Course Outline

MATS4007

Engineered Surfaces to Resist Corrosion and Wear
Materials Science and Engineering

Science

T3, 2022

1. Staff

Position	Name	Email	Consultation times and locations	Contact Details
Course Convenor	Dr Judy Hart	j.hart@unsw.edu.au	Room 339, School of Materials Science and Engineering (Building E10), by appointment	Phone: 9385 7998
Lecturer	Dr Kevin Laws	k.laws@unsw.edu.au	Room 301, School of Materials Science and Engineering (Building E10), by appointment	Phone: 9385 5234

2. Course information

Units of credit: 6

Pre-requisite(s): None

Timetabling website: http://timetable.unsw.edu.au/2022/MATS4007.html

Teaching times and locations:

	Lecture	Lecture	Lecture	Laboratory
Day	Monday	Wednesday	Friday	Online, see Moodle for details
Location	Online/hybrid*	Online/hybrid*	Online/hybrid*	
Time	10:00-12:00	13:00-15:00	10:00-12:00	
Weeks	1-5, 7-10	1-5, 7-10	1-5, 7-10	TBC

*Classes in the first half of term will be online. Classes in the second half of term (starting from end of Week 5) will be either hybrid or online – see Moodle for details. Not all scheduled class times will be used each week – a detailed schedule will be communicated in classes and on Moodle.

2.1 Course summary

Degradation of engineering materials occurs in all applications through corrosion and wear. This advanced level course teaches students how to minimise and control the rate at which this occurs to extend the lifespan of engineered components. The course is taught through lecture and laboratories and covers three main areas:

Corrosion and control: Corrosion occurs in several ways. Students will learn the causes of each type of corrosion and how to prevent corrosion from happening and reduce the rate at which corrosion occurs in established systems.

Surface Engineering: Students will learn about the purpose and processes of engineering surfaces to increase the lifespan of materials with a focus on the hardening of steel and the common methods used in industry to protect different materials.

Wear: Wear occurs in many engineering applications; this course will inform students of the economic reasons for developing wear-resistant materials and how other material properties affect the wear resistance. To understand the complex wear system, the fundamental models of wear will be taught through the wholistic tribological approach.

2.2 Course aims

To learn the behaviour of surfaces, electrochemical series, corrosion, methods for prevention of corrosion, stress corrosion cracking, wear and friction phenomena, surface hardening – nitriding, carburisation, hard coatings, oxidation, oxidation resistant coatings; Examples of materials selection for corrosion and wear resistance; Common corrosion-resistant alloys will be introduced to illustrate some of these principles involved.

2.3 Course learning outcomes (CLO)

At the successful completion of this course you (the student) should be able to:

1. Explain the mechanisms of wear and the environmental effect upon wear of different materials, and how to combat wear by correct selection of materials and/or lubrication.
2. Use the theories of different surface treatment processes and the properties of surfaces produced, so as to employ surface treatment processes professionally in engineering applications.
3. Identify the relationships between materials, microstructures and environments on corrosion behaviour of metals.
4. Select the right materials and apply different technologies for corrosion prevention.

2.4 Relationship between course and program learning outcomes and assessments

Course Learning Outcome (CLO)	LO Statement	Program Learning Outcome (PLO)	Related Tasks & Assessment
CLO 1	Explain…	1.3 & 3.4	1 & 4
CLO 2	Use…	1.3, 3.2, 3.4 & 3.6	1 & 4
CLO 3	Identify…	1.3 & 3.4	1, 2 & 3
CLO 4	Select…	1.3 & 3.4	1, 2 & 3

3. Strategies and approaches to learning

3.1 Learning and teaching activities

(Based on UNSW Learning Guidelines)

- *Students are actively engaged in the learning process.*

  It is expected that, in addition to attending classes, students will read, write, discuss, and engage in analysing the course content.

- *Effective learning is supported by a climate of inquiry where students feel appropriately challenged.*

  Students are expected to be challenged by the course content and to challenge their own preconceptions, knowledge, and understanding by questioning information, concepts, and approaches during class and study.

