UNSW Course Outline

MATS4007 Engineered Surfaces to Resist Corrosion and Wear - 2024

Published on the 03 Sep 2024

General Course Information

Course Code : MATS4007
Year : 2024
Term : Term 3
Teaching Period : T3
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

Degradation of engineering materials occurs most commonly through corrosion and wear. This Level 4 elective course in materials science and engineering teaches students how to minimise and control the rate at which these occur to extend the lifespan of engineering components. The

course is taught through lectures and laboratories and covers three main areas:

Corrosion and Control Strategies: Corrosion occurs in several ways. Students will learn the causes of each type of corrosion, and how to prevent corrosion, or reduce the rate at which corrosion occurs in established systems.

Wear: Wear occurs in many engineering applications. Students will learn about the primary mechanisms by which wear occurs, and how simple models of these wear mechanisms allow the main parameters and materials properties affecting wear rates to be identified.

Surface Engineering: Students will learn about the purpose of engineered surfaces to increase the lifespan of materials by increasing resistance to both corrosion and wear, with a focus on the hardening of steel and the common coating methods used in industry to protect different materials.

Previous knowledge of thermodynamics, kinetics, and mechanical properties is required.

Course Aims

The aim of this course is to develop students' advanced-level knowledge of common ways that materials can degrade in engineering applications, specifically degradation by corrosion and wear, and how this degradation can be prevented or mitigated through corrosion prevention and surface engineering methods. The course will focus particularly on real-world applications through the use of case studies and examples. The course will also provide an observational and hands-on experience through a laboratory-based materials testing and results analysis exercise.

Course Learning Outcomes

Course Learning Outcomes
CLO1 : Identify and explain the relationships between materials, microstructures and environments in relation to corrosion behaviour.
CLO2 : Explain the main mechanisms by which wear occurs and the key parameters and material properties that affect wear rates.
CLO3 : Select and justify appropriate materials, protection strategies and surface engineering methods to be used in practical scenarios where resistance to corrosion and/or wear is required.

Course Learning Outcomes	Assessment Item
CLO1 : Identify and explain the relationships between materials, microstructures and environments in relation to corrosion behaviour.	• Corrosion Laboratory and Demonstration • Mid-term Test • Assignments
CLO2 : Explain the main mechanisms by which wear occurs and the key parameters and material properties that affect wear rates.	• Final Exam • Assignments
CLO3 : Select and justify appropriate materials, protection strategies and surface engineering methods to be used in practical scenarios where resistance to corrosion and/or wear is required.	• Corrosion Laboratory and Demonstration • Mid-term Test • Final Exam • Assignments

Learning and Teaching Technologies

Moodle - Learning Management System

Assessments

Assessment Structure

Assessment Item	Weight	Relevant Dates
Corrosion Laboratory and Demonstration Assessment Format: Individual	10%	Start Date: See your timetable for lab times Due Date: 10/10/2024 05:00 PM
Mid-term Test Assessment Format: Individual	30%	Start Date: 21/10/2024 10:00 AM Due Date: 21/10/2024 12:00 PM
Final Exam Assessment Format: Individual	30%	Start Date: In official exam period at the end of term Due Date: Not Applicable
Assignments Assessment Format: Individual	30%	Start Date: Not Applicable Due Date: Not Applicable

Assessment Details

Corrosion Laboratory and Demonstration

Assessment Overview

This laboratory exercise will apply your knowledge and understanding of corrosion theory to selected materials and will familiarise you with typical laboratory corrosion testing methods, and the theory associated with these methods. You will learn to assess laboratory generated data and will correlate these to environmental corrosion of materials in real-world applications.

This laboratory exercise and submitted report are worth 10% of your final grade.

The laboratory exercise is typically timetabled in Week 4.

The laboratory results will be unique to each lab session. These results will be provided to you at the end of all laboratory sessions for you to analyse and assess.

You will provide your analysis of the results in the form of a report using the format provided, typically due one week after the laboratory exercise takes place.

Feedback on your performance will be provided two weeks after submission of the report, in the form of your mark, an accepted answer sheet and overall comments on how the class performed and common areas that were not completed correctly.

Course Learning Outcomes

- CLO1 : Identify and explain the relationships between materials, microstructures and

environments in relation to corrosion behaviour.
- CLO3 : Select and justify appropriate materials, protection strategies and surface engineering methods to be used in practical scenarios where resistance to corrosion and/or wear is required.

Detailed Assessment Description

This laboratory class provides a laboratory demonstration of potentiodynamic polarisation used to study and compare electrode behaviour of different steels. The results provided from these series of experiments shall be analysed to determine characteristic values of factors that help in the assessment of materials corrosion.

Assignment submission Turnitin type

Not Applicable

Generative AI Permission Level

No Assistance

This assessment is designed for you to complete without the use of any generative AI. You are not permitted to use any generative AI tools, software or service to search for or generate information or answers.
For more information on Generative AI and permitted use please see here.

