical methods
CLO2 : Explain the importance of the maintenance and process improvement functions within industry
CLO3 : Apply 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
CLO4 : Conduct a reliability study and make recommendations with respect to the maintenance plan and ongoing reliability program

Course Learning Outcomes	Assessment Item
CLO1 : Analyse industrial processes using different statistical methods	• Group Project • Online Quizzes • Individual Reflections
CLO2 : Explain the importance of the maintenance and process improvement functions within industry	• Group Project • Online Quizzes • Individual Reflections
CLO3 : Apply 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	• Group Project • Online Quizzes • Individual Reflections
CLO4 : Conduct a reliability study and make recommendations with respect to the maintenance plan and ongoing reliability program	• Group Project • Individual Reflections

Learning and Teaching Technologies

Moodle - Learning Management System | Microsoft Teams

Assessments

Assessment Structure

Assessment Item	Weight	Relevant Dates
Group Project Assessment Format: Group	30%	Start Date: Week 4 and 7 Due Date: Week 7 and 10
Online Quizzes Assessment Format: Individual	50%	Start Date: Week 3, 5, 8 and 10 Due Date: Week 3, 5, 8 and 10
Individual Reflections Assessment Format: Individual	20%	Start Date: Week 4 and 7 Due Date: Week 7 and 10

Assessment Details

Group Project

Assessment Overview

Students will work in a team (min. 3, max. 4 members per team) to solve 2 separate real-life problems. Both involves uncovering information from a dataset. The dataset will contain performance data (simulated) based on an industry/real-life scenario.

Each project will consist of an (assessable) individual reflection component which students need to submit separate to their group report.

Indicative Effort

An assignment template will be provided to outline the requirement of this assessment - word counts and other guidelines will be provided in the template.

Project 1

- Executive Summary – is the executive summary presented with high quality and accurate information with recommendation in plain English? (/2)
- Summary of Key Findings – provide a summary of your key finding in NON-STATISTICAL language (/3)
- Graphical Evidences – insert at least one appropriate data visualisation tool that supports each key finding (/5)
- Hypothesis Tests – provide a formal hypothesis test to support each key finding (/5)
- Recommendation – provide a concise and clear recommendation using NON-STATISTICAL language for each key finding (/5) • Documentation – readability of the document (/5)

Project 2

- Executive Summary – is the executive summary presented with high quality and accurate information with recommendation in plain English? (/2)
- Summary of Key Findings – provide a summary of your key finding in NON-STATISTICAL language (/3)
- Graphical Evidences – insert at least one appropriate data visualisation tool that supports each key finding (/5)
- Reliability analysis and Cost Model – provide detail analysis to support each key finding (/10)
- Recommendation – provide a concise and clear recommendation using NON-STATISTICAL language for each key finding (/5)
- Documentation – readability of the document (/5)

Marking will be done with a rubric. Feedback will be provided in class within 2 weeks after the assessment is due.

Course Learning Outcomes

- CLO1 : Analyse industrial processes using different statistical methods
- CLO2 : Explain the importance of the maintenance and process improvement functions within industry
- CLO3 : Apply 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
- CLO4 : Conduct a reliability study and make recommendations with respect to the maintenance plan and ongoing reliability program

Detailed Assessment Description

See above

Student will be working in a group of 4-5 members.

Assignment submission Turnitin type

Not Applicable

Online Quizzes

Assessment Overview

Assessment length: 75 minutes

Students have to conduct 4 online quizzes. Quiz 1 to 4 has equal weight to the final assessment mark.

Indicative Effort:

- Complete the quiz within the time limit
- Correct value entered (in filling-the-box questions)
- Correct choice of answer (in multiple choice questions)

Students are expected to submit their working out at the end each quiz. The working out can be in the form of handwritten notes, Excel files, Minitab files or equivalent that demonstrate the student's own work.

Marking will be done with a rubric. Feedback will be provided in class.

Course Learning Outcomes

- CLO1 : Analyse industrial processes using different statistical methods
- CLO2 : Explain the importance of the maintenance and process improvement functions within industry
- CLO3 : Apply 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

Detailed Assessment Description

See above

Assignment submission Turnitin type

Not Applicable

Hurdle rules

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.

Individual Reflections

Assessment Overview

Each student is to produce an individual reflection for each group project.

Indicative Effort

A reflection template will be provided to outline the requirement of this assessment - word counts and other guidelines will be provided in the template.

