UNSW Course Outline

MATS3001 Micromechanisms of Mechanical Behaviour of Metals - 2024

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General Course Information

Course Code : MATS3001
Year : 2024
Term : Term 1
Teaching Period : T1
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 course provides students with a comprehensive understanding of the fundamental

concepts that govern the behaviour of metals under mechanical stress. Through a structured curriculum, this course examines the behaviour of crystalline defects, especially dislocations, and the strategies employed to enhance mechanical properties. Students engage in lectures where they unravel the theoretical foundations underlying dislocation behaviour and strengthening mechanisms. These sessions serve as a platform for in-depth exploration, as students grasp the significance of dislocations in materials' plastic deformation, their role in influencing mechanical strength and their application in alloy design. The course extensively covers dislocation theory, as well as strengthening mechanisms, including work-hardening, solid solution strengthening, precipitation hardening and grain boundary effects. In addition, through participating in interactive online tutorials, students are provided with the opportunity to practise their problem solving skills, apply their theoretical knowledge in the context of real-world scenarios, deepen their comprehension of the subject matter and receive feedback on their learning. By the end of the course, students should have a profound appreciation of how dislocation theory intertwines with strengthening mechanisms to dictate and allow control over the mechanical properties of materials. This knowledge will equip students to analyse and design materials with improved mechanical performance for real-world applications in industries ranging from aerospace to advanced manufacturing.

Course Aims

The overall aim of the course is to provide a solid foundation in dislocation theory and strengthening mechanisms, enabling students to explain the behaviour of metals under stress in terms of the underlying atomic- and micro-scale phenomena. The course also aims to support students in acquiring and practising problem-solving and technical communication skills through tutorials and assignments. This will equip students to recognise and explain diverse strengthening mechanisms, and recommend appropriate mechanisms to apply in practical scenarios, preparing them to contribute effectively to materials engineering across various industries, including advanced manufacturing.

Course Learning Outcomes

Course Learning Outcomes
CLO1 : Apply theories of dislocation behaviour to explain plasticity in metals and alloys.
CLO2 : Explain how knowledge of strengthening mechanisms can be applied to predict and optimise mechanical properties of alloy systems.
CLO3 : Correlate the effect of microstructural development through alloying and heat treatment to mechanical properties.
CLO4 : Solve problems in alloy design by consideration of the interplay between crystalline defects and material microstructure.
CLO5 : Communicate information regarding the mechanical behaviour of metals in written format using precise scientific terminology.

Course Learning Outcomes	Assessment Item
CLO1 : Apply theories of dislocation behaviour to explain plasticity in metals and alloys.	• Assignment • Mid-Term Test
CLO2 : Explain how knowledge of strengthening mechanisms can be applied to predict and optimise mechanical properties of alloy systems.	• Tutorial Work • Final Examination
CLO3 : Correlate the effect of microstructural development through alloying and heat treatment to mechanical properties.	• Tutorial Work • Final Examination
CLO4 : Solve problems in alloy design by consideration of the interplay between crystalline defects and material microstructure.	• Tutorial Work • Final Examination
CLO5 : Communicate information regarding the mechanical behaviour of metals in written format using precise scientific terminology.	• Assignment • Mid-Term Test • Tutorial Work • Final Examination

Learning and Teaching Technologies

Moodle - Learning Management System | Echo 360

Learning and Teaching in this course

You are expected to undertake a total of approximately 150 hours of work for this course, including working through the online lessons, attending classes, completing assessments, reading the textbooks and other resources, and revising and preparing for the exam.

Assessments

Assessment Structure

Assessment Item	Weight	Relevant Dates
Assignment Assessment Format: Individual	10%	Start Date: Week 2 Due Date: Week 5: 11 March - 17 March
Mid-Term Test Assessment Format: Individual	40%	Start Date: Week 7 Due Date: Week 7: 25 March - 31 March
Tutorial Work Assessment Format: Individual	10%	Start Date: Week 8 Due Date: Week 10: 15 April - 21 April
Final Examination Assessment Format: Individual	40%	Start Date: Final exam period Due Date: Final exam period

Assessment Details

Assignment

Assessment Overview

You will complete an assignment in which you will answer questions with written explanations of phenomena related to the mechanical behaviour of metals based on the theory of dislocations. The aim of this assignment is to develop your understanding of, and ability to explain in writing using correct technical language, the concepts covered in Weeks 1-4 (inclusive).