- *Learning is more effective when students' prior experience and knowledge are recognised and built on.*

  Coursework, tutorials, assignments, laboratories, examinations, and other forms of learning and assessment are intended to provide students with the opportunity to cross-reference these activities in a meaningful way with their own experience and knowledge.

- *Students become more engaged in the learning process if they can see the relevance of their studies to professional and disciplinary contexts*

  The course content is designed to incorporate both theoretical and practical concepts, where the latter is intended to be applicable to real-world situations and contexts.

Lectures: The core concepts will be taught in lectures; students will have access to the lectures notes before class for annotation during the lectures. Students will be engaged in the learning process through class discussions and problem-solving questions independently and working together with partners and groups.

Labs: Experimental techniques and procedures will be taught through laboratories classes and laboratory reports following the class. Students will actively complete the experiments gaining experience of important materials testing and characterisation techniques. Students will be able to reflect on the experiments and learn to process data through the lab reports after class.

3.2 Expectations of students

- Students must attend at least 80% of all classes with the expectation that students only miss classes due to illness or unforeseen circumstances
- Students must read through lecture notes and lab sheets prior to class
- During class, students are expected to engage actively in class discussions
- Students should work through lecture, tutorial and textbook questions
- Students should read through the relevant chapters of the prescribed textbook
- Students should complete all assessment tasks and submit them on time.
- Students are expected to participate in online discussions through the Moodle page

4. Course schedule and structure

You are expected to undertake a total of approximately 150 hours of work for this course, spread over the entire term, including attending live online classes, working through the online tutorials and watching video lectures, completing assessments, reading the recommended textbooks and other resources, and revising and preparing for the exam.

Week	Topics		Activity
1	Introduction to corrosion Basic principles and classifications of corrosion		
2	Thermodynamics of corrosion 1 Thermodynamics of corrosion 2 Electrode kinetics 1		
3	Electrode kinetics 2 Passivity and pitting		Assignment – Corrosion 1
4	Atmospheric corrosion and oxidation Corrosion in soil and biological corrosion		
5	Corrosion under stress	Introduction to surface engineering	Assignment – Corrosion 2
7	Surface hardening of steel Coating by electrochemical methods	Mid-term exam on corrosion	Mid-term exam
8	Thermal spray coatings Galvanising (guest lecture) Physical vapour deposition and chemical vapour deposition Comparison of surface coating methods Revision of surface coating methods		
9	Introduction to friction and wear Interactions between surfaces and friction Abrasive and erosive wear Adhesive wear		Assignment – Surface treatment
10	Fatigue and corrosive wear Wear of different materials Lubrication Revision of friction and wear mechanisms		Assignment – Friction and Wear

5. Assessment

5.1 Assessment tasks

Assessment task	Description	Weight	Due date
Written assignments:	Four short assignments on the following topics: 1. Corrosion 1 (5%) 2. Corrosion 2 (5%) 3. Surface treatment (10%) 4. Wear (10%)	30%	Week 3 Week 5 Week 9 Week 10
Corrosion laboratories:	This will be a face-to-face laboratory. An online laboratory will be available strictly for students unable to attend due to international travel issues – contact Dr Kevin Laws if you need to do the lab online. Details of the lab will be provided on Moodle during the term.	10%	Please refer to Moodle
Mid-term exam:	The in-class exam will cover the topics taught in Weeks 1-5 (only the part on corrosion).	30%	Week 7
Final exam:	The exam will assess the topics covered in Weeks 5-10 on Surface Engineering and Wear.	30%	Final exam period

Further information

UNSW grading system: https://student.unsw.edu.au/grades

UNSW assessment policy: https://student.unsw.edu.au/assessment

5.2 Assessment criteria and standards

- Assignment and laboratory criteria and standards will be available on the course Moodle page.
- Students who fail to achieve a score of at least 35% for both the mid-term exam and the final exam, and an average exam mark of 45%, but achieve a final mark >50% for the course, may still be awarded a UF (Unsatisfactory Fail) for the course.
- Please refer to the UNSW guide to grades: https://student.unsw.edu.au/grades

5.3 Submission of assessment tasks

- UNSW operates under a Fit to Sit/Submit rule for all assessments. If a student wishes to submit an application for special consideration for an exam or assessment, the application must be submitted prior to the start of the exam or before an assessment is submitted. If a student sits the exam/ submits an assignment, they are declaring themselves well enough to do so. Information on this process can be found here: https://student.unsw.edu.au/special-consideration. Medical certificates or other appropriate documents must be included. Students should also advise the lecturer of the situation.

