MECH205

Engineering Materials

S1 Day 2019

School of Engineering

Contents

General Information

Unit convenor and teaching staff
Unit Convenor / Lecturer
Noushin Nasiri
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E6B-142
Wednesday 2-4pm / Thursday 2-4pm

Unit co-convenor / Lecturer
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Friday 2-3pm

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Credit points
3

Prerequisites
(ENGG170 or ELEC170 or ENGG150) and (MATH132 or MATH135)

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:

Students will demonstrate the ability to classify primary engineering materials and their major applications, and demonstrate knowledge of how materials are structured based on the arrangement of atoms.
Students will develop essential engineering skills in interpreting phase diagrams and identifying possible phase transformations under different scenarios, on the basis of binary phase diagrams.
Students will build capacity in evaluating 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.
Students will demonstrate in-depth knowledge of strengthening mechanisms in metallic materials, including work hardening, grain boundary strengthening, solution strengthening, and precipitation hardening. Students will develop knowledge of microstructure-mechanical property relationships and essential methodology in microstructural control.
Students will build up essential knowledge of and skills in materials selection in mechanical design, and have the ability to select materials that best fit the design demands of stiffness, strength, toughness, and/or durability.
Students will demonstrate an appreciation of the role of different types of materials in a composite. Students will be able to explain the function of secondary reinforcing materials in a matrix, in particular their role in increasing strength and resistance to fracture.

General Assessment Information

Hurdle Requirement

- The final examination is a hurdle requirement. Achieving a grade of 40% or more in the final examination is a condition of passing this unit.
- Attendance at workshop sessions is compulsory. Participation in a minimum of 80% of workshops is a hurdle requirement.

Grading and Passing Requirement

- In order to pass this unit, students must achieve an overall grade of 50% or more, with a grade of 40% or more on the final exam.

Late Submissions

- Late assignments will incur a 50% mark penalty.

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

- Student's attendance is based on workshop participation. All class activities are to be dated and documented in a bound A4 book.
- Any student who misses 20 mins of a workshop will be deemed absent for that workshop.
- 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. (http://web.science.mq.edu.au/intranet/It/barcode/coversheet.php)
- All submitted assignments should be submitted on iLearn via Turnitin.

Assessment Tasks

Name	Weighting	Hurdle	Due
Materials Assignment 1	10%	No	Week 4
Materials Assignment 2	10%	No	Week 8
Materials Assignment 3	15%	No	Week 12

Name	Weighting	Hurdle	Due
In-class Quiz	15%	No	Fortnightly from Week 3
Final Examination	50%	Yes	See Exam Timetable

Materials Assignment 1

Due: **Week 4**
Weighting: **10%**

Assignment 1 will cover Week 1 - Week 3

• Introduction to engineering materials

• Atomic bonding, crystalline structure and imperfections in solids

• Phase diagrams and phase transformations in solids

On successful completion you will be able to:

- Students will demonstrate the ability to classify primary engineering materials and their major applications, and demonstrate knowledge of how materials are structured based on the arrangement of atoms.
- Students will develop essential engineering skills in interpreting phase diagrams and identifying possible phase transformations under different scenarios, on the basis of binary phase diagrams.

Materials Assignment 2

Due: **Week 8**
Weighting: **10%**

Assignment 2 will cover Week 4 - Week 6

• Mechanical properties of metals

• Dislocation and strengthening mechanisms

• Fracture and fatigue failures

On successful completion you will be able to:

- Students will build capacity in evaluating 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.
- Students will demonstrate in-depth knowledge of strengthening mechanisms in metallic materials, including work hardening, grain boundary strengthening, solution

strengthening, and precipitation hardening. Students will develop knowledge of microstructure-mechanical property relationships and essential methodology in microstructural control.

Materials Assignment 3

Due: **Week 12**
Weighting: **15%**

Assignment 3 will cover Week 7 - Week 9

- Microstructure-property relationship and microstructural control
- Steels

On successful completion you will be able to:

- Students will develop essential engineering skills in interpreting phase diagrams and identifying possible phase transformations under different scenarios, on the basis of binary phase diagrams.
- Students will demonstrate in-depth knowledge of strengthening mechanisms in metallic materials, including work hardening, grain boundary strengthening, solution strengthening, and precipitation hardening. Students will develop knowledge of microstructure-mechanical property relationships and essential methodology in microstructural control.
- Students will build up essential knowledge of and skills in materials selection in mechanical design, and have the ability to select materials that best fit the design demands of stiffness, strength, toughness, and/or durability.

In-class Quiz

Due: **Fortnightly from Week 3**
Weighting: **15%**

This Assessment Task is a fortnightly 20-min 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.

• In total, there are five fortnightly quizzes that will be conducted during workshops, starting from Week 3.

On successful completion you will be able to:

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- Students will demonstrate in-depth knowledge of strengthening mechanisms in metallic materials, including work hardening, grain boundary strengthening, solution strengthening, and precipitation hardening. Students will develop knowledge of microstructure-mechanical property relationships and essential methodology in microstructural control.
- Students will build up essential knowledge of and skills in materials selection in mechanical design, and have the ability to select materials that best fit the design demands of stiffness, strength, toughness, and/or durability.
- Students will demonstrate an appreciation of the role of different types of materials in a composite. Students will be able to explain the function of secondary reinforcing materials in a matrix, in particular their role in increasing strength and resistance to fracture.

Final Examination

Due: **See Exam Timetable**
Weighting: **50%**
This is a hurdle assessment task (see assessment policy for more information on hurdle assessment tasks)

The final examination will cover the entire unit and is a hurdle: students must achieve a minimum grade of 40%.