Marking will be done with a rubric. Feedback will be provided in class within 2 weeks after the assessment is due.

Course Learning Outcomes

- CLO1 : Analyse industrial processes using different statistical methods
- CLO2 : Explain the importance of the maintenance and process improvement functions within industry
- CLO3 : Apply 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
- CLO4 : Conduct a reliability study and make recommendations with respect to the maintenance plan and ongoing reliability program

Detailed Assessment Description

See above

Assignment submission Turnitin type

Not Applicable

General Assessment Information

Grading Basis

Standard

Requirements to pass course

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 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.

Course Schedule

Teaching Week/Module	Activity Type	Content
Week 1 : 12 February - 18 February	Lecture	• Data-Driven Decision • Data Visualisation • Introduction to the Minitab Software • Basic Probability Distributions
Week 2 : 19 February - 25 February	Lecture	• 1-sample t-test • 2-sample t-test • Pairwise t-test
Week 3 : 26 February - 3 March	Lecture	• Notations in ANOVA • Constructing ANOVA Table • Tukey's Comparison Test • Model Adequacy Checking
	Assessment	Quiz 1 • Content covered - Week 1 and 2 content • You MUST complete your quiz within the strict time window • You get 1 attempt to this quiz with 75 minutes time limit
Week 4 : 4 March - 10 March	Lecture	• Continuous vs Discrete Data • Two-way Table • Chi-Squares Test • Test of Independence
Week 5 : 11 March - 17 March	Lecture	• Basic probability theory • Conditional probability
	Assessment	Quiz 1 • Content covered - Week 1 to 4 content • You MUST complete your quiz within the strict time window • You get 1 attempt to this quiz with 75 minutes time limit
Week 6 : 18 March - 24 March	Lecture	• Wrap-up • Assignment 1 Support
Week 7 : 25 March - 31 March	Lecture	• Terms and Notations in Reliability Engineering • Component Reliability Analysis • Weibull Distribution • Constructing Weibull Curve • Component vs System Reliability • Minimal Cut Set • Path Set Method • Fault Tree Method
	Assessment	Assignment 1 due
Week 8 : 1 April - 7 April	Lecture	• P-F Curve • Major Degradation Modes • Inspection Intervals • System Reliability Analysis
	Assessment	Quiz 3 • Content covered - Week 7 and 8 content • You MUST complete your quiz within the strict time window • You get 1 attempt to this quiz with 75 minutes time limit
Week 9 : 8 April - 14 April	Lecture	• Reliability-Centred Maintenance (RCM) • Elements of Maintenance Strategy and Planning • Category of Maintenance Works • Maintenance KPIs
Week 10 : 15 April - 21 April	Lecture	• Complex Process and System Characterisation • Data-Driven Model • Building Causal Network
	Assessment	Quiz 4 • Content covered - Week 7 to 9 content • You MUST complete your quiz within the strict time window • You get 1 attempt to this quiz with 75 minutes time limit
	Assessment	Assignment 2 due

Attendance Requirements

Students are strongly encouraged to attend all classes and review lecture recordings.

Course Resources

Prescribed Resources

- 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.

Course Evaluation and Development

In this course, recent improvements resulting from student feedback include providing continuous assignment support.

Staff Details

Position	Name	Email	Location	Phone	Availability	Equitable Learning Services Contact	Primary Contact
Convenor	Ron Chan		Room ME507, Ainsworth Building	9385 1535	Send Ron a text using Microsoft Team to book a private consultation session outside class time	No	Yes
Lecturer	Erik van Voorthuysen		ME507, Ainsworth Building	9385 4147	Send Erik a text using Microsoft Team to book a private consultation session outside class time	No	No

Other Useful Information

Academic Information

I. 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, or within 3 working days of, submitting an assessment or sitting an exam.

Please note that UNSW has a Fit to Sit rule, which means that if you sit an exam, 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.

II. 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

III. Equity and diversity

Those students who have a disability that requires some adjustment in their teaching or learning environment are encouraged to discuss their study needs with the course convener prior to, or at the commencement of, their course, or with the Equity Officer (Disability) in the Equitable Learning Services. Issues to be discussed may include access to materials, signers or note-takers, the provision of services and additional exam and assessment arrangements. Early notification is essential to enable any necessary adjustments to be made.