After preparing your own answers to the questions, you will submit your work for peer feedback and will also provide feedback to your peers on the clarity, correctness and completeness of their answers.

Finally, you will have an opportunity to modify your own work based on the peer feedback received before submitting your work for final assessment. You will be assessed of the clarity, correctness and completeness of your own answers as well as the quality, detail and correctness of the feedback you provided. The length of your submission should be ~500 words. Details of the assignment will be made available in Week 2.

In addition to the aim above, the peer feedback component will also develop your ability to think critically through assessing the clarity and correctness of both other students' submissions and the feedback provided by your peers.

The final submission for the assignment will typically be due in Week 5.

Feedback will be given within 10 working days of submission of the assignment and will 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 : Apply theories of dislocation behaviour to explain plasticity in metals and alloys.
- CLO5 : Communicate information regarding the mechanical behaviour of metals in written format using precise scientific terminology.

Assignment submission Turnitin type

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

Mid-Term Test

Assessment Overview

A test will be held in Week 7 covering content taught in Weeks 1-5 (inclusive); this component of the assessment is worth 34% of the course mark. The test is typically of two hours' duration and held during class time. Questions typically include calculations, short answers and problem solving. The test is designed to assess your understanding of the behaviour of crystalline defects and their influence on metal plasticity. Details of the test including time and location will announced in class.

Prior to the Week 7 test, there will be 3 short online practice quizzes, typically due in Weeks 2, 4 and 5. These quizzes will provide you with feedback on your learning and preparedness for the Week 7 test. The quizzes will each contribute 2% of the course mark. Details of the content and timing of the quizzes will be announced in class.

For the practice quizzes, you will receive your mark and either personalised feedback or general feedback to the class within 10 days of each quiz closing. For the Week 7 test, you will receive your mark within 10 days of the test and overall comments will be provided to the class. For both the practice quizzes and the Week 7 test, further feedback is available by contacting the lecturer.

Hurdle requirement: To pass this course you are required to achieve a 45% weighted average over the mid-term test and final exam, with a minimum of 35% achieved in each of these tasks.

Course Learning Outcomes

- CLO1 : Apply theories of dislocation behaviour to explain plasticity in metals and alloys.
- CLO5 : Communicate information regarding the mechanical behaviour of metals in written format using precise scientific terminology.

Assessment Length

2 hours

Assignment submission Turnitin type

This is not a Turnitin assignment

Hurdle rules

Hurdle requirement: To pass this course you are required to achieve a 45% weighted average over the mid-term test and final exam, with a minimum of 35% achieved in each of these tasks.

Tutorial Work

Assessment Overview

You will attempt a number of numerically-based problems that demonstrate how mechanisms are used to enhance strength or durability at high temperatures in advanced alloys. You will be asked to interpret research data and use theoretical models to predict alloy behaviour. The tutorial worksheet will be provided in Week 8 and you will be given two weeks to complete this assignment. Feedback will be given one week 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

- CLO2 : Explain how knowledge of strengthening mechanisms can be applied to predict and optimise mechanical properties of alloy systems.
- CLO3 : Correlate the effect of microstructural development through alloying and heat treatment to mechanical properties.
- CLO4 : Solve problems in alloy design by consideration of the interplay between crystalline defects and material microstructure.
- CLO5 : Communicate information regarding the mechanical behaviour of metals in written format using precise scientific terminology.

Assignment submission Turnitin type

This is not a Turnitin assignment

Final Examination

Assessment Overview

This written test will be held during the end of term examination period covering content taught in Weeks 5-10. The test is typically of two hours' duration with 10 minutes reading time. You will

be expected to answer a number of short answer questions, including calculations, to demonstrate an understanding of strategies used to strengthen materials, as well as their application in the design of advanced alloys. You will be expected to analyse experimental research data and use this to predict material behaviour.

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

Hurdle requirement: To pass this course you are required to achieve a 45% weighted average over the mid-term test and final exam, with a minimum of 35% achieved in each of these tasks.

