UNSW Course Outline

MATS4004 Fracture Mechanics and Failure Analysis - 2024

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General Course Information

Course Code : MATS4004
Year : 2024
Term : Term 2
Teaching Period : T2
Is a multi-term course? : No
Faculty : Faculty of Science
Academic Unit : School of Materials Science & Engineering
Delivery Mode : In Person
Delivery Format : Standard
Delivery Location : Kensington
Campus : Sydney
Study Level : Undergraduate
Units of Credit : 6

Useful Links

Handbook Class Timetable

Course Details & Outcomes

Course Description

This Level 4 elective course in materials science and engineering will further develop capabilities in fracture mechanics and fractography for students with a Materials or general Engineering background.

Fracture is the most common form of engineering failure, costing the global economy enormous amounts of money as well as many lives. Through a combination of lectures, tutorials, laboratories and project work, students will develop advanced knowledge fracture mechanics. Understanding methods for calculating stress distributions in real-world components, risks for fracture initiation, fatigue and lifetime analysis, and materials degradation mechanisms provides engineers with the tools for the design of components that can operate safely for known time-periods. By applying forensic fractographic analysis, students will learn how to identify the causes of fracture in real industrial-scale failures.

Previous knowledge of mechanical properties of materials is required.

Course Aims

The aim of this course is to provide students with an advanced understanding of materials failure due to fracture. The lectures will examine the root causes and underlying mechanism of fracture, their impact and how to make safe designs to avoid fracture risk. Lab classes will introduce students to fractography, or the study of fracture surfaces to forensically investigate the mechanisms by which a component has failed.

Course Learning Outcomes

Course Learning Outcomes
CLO1 : Predict mechanical loading and material preparation conditions leading to the onset of failure.
CLO2 : Evaluate component lifetimes under cyclic loading using fatigue failure descriptions.
CLO3 : Assess various mechanisms of materials degradation leading to increased chance of failure.
CLO4 : Recommend remedial actions for the prevention of material failure in damaged structures.
CLO5 : Analyse fracture surfaces and assess the distinguishing features of the different types of service failure.
CLO6 : Communicate effectively on materials failure, fractographic and fracture mechanic analyses in written form using the correct terminology and appropriate style.

Course Learning Outcomes	Assessment Item
CLO1 : Predict mechanical loading and material preparation conditions leading to the onset of failure.	• Mid-Term Test • Assignment
CLO2 : Evaluate component lifetimes under cyclic loading using fatigue failure descriptions.	• Final Exam • Mid-Term Test • Assignment
CLO3 : Assess various mechanisms of materials degradation leading to increased chance of failure.	• Laboratory report • Final Exam • Mid-Term Test • Assignment
CLO4 : Recommend remedial actions for the prevention of material failure in damaged structures.	• Laboratory report • Final Exam • Mid-Term Test • Assignment
CLO5 : Analyse fracture surfaces and assess the distinguishing features of the different types of service failure.	• Laboratory report • Final Exam
CLO6 : Communicate effectively on materials failure, fractographic and fracture mechanic analyses in written form using the correct terminology and appropriate style.	• Laboratory report • Assignment

Learning and Teaching Technologies

Moodle - Learning Management System

Assessments

Assessment Structure

Assessment Item	Weight	Relevant Dates
Final Exam Assessment Format: Individual	30%	
Laboratory report Assessment Format: Individual	20%	
Mid-Term Test Assessment Format: Individual	30%	
Assignment Assessment Format: Individual	20%	

Assessment Details

Final Exam

Assessment Overview

The final exam will assess content from the lectures and laboratory held in weeks 5-10.

The duration of the exam will be 90 minutes and typically include multiple choice, calculation and short answer questions. The exam will take place during the official exam period.

Feedback may be available through inquiry with the course convenor.

To pass the course you must achieve a score of at least 35% for both the mid-term test and the final exam, and an average mark of 45% for the two assessments.

Course Learning Outcomes

- CLO2 : Evaluate component lifetimes under cyclic loading using fatigue failure descriptions.
- CLO3 : Assess various mechanisms of materials degradation leading to increased chance of failure.
- CLO4 : Recommend remedial actions for the prevention of material failure in damaged structures.
- CLO5 : Analyse fracture surfaces and assess the distinguishing features of the different types of service failure.

Hurdle rules

Average of course exam components must be >40%

Laboratory report

Assessment Overview

You will complete three lab activities over a week to undertake a detailed investigation of a range of fractured surfaces. Each lab will focus on the following:

1. The macroscopic fracture-surface
2. The microstructure of the samples
3. The microscopic fracture surface using an SEM

The results of all three labs will be provided to you after attending and you will write a single lab report for all samples. You will complete the labs in week 8 and submit the report in week 10. Attendance at all three labs is compulsory; if you are not able to attend any of the lab sessions, you will need to apply for Special Consideration.

Feedback: Students will receive their mark and individualised feedback on the areas they excelled at and which areas of the reports that were not answered correctly. Feedback will be provided through Moodle, two weeks after submission.

Course Learning Outcomes

- CLO3 : Assess various mechanisms of materials degradation leading to increased chance of failure.
- CLO4 : Recommend remedial actions for the prevention of material failure in damaged structures.
- CLO5 : Analyse fracture surfaces and assess the distinguishing features of the different types of service failure.
- CLO6 : Communicate effectively on materials failure, fractographic and fracture mechanic analyses in written form using the correct terminology and appropriate style.

