# ENGG250

## Materials

S1 Day 2016

*Dept of Engineering*

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General Information

Unit convenor and teaching staff
Unit Convenor
Candace Lang
candace.lang@mq.edu.au
Contact via candace.lang@mq.edu.au
E6A 239

Head tutor
Nicholas Tse
nicholas.tse@mq.edu.au
Contact via nicholas.tse@mq.edu.au
Nicholas Tse
nicholas.tse@mq.edu.au

Credit points
3

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

Corequisites

Co-badged status

Unit description
This unit provides an introduction to engineering materials and the relationship of mechanical, electrical and chemical properties to the structure of materials in an engineering context. Mechanical and electrical properties will be of particular focus and be the subject of lectures and practical giving an underpinning to an appreciation of engineering materials, at present and in their future development.

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 understand the basis upon which materials are categorised as metals,
ceramics, polymers or composites; electrical insulators, semiconductors or conductors; brittle or ductile materials.

Students will be able to account for the observed difference in conductivity between insulators, conductors and semiconductors. Students will understand the concept of majority charge carriers in semiconductors, and will thus be able to explain the difference between p-type and n-type semiconductors.

Students will have a good understanding of the behaviour of semiconductor diodes; and will hence be able to explain electron flow in a PNP or NPN transistor.

Students will be able to account for the observed features of a stress-strain curve, for ductile materials. Students will have knowledge of methods of increasing yield strength, including work hardening, solute strengthening, grain refinement and precipitation hardening. Steels will be used as a case study for each of these, leading to a familiarity with a dominant group of engineering materials.

Students will understand the role of different types of material in a composite. Students will be able to explain the function of a material dispersion in a matrix of a second material; and will be able to explain how this increases strength and also increases resistance to cracking.

**General Assessment Information**

Students must attend a minimum of 75% of workshops (/tutorials/pracs) to be eligible for the final exam.

Any student who misses 15 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
coversheets will not be marked. (http://web.science.mq.edu.au/intranet/lt/barcode/coversheet.php)

All submitted assignments should be submitted on iLearn via Turnitin.

- In order to pass this unit, students must achieve an overall mark of 50%, including satisfactory performance in all aspects of the unit including the final examination.
- 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.

## Assessment Tasks

<table>
<thead>
<tr>
<th>Name</th>
<th>Weighting</th>
<th>Due</th>
</tr>
</thead>
<tbody>
<tr>
<td>Materials Assignment 1</td>
<td>10%</td>
<td>End week 4</td>
</tr>
<tr>
<td>Test 1</td>
<td>15%</td>
<td>Week 5</td>
</tr>
<tr>
<td>Materials Assignment 2</td>
<td>10%</td>
<td>End week 8</td>
</tr>
<tr>
<td>Test 2</td>
<td>15%</td>
<td>Week 10</td>
</tr>
<tr>
<td>Materials Assignment 3</td>
<td>10%</td>
<td>End week 12</td>
</tr>
<tr>
<td>Examination</td>
<td>40%</td>
<td>See examination timetable</td>
</tr>
</tbody>
</table>

### Materials Assignment 1

**Due:** End week 4  
**Weighting:** 10%

Introduction to materials; free electron theory.

On successful completion you will be able to:

- Students will understand the basis upon which materials are categorised as metals, ceramics, polymers or composites; electrical insulators, semiconductors or conductors; brittle or ductile materials.
Test 1
Due: Week 5
Weighting: 15%
Test (on weeks 1 - 4).

On successful completion you will be able to:

- Students will understand the basis upon which materials are categorised as metals, ceramics, polymers or composites; electrical insulators, semiconductors or conductors; brittle or ductile materials.
- Students will be able to account for the observed difference in conductivity between insulators, conductors and semiconductors. Students will understand the concept of majority charge carriers in semiconductors, and will thus be able to explain the difference between p-type and n-type semiconductors.

Materials Assignment 2
Due: End week 8
Weighting: 10%

Electrical and Mechanical properties of materials.

On successful completion you will be able to:

- Students will be able to account for the observed difference in conductivity between insulators, conductors and semiconductors. Students will understand the concept of majority charge carriers in semiconductors, and will thus be able to explain the difference between p-type and n-type semiconductors.
- Students will have a good understanding of the behaviour of semiconductor diodes; and will hence be able to explain electron flow in a PNP or NPN transistor.

Test 2
Due: Week 10
Weighting: 15%
Test (on weeks 5 - 9)

On successful completion you will be able to:

- Students will have a good understanding of the behaviour of semiconductor diodes; and will hence be able to explain electron flow in a PNP or NPN transistor.
- Students will be able to account for the observed features of a stress-strain curve, for
ductile materials. Students will have knowledge of methods of increasing yield strength, including work hardening, solute strengthening, grain refinement and precipitation hardening. Steels will be used as a case study for each of these, leading to a familiarity with a dominant group of engineering materials.

Materials Assignment 3
Due: End week 12
Weighting: 10%

Composite materials

On successful completion you will be able to:
- Students will be able to account for the observed features of a stress-strain curve, for ductile materials. Students will have knowledge of methods of increasing yield strength, including work hardening, solute strengthening, grain refinement and precipitation hardening. Steels will be used as a case study for each of these, leading to a familiarity with a dominant group of engineering materials.
- Students will understand the role of different types of material in a composite. Students will be able to explain the function of a material dispersion in a matrix of a second material; and will be able to explain how this increases strength and also increases resistance to cracking.

