MECH205

Engineering Materials

S1 Day 2017

Dept of Engineering

Contents

General Information

Unit convenor and teaching staff
Unit Co-Convenor and Lecturer
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Lecturer
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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 understand how materials are constructed based on the arrangement of atoms.
Students will develop essential engineering skills in interpreting phase diagrams and understanding possible phase transformations under different scenarios on the basis of binary phase diagram.
Students will build capacity in understanding of mechanical properties of different engineering materials and their limitations, and will demonstrate the ability to account for the observed features of a stress-strain curve.
Students will demonstrate in-depth understanding 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 relationship and essential methodology in microstructural control.
Students will build up essential knowledge and skills of 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 understanding 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, and understand how this increases strength and resistance to fracture.

General Assessment Information

- In order to pass this unit, students must achieve **an overall mark of 50% with satisfactory performance in all aspects of the unit** including the final exam.
- Attendance at workshop sessions is compulsory. **A minimum of 75% of workshops must be attended to be eligible for the sitting of the final exam**.
- 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**.
- Late assignments will incur at least a 50% mark penalty.
- 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	End Week 4
Materials Assignment 2	10%	No	End Week 8
Materials Assignment 3	15%	No	End Week 12
Quiz	10%	No	See unit schedule
Final Examination	55%	Yes	See examination timetable

Materials Assignment 1

Due: **End 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

This Assessment Task is relevant to Learning Outcomes 1 and 2

- Students will demonstrate the ability to classify primary engineering materials and their major applications, and understand how materials are constructed based on the

arrangement of atoms.
- Students will develop essential engineering skills in interpreting phase diagrams and understanding possible phase transformations under different scenarios on the basis of binary phase diagram.

On successful completion you will be able to:
- Students will demonstrate the ability to classify primary engineering materials and their major applications, and understand how materials are constructed based on the arrangement of atoms.
- Students will develop essential engineering skills in interpreting phase diagrams and understanding possible phase transformations under different scenarios on the basis of binary phase diagram.

Materials Assignment 2

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

Assignment 2 will cover Week 4 - Week 6

- Mechanical properties of metals
- Dislocation and strengthening mechanisms
- Fracture and fatigue failures

This Assessment Task is relevant to Learning Outcomes 3 and 4

- Students will build capacity in understanding of mechanical properties of different engineering materials and their limitations, and will demonstrate the ability to account for the observed features of a stress-strain curve.
- Students will demonstrate in-depth understanding 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 relationship and essential methodology in microstructural control.

On successful completion you will be able to:
- Students will build capacity in understanding of mechanical properties of different engineering materials and their limitations, and will demonstrate the ability to account for the observed features of a stress-strain curve.

- Students will demonstrate in-depth understanding 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 relationship and essential methodology in microstructural control.

Materials Assignment 3

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

Assignment 3 will cover Week 7 - Week 12

- Materials selection in mechanical design
- Steels
- Light alloys
- Advanced structural materials
- Polymers
- Composites

This Assessment Task is relevant to Learning Outcomes 5 and 6

- Students will build up essential knowledge and skills of 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 understanding 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, and understand how this increases strength and resistance to fracture.

On successful completion you will be able to:

- Students will build up essential knowledge and skills of 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 understanding 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, and understand how this increases strength and resistance to fracture.

Quiz

Due: **See unit schedule**
Weighting: **10%**

This Assessment Task is a fortnightly quiz that will cover the information of the preceding 2-3 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.

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Final Examination

Due: **See examination timetable**
Weighting: **55%**
This is a hurdle assessment task (see assessment policy for more information on hurdle

assessment tasks)

MECH205 final examination will cover the entire unit and is a hurdle that students must achieve a minimum mark of 50%.

This Assessment Task is relevant to all Learning Outcomes:

- Students will demonstrate the ability to classify primary engineering materials and their major applications, and understand how materials are constructed based on the arrangement of atoms.
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- Students will build up essential knowledge and skills of 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.
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On successful completion you will be able to:

- Students will demonstrate the ability to classify primary engineering materials and their major applications, and understand how materials are constructed based on the arrangement of atoms.
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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

Unit Schedule

Week	Date	**Lectures** (S1 2017, Tuesdays 14:00-16:00, E7B T4)	Remarks

1	28-Feb	Course Welcome. Introduction to Engineering Materials	No Workshop
2	7-Mar	Atomic Bonding, Crystalline Structure and Imperfections in Solids	Workshop 1 / Issue Assignment 1
3	14-Mar	Phase Diagrams and Phase Transformations in Metals	Workshop 2 / Quiz 1
4	21-Mar	Mechanical Properties of Metals	Workshop 3 / Submit Assignment 1
5	28-Mar	Dislocations and Strengthening Mechanisms	Workshop 4 / Quiz 2 / Issue Assignment 2
6	4-Apr	Fracture and Fatigue Failures	Workshop 5
7	11-Apr	Microstructure-Property Relationship and Microstructural Control	No Workshop (Good Friday, 14 April)
Break			
8	2-May	Materials Selection in Mechanical Design	Workshop 6 / Quiz 3 / Submit Assignment 2
9	9-May	Steels	Workshop 7 / Issue Assignment 3
10	16-May	Light Alloys	Workshop 8 / Quiz 4
11	23-May	Polymers	Workshop 9
12	30-May	Composites	Workshop 10 / Quiz 5 / Submit Assignment 3
13	6-Jun	Final Review and Course Summary	No Workshop

Policies and Procedures

Macquarie University policies and procedures are accessible from Policy Central. Students should be aware of the following policies in particular with regard to Learning and Teaching:

Academic Honesty Policy http://mq.edu.au/policy/docs/academic_honesty/policy.html

Assessment Policy http://mq.edu.au/policy/docs/assessment/policy_2016.html

Grade Appeal Policy http://mq.edu.au/policy/docs/gradeappeal/policy.html

Complaint Management Procedure for Students and Members of the Public http://www.mq.edu.au/policy/docs/complaint_management/procedure.html

Disruption to Studies Policy (in effect until Dec 4th, 2017): http://www.mq.edu.au/policy/docs/disruption_studies/policy.html

Special Consideration Policy (in effect from Dec 4th, 2017): https://staff.mq.edu.au/work/strategy-planning-and-governance/university-policies-and-procedures/policies/special-consideration

In addition, a number of other policies can be found in the Learning and Teaching Category of 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/support/student_conduct/

Results

Results shown in *iLearn*, 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.

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

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 the ability to classify primary engineering materials and their major applications, and understand how materials are constructed based on the arrangement of atoms.
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- Students will demonstrate understanding 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, and understand how this increases strength and resistance to fracture.

Assessment tasks

- Materials Assignment 1
- Materials Assignment 2
- Materials Assignment 3
- 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:

Assessment tasks

- Materials Assignment 2
- Materials Assignment 3
- Final Examination

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 understand how materials are constructed based on the arrangement of atoms.
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Assessment tasks

- Materials Assignment 1
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- Materials Assignment 3
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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 demonstrate the ability to classify primary engineering materials and their major applications, and understand how materials are constructed based on the arrangement of atoms.
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- Quiz
- Final Examination

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 demonstrate the ability to classify primary engineering materials and their major applications, and understand how materials are constructed based on the arrangement of atoms.
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Assessment tasks

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- Materials Assignment 2
- Materials Assignment 3
- Quiz
- Final Examination

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:

Assessment tasks

- Materials Assignment 1
- Materials Assignment 2
- Materials Assignment 3
- Quiz
- Final Examination