# MECH2005

## Engineering Materials

Session 2, Weekday attendance, North Ryde 2021

*School of Engineering*

## Contents





**Session 2 Learning and Teaching Update**

The decision has been made to conduct study online for the remainder of Session 2 for all units WITHOUT mandatory on-campus learning activities. Exams for Session 2 will also be online where possible to do so.

This is due to the extension of the lockdown orders and to provide certainty around arrangements for the remainder of Session 2. We hope to return to campus beyond Session 2 as soon as it is safe and appropriate to do so.

Some classes/teaching activities cannot be moved online and must be taught on campus. You should already know if you are in one of these classes/teaching activities and your unit convenor will provide you with more information via iLearn. If you want to confirm, see the list of units with mandatory on-campus classes/teaching activities.

Visit the MQ COVID-19 information page for more detail.

# General Information

Unit convenor and teaching staff

Noushin Nasiri
noushin.nasiri@mq.edu.au
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Room 358, Level 3, E6A, 7-9 Wally's Walk
Tuesdays 11:30am-12:30pm

Nicholas Tse
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Contact via nicholas.tse@mq.edu.au
Level 1, 50 Waterloo Road, School of Engineering
Wed 11:30am-12:00pm

Credit points
10

Prerequisites
MECH1001 or ENGG150 or ENGG1050

Corequisites

Co-badged status

Unit description
The purpose of this unit is to develop an understanding and insight into the design and utilisation of engineering materials; these materials include metals, polymers, ceramics, and composites. Students will develop knowledge of the mechanical properties of different materials in relations to the physical and chemical phenomenon. Topics covered in this unit will include physical and chemical nature of materials, the effects of nano-, micro- and macro-structures in material properties, considerations in modifying mechanical properties in metallic systems, composite design and materials selection.

## Important Academic Dates

Information about important academic dates including deadlines for withdrawing from units are available at https://www.mq.edu.au/study/calendar-of-dates

# Learning Outcomes

On successful completion of this unit, you will be able to:

**ULO1:** Classify primary engineering materials and their major applications, and

demonstrate knowledge of how materials are structured based on the arrangement of atoms.

**ULO2:** Demonstrate essential engineering skills in interpreting phase diagrams and identifying possible phase transformations under different scenarios, on the basis of binary phase diagrams.

**ULO3:** Evaluate the mechanical properties of different engineering materials and their limitations, and will be able to account for the observed features of a stress-strain curve.

**ULO4:** Demonstrate in-depth knowledge of strengthening mechanisms in metallic materials, including work hardening, grain boundary strengthening, solution strengthening, and precipitation hardening, as wel as knowledge of microstructure-mechanical property relationships and essential methodology in microstructural control.

**ULO5:** Demonstrate essential knowledge of and skills in materials selection in mechanical design, and select materials that best fit the design demands of stiffness, strength, toughness, and/or durability.

**ULO6:** Explain the role of different types of materials in a composite, and the function of secondary reinforcing materials in a matrix, in particular their role in increasing strength and resistance to fracture.

# General Assessment Information

**Grading and Passing Requirement**

In order to pass this unit a student must obtain a mark of 50 or more for the unit (i.e. obtain a passing grade P/ CR/ D/ HD). For further details about grading, please refer to the policies and procedures section below.

***Late Submissions***

- Up to 12 h late: 10% of the maximum marks available for the assessment item will be deducted. - 1 working day late: 20% of the maximum marks available for the assessment item will be deducted. - 2-4 working days late: 50% of the maximum marks available for the assessment item will be deducted. - 5 working days late (or more): The assignment can be perused, but no marks will be awarded

***Final Examinations***

- Final examinations will take place at the end of the semester. For further information, please refer to the Examination Timetable website on www.mq.edu.au

***Other Relevant Information***

- Only in-class assessments should be handwritten, in blue or black ink; all other assessments should be typed. - Diagrams should be drawn neatly and be presented in a legible manner. Any work that is deemed untidy may not be marked or marks may be deducted. - All numerical answers must have correct units and an appropriate number of trailing digits. A mark deduction

will be made for answers without appropriate units and trailing digits. - All citations should be referenced appropriately. - Do not exceed the maximum length requirement. Any work that exceeds the specified word or page limit may not be marked or marks may be deducted. - Your name, your student number, your tutor's name and your workshop class time should be clearly indicated on your assignment. Assignments without this information may not be marked or marks may be deducted. - All submitted assignments should have the Faculty coversheet attached. Assignments without coversheet will not be marked. - All submitted assignments should be submitted on iLearn via Turnitin.

