Course Outline

MATS3001

Micromechanisms of Mechanical Behaviour in Metals

Materials Science and Engineering

Science

T2, 2020

1. Staff

Position	Name	Email	Consultation times and locations	Contact Details
Course Convenor	Professor Paul Munroe	p.munroe@unsw.edu.au	Room 250, School of Materials Science and Engineering (Building E10) by appointment	Phone: 9385 5673
Lecturer	Dr Judy Hart	j.hart@unsw.edu.au	Room 339, School of Materials Science and Engineering (Building E10) by appointment	Phone: 9385 5386

2. Course information

Units of credit: 6

Pre-requisite(s): MATS2003 and MATS2004

The course will be taught fully online. Course notes and other teaching materials are provided on the course Moodle site. These include notes (in either the form of Word, pdf or Powerpoint documents) and recorded lectures, via Echo 360.

There will be assignments set through the course as well as a mid-term exam in ~ Week 7, and an end of term exam held during the exam period.

2.1 Course summary

Crystallography revision. Theoretical strength; slip; twinning; deformation of single and polycrystals; dislocation multiplication; cross slip; climb; dislocation interactions. Strain hardening; solid solution hardening; age-hardening; dispersion hardening; grain size strengthening; other strengthening mechanisms. High temperature deformation; creep; stress relaxation; effect of strain rate and temperature. Common classes of aluminium and nickel-based and titanium alloys to be taught illustrating some of the principles involved.

2.2 Course aims

To relate dislocation theory and strengthening mechanisms to the mechanical behaviour of materials. These principles will be illustrated with respect to commercial aluminium, titanium and nickel alloys.

2.3 Course learning outcomes (CLO)

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

1. Relate the role of dislocations and other defects to mechanical behaviour
2. Apply strengthening mechanisms to alloy systems and predict behaviour
3. Correlate the effect of microstructural development through alloying and heat treatment to mechanical properties

4. Think critically in decision making, problem-solving
5. Communicate with correct terminology
6. Conducting online research
7. Work effectively in a team to solve problems

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	Relate…	1.3 & 1.4	1-5
CLO 2	Apply…	1.3 & 1.4	4 & 5
CLO 3	Correlate…	1.3 & 1.4	4 & 5
CLO 4	Think critically…	2.1 & 2.3	1-5
CLO 5	Communicate…	1.3	1-5
CLO 6	Conducting…	3.4	2 & 4
CLO 7	Work effectively…	3.6	2

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 read, write, discuss, and are engaged in solving problems on the deformation and strengthening behaviour of materials, and in analysis and evaluation of the mechanical behaviour of metals.

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

  Problems involving dislocation theory are challenging; students will be given assignments that will motivate deep analysis of various deformation and strengthening phenomena in materials science and engineering.

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

  This course is built on prior courses in mathematics, physics and chemistry as well as stage 2 courses such as MATS2003 and MATS2004.

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

  Students will be asked to analyse the role of dislocations in understanding various physical phenomena in materials science and how properties such as strength, ductility and creep resistance are affected by dislocation theory.

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

3.2 Expectations of students

- Students should ensure they watch all of the recorded classes
- Students must read through lecture notes to read along side the recorded classes
- 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

This course normally consists of 50 hours of class contact hours in lecture form. You are also expected to take an additional 100 hours of non-class contact hours to complete assessments, readings and exam preparation spread over the term.

Students should work through the on line course material at a pace to keep up with the topic listings below.

Week	Topics	Activity
1	Revision of crystallography Properties of dislocations	
2	Properties of dislocations	
3	Properties of dislocations Dislocations in FCC, HCP and BCC crystals	Formative Online Quiz
4	Dislocations in FCC, HCP and BCC crystals Dislocations in covalent and ionic crystals	
5	Revision Introduction to strengthening, work-hardening	Assignment 1
6	Flexibility week.	
7	Solid solution hardening	Mid-term exam
8	Second phase hardening	
9	High temperature deformation Commercial Ai, Ni and Ti alloys	
10	Commercial Ai, Ni and Ti alloys	Assignment 2

5. Assessment

5.1 Assessment tasks

Assessment task	Description	Weight	Due date
Online quiz:	You will be required to undertake calculations involving the application of dislocation theory to topics covered in Weeks 1-3	0%	Week 3
Assignment 1:	You will work in groups to answer questions relating to the key concepts covered in Weeks 1-3	10%	Week 5
Mid-term exam:	You will solve dislocation and strengthening problems pertaining to information learnt in Weeks 1-5	40%	Week 7
Assignment 2:	You will answer tutorial relating to the key concepts covered in Weeks 5-8.	10%	Week 10
Final Exam:	The exam will be 2hrs in duration and held in the final exam period. It will cover topics taught in the second half of the course.	40%	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

Assessment for this course will result in a grading of either SY (Satisfactory) or FL (Unsatisfactory performance).

NOTE: Students who fail to achieve a score of at least 40% for either the mid-term exam and/or final exam but achieve a final mark >50% for the course, may still be awarded a FL 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.
- Online quizzes will be opened for a limited amount of time, students must complete the quiz during the allocated time and only have one attempt.
- Unless otherwise specified in the task criteria, all assignments must be uploaded via Moodle prior to the due date for submission.
- Assignments/lab reports submitted after the due date for submission will receive a 10% of maximum grade penalty for every day late, or part thereof.

- 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 coordinator 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

Online quizzes: Students will receive feedback on completion of the quizzes; this feedback will be provided before the Census date.

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.

Mid-term exam: Students will receive their marked exams indicating what questions were answered correctly and incorrectly. Overall comments and worked solutions may be provided to the class.

Final exam: This will be used, with other marks, to determine whether performance is satisfactory performance.

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.

7. Readings and resources

- D. Hull and D.J. Bacon, Introduction to Dislocations, 5th Ed., 2011
- M.A. Meyers and K.K. Chawla, Mechanical Behavior of Materials, 2nd Ed., 2008
- W.K. Honeycombe, The Plastic Deformation of Metals, 1968

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

- G.E. Dieter, Mechanical Metallurgy, 3rd Ed., 1988
- R.E. Reed-Hill and R. Abbaschian, Physical Metallurgy Principles, 1994
- R.E. Smallman and R. Bishop, Metals and Materials, 1996
- I.R. Polmear, Light Metals, 1995

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