# ENGG250

## Materials

S1 Day 2016

*Dept of Engineering*

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### Disclaimer

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General Information

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E6A 239

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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 http://students.mq.edu.au/student_admin/enrolmentguide/academicdates/

Learning Outcomes

1. 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.
2. 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.

3. 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.

4. 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.

5. 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.

This Assessment Task relates to the following 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.
Test 1
Due: Week 5
Weighting: 15%

Test (on weeks 1 - 4).

This Assessment Task relates to the following 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.

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

Electrical and Mechanical properties of materials.

This Assessment Task relates to the following Learning Outcomes:
• 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)

This Assessment Task relates to the following 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.
Materials Assignment 3
Due: **End week 12**
Weighting: **10%**

Composite materials

This Assessment Task relates to the following Learning Outcomes:
- 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)

This Assessment Task relates to the following 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.
• 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=jI5ixQmCXDU&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=QXiO98z_yFs
## Unit Schedule

<table>
<thead>
<tr>
<th>Week</th>
<th>Date</th>
<th>Lecture</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3-Mar</td>
<td>Basic Course outline/introduction to materials/Bonding and e interaction</td>
</tr>
<tr>
<td>2</td>
<td>10-Mar</td>
<td>Millar index's/ X'tal structures/semiconductor</td>
</tr>
<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>Test1/ Band gap/Brillouin zone</td>
</tr>
<tr>
<td>6</td>
<td>7-Apr</td>
<td>PN Junction/BPJ</td>
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<tr>
<td></td>
<td></td>
<td><strong>Break</strong></td>
</tr>
<tr>
<td>7</td>
<td>28-Apr</td>
<td>Metals/Phase diagram</td>
</tr>
<tr>
<td>8</td>
<td>5-May</td>
<td>Phase diagram/ Hardening techniques</td>
</tr>
<tr>
<td>9</td>
<td>12-May</td>
<td>Steels/ <strong>Test 2</strong></td>
</tr>
<tr>
<td>10</td>
<td>19-May</td>
<td>Ceramics and plastics by Kaveh/Nic</td>
</tr>
<tr>
<td>11</td>
<td>26-May</td>
<td>Particulate/ Fibrous composites by Kaveh/Nic</td>
</tr>
<tr>
<td>12</td>
<td>2-Jun</td>
<td>Structural composite by Kaveh/Nic</td>
</tr>
<tr>
<td>13</td>
<td>9-Jun</td>
<td>Material selections/exam revision by Kaveh/Nic</td>
</tr>
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## 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:


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/](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](http://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/](http://students.mq.edu.au/support/)

**Learning Skills**

Learning Skills ([mq.edu.au/learningskills](http://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 Enquiry Service**

For all student enquiries, visit Student Connect at [ask.mq.edu.au](http://ask.mq.edu.au).

**Equity 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.

**IT Help**

For help with University computer systems and technology, visit [http://www.mq.edu.au/about_us/offices_and_units/information_technology/help/](http://www.mq.edu.au/about_us/offices_and_units/information_technology/help/).
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.
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Assessment tasks

- Materials Assignment 1
- Test 1
- Materials Assignment 2
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, 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 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