# Assessment Tasks

| Name | Weighting | Hurdle | Due |
|---|---|---|---|
| Assignments | 20% | No | Week 6 and Week 9 |
| Final Exam | 40% | No | See Exam Timetable |
| Quiz | 40% | No | Weeks 4, 7, 10 and 12 |

## Assignments

Assessment Type [1]: Essay
Indicative Time on Task [2]: 10 hours
Due: **Week 6 and Week 9**
Weighting: **20%**

This assessment consists of two individual assignments, which will build students' progressive understanding of the unit content.

On successful completion you will be able to:

- Classify primary engineering materials and their major applications, and demonstrate knowledge of how materials are structured based on the arrangement of atoms.
- Demonstrate essential engineering skills in interpreting phase diagrams and identifying possible phase transformations under different scenarios, on the basis of binary phase diagrams.
- Evaluate the mechanical properties of different engineering materials and their limitations, and will be able to account for the observed features of a stress-strain curve.
- Demonstrate in-depth knowledge of strengthening mechanisms in metallic materials, including work hardening, grain boundary strengthening, solution strengthening, and precipitation hardening, as wel as knowledge of microstructure-mechanical property

relationships and essential methodology in microstructural control.
- Demonstrate essential knowledge of and skills in materials selection in mechanical design, and select materials that best fit the design demands of stiffness, strength, toughness, and/or durability.
- Explain the role of different types of materials in a composite, and the function of secondary reinforcing materials in a matrix, in particular their role in increasing strength and resistance to fracture.

## Final Exam

Assessment Type [1]: Examination
Indicative Time on Task [2]: 20 hours
Due: **See Exam Timetable**
Weighting: **40%**

The final examination will cover the entire unit

On successful completion you will be able to:
- Classify primary engineering materials and their major applications, and demonstrate knowledge of how materials are structured based on the arrangement of atoms.
- Demonstrate essential engineering skills in interpreting phase diagrams and identifying possible phase transformations under different scenarios, on the basis of binary phase diagrams.
- Evaluate the mechanical properties of different engineering materials and their limitations, and will be able to account for the observed features of a stress-strain curve.
- Demonstrate in-depth knowledge of strengthening mechanisms in metallic materials, including work hardening, grain boundary strengthening, solution strengthening, and precipitation hardening, as wel as knowledge of microstructure-mechanical property relationships and essential methodology in microstructural control.
- Demonstrate essential knowledge of and skills in materials selection in mechanical design, and select materials that best fit the design demands of stiffness, strength, toughness, and/or durability.
- Explain the role of different types of materials in a composite, and the function of secondary reinforcing materials in a matrix, in particular their role in increasing strength and resistance to fracture.

# Quiz

Assessment Type [1]: Quiz/Test
Indicative Time on Task [2]: 30 hours
Due: **Weeks 4, 7, 10 and 12**
Weighting: **40%**

This Assessment Task is a fortnightly in-class quiz that will cover the information of the preceding 2 Lectures. It aims to build an environment of progressive learning and enhance students' understanding of relevant course materials being delivered in the lecture.

On successful completion you will be able to:

- Classify primary engineering materials and their major applications, and demonstrate knowledge of how materials are structured based on the arrangement of atoms.
- Demonstrate essential engineering skills in interpreting phase diagrams and identifying possible phase transformations under different scenarios, on the basis of binary phase diagrams.
- Evaluate the mechanical properties of different engineering materials and their limitations, and will be able to account for the observed features of a stress-strain curve.
- Demonstrate in-depth knowledge of strengthening mechanisms in metallic materials, including work hardening, grain boundary strengthening, solution strengthening, and precipitation hardening, as wel as knowledge of microstructure-mechanical property relationships and essential methodology in microstructural control.
- Demonstrate essential knowledge of and skills in materials selection in mechanical design, and select materials that best fit the design demands of stiffness, strength, toughness, and/or durability.
- Explain the role of different types of materials in a composite, and the function of secondary reinforcing materials in a matrix, in particular their role in increasing strength and resistance to fracture.

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[1] If you need help with your assignment, please contact:

- the academic teaching staff in your unit for guidance in understanding or completing this type of assessment
- the Writing Centre for academic skills support.

[2] Indicative time-on-task is an estimate of the time required for completion of the assessment

task and is subject to individual variation

# Delivery and Resources

Unit details can be found on iLearn, https://ilearn.mq.edu.au/login/MQ/

Useful reading and websites will be posted to iLearn.