Mid-Term Test

Assessment Overview

The mid-term test will cover material presented in lectures and laboratories during weeks 1-5. The duration of the test will be 90 minutes and typically include multiple choice, calculation and short answer questions. The test will typically take place in Week 7.

Feedback will be provided by your grade and the class distribution of grades.

To pass the course you must achieve a score of at least 35% for both the mid-term test and the final exam, and an average mark of 45% for the two assessments.

Course Learning Outcomes

- CLO1 : Predict mechanical loading and material preparation conditions leading to the onset of failure.
- CLO2 : Evaluate component lifetimes under cyclic loading using fatigue failure descriptions.
- CLO3 : Assess various mechanisms of materials degradation leading to increased chance of failure.
- CLO4 : Recommend remedial actions for the prevention of material failure in damaged structures.

Hurdle rules

Average of course exam components must be >40%

Assignment

Assessment Overview

In this assignment you will research and report on a historic materials failure that caused a major industrial disruption and resulted in legal proceedings. You will be required to prepare a report (max. 2000 words) over a two-week period, with an additional peer-review component over the following week. The report is worth 70% of the assignment grade, while the quality of peer review provided makes up the remaining 30%. The report and peer review are typically due in week 5.

Peer review and lecturer feedback will be given two weeks after submission, including your marked assignment and peer-review quality. Overall comments on how the class performed will also be provided.

Course Learning Outcomes

- CLO1 : Predict mechanical loading and material preparation conditions leading to the onset of failure.
- CLO2 : Evaluate component lifetimes under cyclic loading using fatigue failure descriptions.
- CLO3 : Assess various mechanisms of materials degradation leading to increased chance of failure.
- CLO4 : Recommend remedial actions for the prevention of material failure in damaged structures.
- CLO6 : Communicate effectively on materials failure, fractographic and fracture mechanic analyses in written form using the correct terminology and appropriate style.

Assignment submission Turnitin type

This assignment is submitted through Turnitin and students do not see Turnitin similarity reports.

General Assessment Information

Grading Basis

Standard

Course Schedule

Attendance Requirements

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

Staff Details

Position	Name	Email	Location	Phone	Availability	Equitable Learning Services Contact	Primary Contact
Head lecturer	John Daniels				By appointment	No	Yes
Lecturer	Rasoul Khayyam Nekouei				By appointment	No	No

Other Useful Information

Academic Information

Upon your enrolment at UNSW, you share responsibility with us for maintaining a safe, harmonious and tolerant University environment.

You are required to:

- Comply with the University's conditions of enrolment.
- Act responsibly, ethically, safely and with integrity.
- Observe standards of equity and respect in dealing with every member of the UNSW community.
- Engage in lawful behaviour.
- Use and care for University resources in a responsible and appropriate manner.
- Maintain the University's reputation and good standing.

For more information, visit the UNSW Student Code of Conduct Website.

Academic Honesty and Plagarism

Referencing is a way of acknowledging the sources of information that you use to research your assignments. You need to provide a reference whenever you draw on someone else's words,

ideas or research. Not referencing other people's work can constitute plagiarism.
Further information about referencing styles can be located at https://student.unsw.edu.au/referencing

Academic integrity is fundamental to success at university. Academic integrity can be defined as a commitment to six fundamental values in academic pursuits: honesty, trust, fairness, respect, responsibility and courage. At UNSW, this means that your work must be your own, and others' ideas should be appropriately acknowledged. If you don't follow these rules, plagiarism may be detected in your work.
Further information about academic integrity, plagiarism and the use of AI in assessments can be located at:

- The Current Students site,
- The ELISE training site, and
- The Use of AI for assessments site.

The Student Conduct and Integrity Unit provides further resources to assist you to understand your conduct obligations as a student: https://student.unsw.edu.au/conduct

Submission of Assessment Tasks

Penalty for Late Submissions

UNSW has a standard late submission penalty of:

- 5% per day,
- for all assessments where a penalty applies,
- capped at five days (120 hours) from the assessment deadline, after which a student cannot submit an assessment, and
- no permitted variation.

Any variations to the above will be explicitly stated in the Course Outline for a given course or assessment task.

Students are expected to manage their time to meet deadlines and to request extensions as early as possible before the deadline.

Special Consideration

If circumstances prevent you from attending/completing an assessment task, you must officially apply for special consideration, usually within 3 days of the sitting date/due date. You can apply by logging onto myUNSW and following the link in the My Student Profile Tab. Medical

documentation or other documentation explaining your absence must be submitted with your application. Once your application has been assessed, you will be contacted via your student email address to be advised of the official outcome and any actions that need to be taken from there. For more information about special consideration, please visit: https://student.unsw.edu.au/special-consideration

Important note: UNSW 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 to do so and cannot later apply for Special Consideration. This is to ensure that if you feel unwell or are faced with significant circumstances beyond your control that affect your ability to study, you do not sit an examination or submit an assessment that does not reflect your best performance. Instead, you should apply for Special Consideration as soon as you realise you are not well enough or are otherwise unable to sit or submit an assessment.

Faculty-specific Information

Additional support for students

- The Current Students Gateway
- Student Support
- Academic Skills and Support
- Student Wellbeing, Health and Safety
- Equitable Learning Services
- UNSW IT Service Centre
- Science EDI Student Initiatives, Offerings and Guidelines