On successful completion you will be able to:

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- Students will build capacity in evaluating 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.

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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

Policies and Procedures

Macquarie University policies and procedures are accessible from Policy Central (https://staff.mq.edu.au/work/strategy-planning-and-governance/university-policies-and-procedures/policy-central). 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 *(**Note:** The Special Consideration Policy is effective from 4 December 2017 and replaces the Disruption to Studies Policy.)*

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

If you would like to see all the policies relevant to Learning and Teaching visit Policy Central (https://staff.mq.edu.au/work/strategy-planning-and-governance/university-policies-and-procedures/policy-central).

Student Code of Conduct

Macquarie University students have a responsibility to be familiar with the Student Code of Conduct: https://students.mq.edu.au/study/getting-started/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 improve your marks and take control of your study.

- Workshops
- StudyWise
- Academic Integrity Module for Students
- Ask a Learning Adviser

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.

Graduate Capabilities

Creative and Innovative

Our graduates will also be capable of creative thinking and of creating knowledge. They will be imaginative and open to experience and capable of innovation at work and in the community. We want them to be engaged in applying their critical, creative thinking.

This graduate capability is supported by:

Learning outcomes

- Students will demonstrate in-depth knowledge of strengthening mechanisms in metallic materials, including work hardening, grain boundary strengthening, solution strengthening, and precipitation hardening. Students will develop knowledge of microstructure-mechanical property relationships and essential methodology in microstructural control.
- Students will build up essential knowledge of and skills in materials selection in mechanical design, and have the ability to select materials that best fit the design demands of stiffness, strength, toughness, and/or durability.
- Students will demonstrate an appreciation of the role of different types of materials in a composite. Students will be able to explain the function of secondary reinforcing materials in a matrix, in particular their role in increasing strength and resistance to fracture.

Assessment tasks

- Materials Assignment 2

- Materials Assignment 3
- In-class Quiz
- Final Examination

Capable of Professional and Personal Judgement and Initiative

We want our graduates to have emotional intelligence and sound interpersonal skills and to demonstrate discernment and common sense in their professional and personal judgement. They will exercise initiative as needed. They will be capable of risk assessment, and be able to handle ambiguity and complexity, enabling them to be adaptable in diverse and changing environments.

This graduate capability is supported by:

Learning outcomes

- Students will build capacity in evaluating 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.
- Students will demonstrate in-depth knowledge of strengthening mechanisms in metallic materials, including work hardening, grain boundary strengthening, solution strengthening, and precipitation hardening. Students will develop knowledge of microstructure-mechanical property relationships and essential methodology in microstructural control.
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Commitment to Continuous Learning

Our graduates will have enquiring minds and a literate curiosity which will lead them to pursue knowledge for its own sake. They will continue to pursue learning in their careers and as they

participate in the world. They will be capable of reflecting on their experiences and relationships with others and the environment, learning from them, and growing - personally, professionally and socially.

This graduate capability is supported by:

Learning outcomes

- Students will demonstrate the ability to classify primary engineering materials and their major applications, and demonstrate knowledge of how materials are structured based on the arrangement of atoms.
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Discipline Specific Knowledge and Skills

Our graduates will take with them the intellectual development, depth and breadth of knowledge, scholarly understanding, and specific subject content in their chosen fields to make them

competent and confident in their subject or profession. They will be able to demonstrate, where relevant, professional technical competence and meet professional standards. They will be able to articulate the structure of knowledge of their discipline, be able to adapt discipline-specific knowledge to novel situations, and be able to contribute from their discipline to inter-disciplinary solutions to problems.

This graduate capability is supported by:

Learning outcomes

- Students will demonstrate the ability to classify primary engineering materials and their major applications, and demonstrate knowledge of how materials are structured based on the arrangement of atoms.
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Critical, Analytical and Integrative Thinking

We want our graduates to be capable of reasoning, questioning and analysing, and to integrate and synthesise learning and knowledge from a range of sources and environments; to be able to critique constraints, assumptions and limitations; to be able to think independently and systemically in relation to scholarly activity, in the workplace, and in the world. We want them to have a level of scientific and information technology literacy.

This graduate capability is supported by:

Learning outcomes

- Students will develop essential engineering skills in interpreting phase diagrams and identifying possible phase transformations under different scenarios, on the basis of binary phase diagrams.
- Students will build capacity in evaluating 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.
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Problem Solving and Research Capability

Our graduates should be capable of researching; of analysing, and interpreting and assessing

data and information in various forms; of drawing connections across fields of knowledge; and they should be able to relate their knowledge to complex situations at work or in the world, in order to diagnose and solve problems. We want them to have the confidence to take the initiative in doing so, within an awareness of their own limitations.

This graduate capability is supported by:

Learning outcomes

- Students will build capacity in evaluating 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.
- Students will demonstrate in-depth knowledge of strengthening mechanisms in metallic materials, including work hardening, grain boundary strengthening, solution strengthening, and precipitation hardening. Students will develop knowledge of microstructure-mechanical property relationships and essential methodology in microstructural control.
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Effective Communication

We want to develop in our students the ability to communicate and convey their views in forms effective with different audiences. We want our graduates to take with them the capability to read, listen, question, gather and evaluate information resources in a variety of formats, assess, write clearly, speak effectively, and to use visual communication and communication technologies as appropriate.

This graduate capability is supported by:

Learning outcomes

- Students will build capacity in evaluating 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.
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