Useful urls www.materialsaustralia.com.au www.engineersaustralia.org.au

Databases Macquarie Library has a collection of various databases available to MQ students.

http://www.mq.edu.au/about/campus-services-and-facilities/library

How to find a government report

This short video provides you with tips and tricks for finding government reports easily using Google

https://www.youtube.com/watch?v=0grCZuGLkpg

Acknowledging the words and ideas of others

This video introduces Referencing the ideas and works of others, copyright and creative commons licencing.

https://www.youtube.com/watch?v=QXlo98z_yFs

# Unit Schedule

| Week | Date | Lecture Topic | Lecturer | Remarks |
|---|---|---|---|---|
| 1 | 26 Jul | Course Welcome. Introduction to Engineering Materials | N.Nasiri | No Tutorial |
| 2 | 2 Aug | Atomic Bonding, Crystalline Structure and Imperfections in Solids | N.Nasiri | Tutorial 1 |
| 3 | 9 Aug | Phase Diagrams and Phase Transformations in Metals | N.Nasiri | Tutorial 2 / Practical 1/ Issue Assignment 1 |
| 4 | 16 Aug | Mechanical Properties of Metals | N.Nasiri | Tutorial 3 /Quiz 1 |
| 5 | 23 Aug | Dislocations and Strengthening Mechanisms | N.Nasiri | Tutorial 4 |

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|---|---|---|---|---|
| 6 | 30 Aug | Fracture and Fatigue Failures | N.Nasiri | Tutorial 5 / Practical 2/ Submit Assignment 1/Issue Assignment 2 |
| 7 | 6 Sept | Mid Review | N.Nasiri | No Tutorial / Quiz 2 |
| 8 | 27 Sept | Microstructure-Property Relationship and Microstructural Control | N.Nasiri | Tutorial 6 / Practical 3 |
| 9 | 4 Oct | Steels | N.Nasiri | Tutorial 7/<br>Submit Assignment 2 |
| 10 | 11 Oct | Light Alloys | N.Nasiri | Tutorial 8 / Quiz 3 |
| 11 | 18 Oct | Polymers | S. Wu | Tutorial 9 / Practical 4 |
| 12 | 25 OCt | Composites | S. Wu | Tutorial 10 / Quiz 4 |
| 13 | 1 Nov | Final Review and Course Summary | N.Nasiri | No Tutorial |

# Policies and Procedures

Macquarie University policies and procedures are accessible from Policy Central (https://policies.mq.edu.au). Students should be aware of the following policies in particular with regard to Learning and Teaching:

- Academic Appeals Policy
- Academic Integrity Policy
- Academic Progression Policy
- Assessment Policy
- Fitness to Practice Procedure
- Grade Appeal Policy
- Complaint Management Procedure for Students and Members of the Public
- Special Consideration Policy

Students seeking more policy resources can visit Student Policies (https://students.mq.edu.au/support/study/policies). It is your one-stop-shop for the key policies you need to know about throughout your undergraduate student journey.

To find other policies relating to Teaching and Learning, visit Policy Central (https://policies.mq.edu.au) and use the search tool.

## Student Code of Conduct

Macquarie University students have a responsibility to be familiar with the Student Code of Conduct: https://students.mq.edu.au/admin/other-resources/student-conduct

## Results

Results published on platform other than eStudent, (eg. iLearn, Coursera etc.) or released directly by your Unit Convenor, are not confirmed as they are subject to final approval by the University. Once approved, final results will be sent to your student email address and will be made available in eStudent. For more information visit ask.mq.edu.au or if you are a Global MBA student contact globalmba.support@mq.edu.au

# Student Support

Macquarie University provides a range of support services for students. For details, visit http://students.mq.edu.au/support/

## Learning Skills

Learning Skills (mq.edu.au/learningskills) provides academic writing resources and study strategies to help you improve your marks and take control of your study.

- Getting help with your assignment
- Workshops
- StudyWise
- Academic Integrity Module

The Library provides online and face to face support to help you find and use relevant information resources.

- Subject and Research Guides
- Ask a Librarian

# Student Services and Support

Students with a disability are encouraged to contact the Disability Service who can provide appropriate help with any issues that arise during their studies.

# Student Enquiries

For all student enquiries, visit Student Connect at ask.mq.edu.au

If you are a Global MBA student contact globalmba.support@mq.edu.au

# IT Help

For help with University computer systems and technology, visit http://www.mq.edu.au/about_us/offices_and_units/information_technology/help/.

When using the University's IT, you must adhere to the Acceptable Use of IT Resources Policy.

The policy applies to all who connect to the MQ network including students.