Mid-term Test

Assessment Overview

The mid-term test will be held in class, usually in Week 7, and will cover the topics taught in Weeks 1-5.

The test will be ~2 hrs in duration and will assess your understanding of the concepts taught in both lectures and laboratory activities, through a combination of multiple-choice, numerical and descriptive questions.

Feedback will be given two weeks after the test and will take the form of the mark and overall comments on how the class performed and common areas that were not answered correctly.

Hurdle requirement: you must achieve at least 35% in the mid-term test, as well as an average of at least 45% across the mid-term test and final exam, to receive a passing grade in the course.

Course Learning Outcomes

- CLO1 : Identify and explain the relationships between materials, microstructures and environments in relation to corrosion behaviour.

- CLO3 : Select and justify appropriate materials, protection strategies and surface engineering methods to be used in practical scenarios where resistance to corrosion and/or wear is required.

Assignment submission Turnitin type

Not Applicable

Hurdle rules

Hurdle requirement: you must achieve at least 35% in the mid-term test, as well as an average of at least 45% across the mid-term test and final exam, to receive a passing grade in the course.

Generative AI Permission Level

No Assistance

This assessment is designed for you to complete without the use of any generative AI. You are not permitted to use any generative AI tools, software or service to search for or generate information or answers.
For more information on Generative AI and permitted use please see here.

Final Exam

Assessment Overview

The final exam will be held in the official exam period at the end of term. It will cover the topics taught in Weeks 5-10.

The exam will be ~2 hrs in duration and will assess your understanding of, and ability to apply in practical scenarios, the concepts taught in lectures, mainly through descriptive questions.

You will receive your final course mark and feedback is available through inquiry with the course convenor.

Hurdle requirement: you must achieve at least 35% in the final exam, as well as an average of at least 45% across the mid-term test and final exam, to receive a passing grade in the course.

Course Learning Outcomes

- CLO2 : Explain the main mechanisms by which wear occurs and the key parameters and material properties that affect wear rates.
- CLO3 : Select and justify appropriate materials, protection strategies and surface engineering methods to be used in practical scenarios where resistance to corrosion and/or wear is required.

Assignment submission Turnitin type

Not Applicable

Hurdle rules

Hurdle requirement: you must achieve at least 35% in the mid-term test, as well as an average of at least 45% across the mid-term test and final exam, to receive a passing grade in the course.

Generative AI Permission Level

No Assistance

This assessment is designed for you to complete without the use of any generative AI. You are not permitted to use any generative AI tools, software or service to search for or generate information or answers.
For more information on Generative AI and permitted use please see here.

Assignments

Assessment Overview

You will complete 3 short assignments, one for each of the topics of corrosion, wear and surface engineering. Each assignment is worth 10% of the course mark.

The aim of these assignments is to develop your understanding of, and ability to apply, concepts covered in lectures and to explore real-world applications of the course content in industry and research. The assignments will be in the form of either an essay topic or a set of questions requiring a combination of written and numerical answers.

The assignments will typically be due in Weeks 3, 9 and 10.

Feedback will be given two weeks after submission of the assignment and take the form of the mark for the assignment, and either overall comments on how the class performed and common areas that were not answered correctly, or personal feedback on your individual performance.

Course Learning Outcomes

- CLO1 : Identify and explain the relationships between materials, microstructures and environments in relation to corrosion behaviour.
- CLO2 : Explain the main mechanisms by which wear occurs and the key parameters and material properties that affect wear rates.
- CLO3 : Select and justify appropriate materials, protection strategies and surface engineering methods to be used in practical scenarios where resistance to corrosion and/or wear is required.

Assignment submission Turnitin type

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

Generative AI Permission Level

Simple Editing Assistance

In completing this assessment, you are permitted to use standard editing and referencing functions in the software you use to complete your assessment. These functions are described below. You must not use any functions that generate or paraphrase passages of text or other media, whether based on your own work or not.
If your Convenor has concerns that your submission contains passages of AI-generated text or media, you may be asked to account for your work. If you are unable to satisfactorily demonstrate your understanding of your submission you may be referred to UNSW Conduct & Integrity Office for investigation for academic misconduct and possible penalties.
For more information on Generative AI and permitted use please see here.

General Assessment Information

Short Extensions:

The School of Materials Science and Engineering has reviewed its range of assignments and projects to determine their suitability for automatic shortextensions as set out by the UNSW Short Extension Policy. After consultation with teaching staff and examination of our course offerings, we consider our current deadline structures already accommodate the possibility of unexpected circumstances that may lead students to require additional days for submission. Consequently, the School does not offer the Short Extension provision in its MATS courses but students, if needed, can apply for formal Special Consideration via the usual procedure.

Grading Basis

Standard

Requirements to pass course

To pass the course, you must:

1) achieve an overall grade of at least 50;

2) you must achieve at least 35% in the mid-term test, as well as an average of at least 45% across the mid-term test and final exam.