IV. Professional Outcomes and Program Design

Students are able to review the relevant professional outcomes and program designs for their streams by going to the following link: https://www.unsw.edu.au/engineering/student-life/student-resources/program-design.

Note: This course outline sets out the description of classes at the date the Course Outline is published. The nature of classes may change during the Term after the Course Outline is published. Moodle or your primary learning management system (LMS) should be consulted for the up-to-date class descriptions. If there is any inconsistency in the description of activities between the University timetable and the Course Outline/Moodle/LMS, the description in the Course Outline/Moodle/LMS applies.

Academic Honesty and Plagarism

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.

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 or contract cheating) even suspension from the university. The Student Misconduct Procedures are available here:

www.gs.unsw.edu.au/policy/documents/studentmisconductprocedures.pdf

Submission of Assessment Tasks

Work submitted late without an approved extension by the course coordinator or delegated authority is subject to a late penalty of five percent (5%) 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. This is for all assessments where a penalty applies.

Work submitted after five days (120 hours) will not be 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 will be clearly indicated in the course outline, and such assessments will receive a mark of zero if not completed by the specified date. Examples include:

- Weekly online tests or laboratory work worth a small proportion of the subject mark;
- Exams, peer feedback and team evaluation surveys;
- Online quizzes where answers are released to students on completion;
- Professional assessment tasks, where the intention is to create an authentic assessment that has an absolute submission date; and,
- Pass/Fail assessment tasks.

Faculty-specific Information

Engineering Student Support Services – The Nucleus - enrolment, progression checks, clash requests, course issues or program-related queries

Engineering Industrial Training – Industrial training questions

UNSW Study Abroad – study abroad student enquiries (for inbound students)

UNSW Exchange – student exchange enquiries (for inbound students)

UNSW Future Students – potential student enquiries e.g. admissions, fees, programs, credit transfer

Phone

(+61 2) 9385 8500 – Nucleus Student Hub

(+61 2) 9385 7661 – Engineering Industrial Training

(+61 2) 9385 3179 – UNSW Study Abroad and UNSW Exchange (for inbound students)

School-specific Information

Short Extensions

Short extensions are not currently applicable to Mechanical and Manufacturing Engineering Courses.

Review of Results

The purpose of a review of results is if there was a marking error. Review of results is for when you have cause to believe that there is a marking error. Review of Results cannot be used to get feedback. If you would like feedback for assessments prior to the final exam, you are welcome to contact the course convenor directly. No feedback will be provided on final exams.

Use of AI

The use of AI is prohibited unless explicitly permitted by the course convenor. Please respect this and be aware that penalties will apply when unauthorised use is detected, such as through Turnitin. If the use of generative AI, such as ChatGPT, is allowed in a specific assessment, they must be properly credited, and your submissions must be substantially your own work.

School Contact Information

Location

UNSW Mechanical and Manufacturing Engineering

Ainsworth building J17, Level 1

Above Coffee on Campus

Hours

9:00–5:00pm, Monday–Friday*

*Closed on public holidays, School scheduled events and University Shutdown

Web

School of Mechanical and Manufacturing Engineering

Engineering Student Support Services

Engineering Industrial Training

UNSW Study Abroad and Exchange (for inbound students)

UNSW Future Students

Phone

(+61 2) 9385 8500 – Nucleus Student Hub

(+61 2) 9385 7661 – Engineering Industrial Training

(+61 2) 9385 3179 – UNSW Study Abroad and UNSW Exchange (for inbound students)

(+61 2) 9385 4097 – School Office**

**Please note that the School Office will not know when/if your course convenor is on campus or available

Email

Engineering Student Support Services – current student enquiries

- e.g. enrolment, progression, clash requests, course issues or program-related queries

Engineering Industrial Training – Industrial training questions

UNSW Study Abroad – study abroad student enquiries (for inbound students)

UNSW Exchange – student exchange enquiries (for inbound students)

UNSW Future Students – potential student enquiries

- e.g. admissions, fees, programs, credit transfer

School Office – School general office administration enquiries

- NB: the relevant teams listed above must be contacted for all student enquiries. The School will only be able to refer students on to the relevant team if contacted

Important Links

- Student Wellbeing
- Urgent Mental Health & Support
- Equitable Learning Services
- Faculty Transitional Arrangements for COVID-19
- Moodle
- Lab Access

- Computing Facilities
- Student Resources
- Course Outlines
- Makerspace
- UNSW Timetable
- UNSW Handbook