- Assignments and lab reports should be submitted electronically in Moodle prior to the due date/time for submission. All submissions will be checked for plagiarism.
- Assignments/lab reports submitted after the due date for submission will receive a 5% of maximum grade penalty for every day late, or part thereof.
- Work that is more than 5 days late will not be accepted and will receive zero mark.
- 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 convenor prior to, or at the commencement of, their course, or with the Equity Officer (Disability) in the Equity and Diversity Unit: https://student.unsw.edu.au/disability. Early notification is essential to enable any necessary adjustments to be made.
- Rules governing conduct during exams are given at: https://student.unsw.edu.au/exam-rules

5.4. Feedback on assessment

Assignments: Feedback will be given two weeks after submission of the assignment and take the form of the mark for the assignment, overall comments on how the class performed, and any common areas that were not answered correctly. Additionally, personal feedback and how each student performed may be given.

Lab reports: 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.

Mid-term exams: Students will receive their mark for the exam.

Final exam: Students will receive their final mark.

6. Academic integrity, referencing and plagiarism

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.[1] 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 and **plagiarism** can be located at:

- The *Current Students* site https://student.unsw.edu.au/plagiarism**,** and
- The *ELISE* training site http://subjectguides.library.unsw.edu.au/elise/presenting

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

[1] International Center for Academic Integrity, 'The Fundamental Values of Academic Integrity', T. Fishman (ed), Clemson University, 2013.

7. Readings and resources

Textbooks

- 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

Additional References

- R.D. Arnell, P.B. Davies, J. Halling and T.L. Whomes, Tribology, (Macmillan, 1991).
- G.W. Stachowiak and A.W. Batchelor, Engineering Tribology, 3rd Ed. (Elsevier, 2005).
- D. F. Moore, Principles and Applications of Tribology, (Pergamon, 1975).
- M.F. Ashby and D.R. Jones, Engineering Materials, (Pergamon, 1980), Ch. 25 and 26, p223-235.
- Surface Cleaning, Finishing and Coating, Metals Handbook, 9th Ed., Vol. 5, (ASM, 1982)
- R. Kossowsky, Surface Modification Engineering, (CRC Press Inc., 1989)
- R.D. Sisson, Surface Modification and Coatings, (ASM, 1986)
- T.S. Sudarshan and D.G. Bhat, Surface Modification Technologies I & II (The Metallurgical Society 1988 & 1989)
- H. Silman, G. Isserlis and A.F. Averill, Protective and Decorative Coatings for Metals, Finishing Pub. 1978
- M.G. Fontana Corrosion Engineering, McGrew Hill
- H.H. Uhlig and R.W. Revie Corrosion and Corrosion Control, Wiley-Interscience
- K.R. Trethewey and J Chamberlain Corrosion -- for students of Science and Engineering, Longman
- J.M. West, E. Horwood Basic Corrosion and Oxidation, John Wiley & Sons
- U.R. Evans, An Introduction to Metallic Corrosion, Edward Arnold

8. Administrative matters

School Office: Room 137, Building E10 School of Materials Science and Engineering
School Website: http://www.materials.unsw.edu.au/
Faculty Office: Robert Webster Building, Room 128
Faculty Website: http://www.science.unsw.edu.au/

9. Additional support for students

- The Current Students Gateway: https://student.unsw.edu.au/
- Academic Skills and Support: https://student.unsw.edu.au/academic-skills
- Student Wellbeing, Health and Safety: https://student.unsw.edu.au/wellbeing
- Disability Support Services: https://student.unsw.edu.au/disability-services
- UNSW IT Service Centre: https://www.it.unsw.edu.au/students/index.html
- Assessment Implementation Procedure: https://www.gs.unsw.edu.au/policy/documents/assessmentimplementationprocedure.pdf
- Special Consideration: https://student.unsw.edu.au/special-consideration