Course Schedule

Teaching Week/Module	Activity Type	Content
Week 1 : 9 September - 15 September	Lecture	Monday, 10am-12pm: Introduction to the course; Introduction to corrosion & corrosion control Wednesday, 2pm-4pm: Electrochemical reactions Thursday, 11am-1pm: Types of corrosion
	Assessment	Corrosion assignment released
Week 2 : 16 September - 22 September	Lecture	Monday, 10am-12pm: Thermodynamics of corrosion 1 - Electromotive force & Nernst equation Wednesday, 2pm-4pm: Thermodynamics of corrosion 2 - Introduction to Pourbaix diagrams Thursday, 11am-1pm: Electrode kinetics 1
Week 3 : 23 September - 29 September	Lecture	Monday, 10am-12pm: Electrode kinetics 2 Wednesday, 2pm-4pm: Passivity & pitting Thursday, 11am-1pm: Atmospheric corrosion
	Assessment	Corrosion assignment due (end of week)
Week 4 : 30 September - 6 October	Lecture	Monday, 10am-12pm: Corrosion in Soil & Bio-Corrosion Wednesday, 2pm-4pm: Corrosion Under Stress 1 - Stress Corrosion Cracking Thursday, 11am-1pm: Corrosion Under Stress 2 - Hydrogen Damage & Corrosion Fatigue
	Laboratory	See your lab schedule time, report due end of Week 5.
Week 5 : 7 October - 13 October	Lecture	Thursday, 11am-1pm: Introduction to surface engineering
Week 6 : 14 October - 20 October	Other	Revision week
Week 7 : 21 October - 27 October	Assessment	Monday 10am-12pm MID-TERM TEST: : PART 1 CORROSION & CORROSION CONTROL HELD IN CLASS
	Online Activity	1. Thermal hardening of steel (~1 hour) 2. Thermochemical hardening of steel (~1.5 hours) 3. Electrochemical coating methods (~1.25 hours)
	Lecture	Friday, 11am-1pm: Review and discussion of content covered in online lessons
	Assessment	Surface engineering assignment released
Week 8 : 28 October - 3 November	Online Activity	1. Thermal spray coatings (~1 hour) 2. Physical and chemical vapour deposition (~1.25 hours) 3. Chemical conversion coatings and Organic coatings (~0.5 hour)
	Lecture	Monday, 10am-12pm: Galvanising guest lecture Thursday, 11am-1pm: Review and discussion of content covered in online lessons, summary of surface engineering methods
	Assessment	Surface engineering assignment - Task 1 due
Week 9 : 4 November - 10 November	Online Activity	1. Friction (~1.5 hours) 2. Abrasive and erosive wear (~1.25 hours) 3. Adhesive wear (~1.25 hour)
	Lecture	Monday, 10am-12pm: Introduction to friction & wear Thursday, 11am-1pm: Models of friction and abrasive, erosive & adhesive wear
	Assessment	Surface engineering assignment - Final submission due
	Assessment	Friction & wear assignment released
Week 10 : 11 November - 17 November	Online Activity	1. Fatigue & corrosive wear (~0.75 hour) 2. Lubrication (~0.75 hour) 3. Friction & wear of ceramics and polymers (~0.5 hour)
	Lecture	Thursday, 11am-1pm: Review and discussion of content covered in online lessons
	Assessment	Friction & wear assignment due

Attendance Requirements

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

Course Resources

Recommended Resources

I.M. Hutchings, Tribology, Edward Arnold, 1992.

B. Bhushan, Introduction to Tribology, 2nd Ed. (Wiley, 2013).

D.A. Jones, Principles and Prevention of Corrosion, 2nd Ed. Prentice Hall.

Course Evaluation and Development

Feedback will be gathered through the myExperience process at the end of the term. Students should make their feedback as specific as possible so the action required to improve the course is clear. Often the feedback received from myExperience is too general or non-specific to allow course improvements to be made.

While the myExperience process will help to improve the course for future cohorts, we also want to make the learning experience the best possible for current students. Students are welcome to provide feedback to the lecturers at any time they wish, either by email, discussing in person or using the anonymous feedback forum in Moodle. There are many changes that can be made during the term to improve the students' learning experience, but improvements can only be made if students make staff aware of the issues that are affecting their learning experience.

An example of a change made to MATS4007 based on previous feedback: students commented that there were too many low-weighted assignments/assessments in the corrosion section of the course, leading to overload and/or a lower focus, priority or value placed on these assignments, and also that feedback was slow. This was amended within the course to provide fewer, better spaced assignments/assessments and faster feedback mechanisms.

Staff Details

Position	Name	Email	Location	Phone	Availability	Equitable Learning Services Contact	Primary Contact
Convenor	Judy Hart		Room 339, Hilmer Building	02 9385 7998	By apppointment	Yes	Yes
Lecturer	Kevin Laws		Room 301, Hilmer Building	02 9385 5234	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