Course Learning Outcomes

- CLO2 : Explain how knowledge of strengthening mechanisms can be applied to predict and optimise mechanical properties of alloy systems.
- CLO3 : Correlate the effect of microstructural development through alloying and heat treatment to mechanical properties.
- CLO4 : Solve problems in alloy design by consideration of the interplay between crystalline defects and material microstructure.
- CLO5 : Communicate information regarding the mechanical behaviour of metals in written format using precise scientific terminology.

Assessment Length

2 hours

Assignment submission Turnitin type

This is not a Turnitin assignment

Hurdle rules

Hurdle requirement: To pass this course you are required to achieve a 45% weighted average over the mid-term test and final exam, with a minimum of 35% achieved in each of these tasks.

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 short extensions 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) achieve at least 35% in both the mid-term test (Week 7 component) and the final exam, 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 0 : 5 February - 11 February	Online Activity	Complete "Module 0" revision tutorials - https://mats3001.teaching.unsw.edu.au/
Week 1 : 12 February - 18 February	Lecture	Monday, 12pm-2pm: Introduction to the course; Revision of crystallography Wednesday, 1pm-3pm: Revision of Miller indices (optional) Friday, 10am-11am: Q&A drop-in session (optional)
	Online Activity	Complete "Module 1" online lessons, 1A, 1B and 1C - https://mats3001.teaching.unsw.edu.au/
Week 2 : 19 February - 25 February	Lecture	Wednesday, 1pm-3pm: Theoretical and actual strength of metals, Defects in crystal Friday, 10am-11am: Dislocations practice questions, Q&A drop-in session (optional)
	Online Activity	Complete "Module 1" online lessons, 1D and 1E - https://mats3001.teaching.unsw.edu.au/
	Assessment	Assignment released
Week 3 : 26 February - 3 March	Lecture	Monday, 12pm-2pm: Energy of dislocations Wednesday, 1pm-3pm: Forces between dislocations Friday, 10am-11am: Q&A drop-in session (optional)
	Online Activity	Complete "Module 1" online lesson 1F, and "Module 2" online lesson 2A - https://mats3001.teaching.unsw.edu.au/
Week 4 : 4 March - 10 March	Lecture	Wednesday, 1pm-3pm: Macroscopic phenomena Friday, 10am-11am: Q&A drop-in session (optional)
	Online Activity	Complete "Module 2" online lessons, 2B and 2C - https://mats3001.teaching.unsw.edu.au/
Week 5 : 11 March - 17 March	Lecture	Monday, 12pm-1pm: Q&A drop-in session (optional) Wednesday, 1pm-3pm: Comparison of metals with different crystal structures Friday, 9am-11am: Introduction to the second part of the course
	Online Activity	Complete "Module 2" online lesson 2D - https://mats3001.teaching.unsw.edu.au/
	Assessment	Assignment due
Week 6 : 18 March - 24 March	Lecture	Wednesday, 1pm-3pm: Revision class (optional)
	Assessment	Assignment peer assessment due
Week 7 : 25 March - 31 March	Assessment	Monday, 12pm-2pm: Mid-term test
	Lecture	Wednesday, 1pm-3pm: Hall-Petch relationship Friday: Public holiday, no class
Week 8 : 1 April - 7 April	Lecture	Monday: Public holiday, no class Wednesday, 1pm-3pm: Work hardening Friday, 9am-11am: Solid solution hardening
	Assessment	Tutorial work released
Week 9 : 8 April - 14 April	Lecture	Monday, 12pm-1pm: Solid solution hardening Wednesday, 1pm-3pm: Second phase hardening Friday, 9am-11am: Second phase hardening
Week 10 : 15 April - 21 April	Lecture	Monday, 12pm-1pm: Creep Wednesday, 1pm-3pm: Creep Friday, 9am-11am: Revision
	Assessment	Tutorial work due

Attendance Requirements

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

Course Resources

Recommended 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
- 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

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 MATS3001 based on previous feedback: Additional classes have been included to allow time to cover content at a slower pace and to provide more opportunities to review content from the online lessons. Also, the 3 formative quizzes in the first part of the course were introduced to provide additional feedback to help students prepare for the mid-term exam.

Staff Details

Position	Name	Email	Location	Phone	Availability	Equitable Learning Services Contact	Primary Contact
Lecturer	Paul Munroe		Room 250 Hilmer	02-9385-5673	By appointment	Yes	Yes
	Judy Hart		Room 339, Hilmer Building	02 9385 7998	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