Examination
Due: See examination timetable
Weighting: 40%

ENGG250 final examination (on the entire unit)

On successful completion you will be able to:
- Students will understand the basis upon which materials are categorised as metals, ceramics, polymers or composites; electrical insulators, semiconductors or conductors; brittle or ductile materials.
- Students will be able to account for the observed difference in conductivity between insulators, conductors and semiconductors. Students will understand the concept of majority charge carriers in semiconductors, and will thus be able to explain the difference between p-type and n-type semiconductors.
- Students will have a good understanding of the behaviour of semiconductor diodes; and will hence be able to explain electron flow in a PNP or NPN transistor.
• Students will be able to account for the observed features of a stress-strain curve, for ductile materials. Students will have knowledge of methods of increasing yield strength, including work hardening, solute strengthening, grain refinement and precipitation hardening. Steels will be used as a case study for each of these, leading to a familiarity with a dominant group of engineering materials.

• Students will understand the role of different types of material in a composite. Students will be able to explain the function of a material dispersion in a matrix of a second material; and will be able to explain how this increases strength and also increases resistance to cracking.

**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.engineersaustralia.org.au

**Google Scholar**

This video provides a quick introduction to Google Scholar and how to search it effectively. It also shows how to access it, to ensure you link to the full text material Macquarie University Library already subscribes to.

https://www.youtube.com/watch?v=jl5ixQmCXDU&feature=youtu.be

**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=2vqS4P_Q2z8

**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 1  | 3-Mar | Basic Course outline/introduction to materials/Bonding and e interaction |

https://unitguides.mq.edu.au/unit_offerings/59210/unit_guide/print
### Policies and Procedures

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

- **Academic Honesty Policy**  

- **New Assessment Policy in effect from Session 2 2016**  

- **Assessment Policy prior to Session 2 2016**  

- **Grading Policy prior to Session 2 2016**  

- **Grade Appeal Policy**  

- **Complaint Management Procedure for Students and Members of the Public**  

- **Disruption to Studies Policy**  

In addition, a number of other policies can be found in the [Learning and Teaching Category](http://www.mq.edu.au/policy/docs/) of Policy Central.

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<th>Week</th>
<th>Date</th>
<th>Topic</th>
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<td>10-Mar</td>
<td>Millar index's/ X'tal structures/semiconductor</td>
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<tr>
<td>3</td>
<td>17-Mar</td>
<td>Free electron theory/Drude conduction model</td>
</tr>
<tr>
<td>4</td>
<td>24-Mar</td>
<td>Band theory valance conduction etc.</td>
</tr>
<tr>
<td>5</td>
<td>31-Mar</td>
<td><strong>Test1/</strong> Band gap/Brillouin zone</td>
</tr>
<tr>
<td>6</td>
<td>7-Apr</td>
<td>PN Junction/BPJ</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Break</strong></td>
</tr>
<tr>
<td>7</td>
<td>28-Apr</td>
<td>Metals/Phase diagram</td>
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<td>8</td>
<td>5-May</td>
<td>Phase diagram/ Hardening techniques</td>
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<td>9</td>
<td>12-May</td>
<td>Steels/ <strong>Test 2</strong></td>
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<tr>
<td>10</td>
<td>19-May</td>
<td>Ceramics and plastics by Kaveh/Nic</td>
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<td>11</td>
<td>26-May</td>
<td>Particulate/ Fibrous composites by Kaveh/Nic</td>
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<td>12</td>
<td>2-Jun</td>
<td>Structural composite by Kaveh/Nic</td>
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<tr>
<td>13</td>
<td>9-Jun</td>
<td>Material selections/exam revision by Kaveh/Nic</td>
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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

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 understand the basis upon which materials are categorised as metals,
ceramics, polymers or composites; electrical insulators, semiconductors or conductors;
brittle or ductile materials.
- Students will be able to account for the observed difference in conductivity between
insulators, conductors and semiconductors. Students will understand the concept of
majority charge carriers in semiconductors, and will thus be able to explain the difference
between p-type and n-type semiconductors.
- Students will have a good understanding of the behaviour of semiconductor diodes; and
will hence be able to explain electron flow in a PNP or NPN transistor.
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including work hardening, solute strengthening, grain refinement and precipitation
hardening. Steels will be used as a case study for each of these, leading to a familiarity
with a dominant group of engineering materials.
- Students will understand the role of different types of material in a composite. Students
will be able to explain the function of a material dispersion in a matrix of a second
material; and will be able to explain how this increases strength and also increases
resistance to cracking.

**Assessment tasks**

- Materials Assignment 1
- Test 1
- Materials Assignment 2
- Test 2
- Materials Assignment 3
- Examination

**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 have a good understanding of the behaviour of semiconductor diodes; and will hence be able to explain electron flow in a PNP or NPN transistor.
- Students will be able to account for the observed features of a stress-strain curve, for ductile materials. Students will have knowledge of methods of increasing yield strength, including work hardening, solute strengthening, grain refinement and precipitation hardening. Steels will be used as a case study for each of these, leading to a familiarity with a dominant group of engineering materials.
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**Assessment tasks**

- Materials Assignment 1
- Test 1
- Materials Assignment 2
- Test 2
- Materials Assignment 3
- 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 have a good understanding of the behaviour of semiconductor diodes; and will hence be able to explain electron flow in a PNP or NPN transistor.
- Students will be able to account for the observed features of a stress-strain curve, for ductile materials. Students will have knowledge of methods of increasing yield strength,
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- Students will understand the role of different types of material in a composite. Students will be able to explain the function of a material dispersion in a matrix of a second material; and will be able to explain how this increases strength and also increases resistance to cracking.

**Assessment tasks**

- Materials Assignment 2
- Test 2
- Materials Assignment 3
- Examination