MATS1101

Engineering Materials and Chemistry

Course Outline
Session 1, 2015
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Ms Anne Ayres  
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Chemistry Tutorial and Laboratory Administrator  
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Consultation hours:  
Mon–Fri  
9:30-12:30  
2:00-4:00

Timetable

Lectures

Full details of the Chemistry / Materials lecture timetable can be found on Moodle.

<table>
<thead>
<tr>
<th>Day</th>
<th>Time</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tuesday</td>
<td>13:00-14:00</td>
<td>Science Theatre</td>
</tr>
<tr>
<td>Wednesday</td>
<td>12:00-13:00</td>
<td>Law Theatre</td>
</tr>
<tr>
<td>Friday</td>
<td>10:00-11:00</td>
<td>Law Theatre</td>
</tr>
</tbody>
</table>

Tutorials

General tutorial for the Materials strand:

<table>
<thead>
<tr>
<th>Day</th>
<th>Time</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Friday</td>
<td>11:00-12:00</td>
<td>Law Theatre</td>
</tr>
</tbody>
</table>

Tutorials and Laboratory Classes

You must enrol in tutorial and laboratory classes via myUNSW. There will be many times to choose from but the classes fill up fast, so be quick.
Course Outline

The course consists of two strands, Engineering Materials and Chemistry

Engineering Materials Strand

<table>
<thead>
<tr>
<th>Objective</th>
<th>To provide an understanding of engineering materials in terms of the factors which dictate their behavior.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course Outline</td>
<td>Microstructure and structure-property relationships of the main types of engineering materials (metals, ceramics, polymers and composites). Micromechanisms of elastic and plastic deformation. Fracture mechanisms for ductile, brittle, creep and fatigue modes of failure in service; corrosion. Metal forming by casting and wrought processes. Phase equilibria of alloys; microstructural control by thermomechanical processing and application to commercial engineering materials. Laboratory and tutorial work includes experiments on mechanical testing, cast and recrystallised structures, ferrous and non-ferrous microstructures, and fracture and failure analysis.</td>
</tr>
<tr>
<td>Assignments</td>
<td>5 online tutorials to be submitted before start of laboratory class on same topic. 5 laboratory reports to be submitted within 2 weeks of laboratory class. Further details are given in Moodle at <a href="http://moodle.telt.unsw.edu.au/">http://moodle.telt.unsw.edu.au/</a> A group project requires several submissions throughout the semester. Please refer to the details available on Moodle.</td>
</tr>
<tr>
<td>Laboratory Work</td>
<td>5 laboratories are scheduled throughout the semester. You must enroll in a lab group through myUNSW. Further details are given in Moodle at <a href="http://moodle.telt.unsw.edu.au/">http://moodle.telt.unsw.edu.au/</a></td>
</tr>
<tr>
<td>Assessment (% of assessment for Materials Strand)</td>
<td>Midsession quiz 17% End of session examination 33% Tutorial answers 10% Laboratory reports 10% Group project 30% <strong>Total</strong> 100% (50% of the total course grade)</td>
</tr>
<tr>
<td>Test / Quiz</td>
<td>Midsession quiz to be held Monday in Week 8 plus end of session examination to be held during exam period.</td>
</tr>
<tr>
<td>Textbooks</td>
<td>Engineering Materials, Volumes 1 &amp; 2 Ashby &amp; Jones Butterworth Heinemann, 2005 An electronic version of this book is available via the UNSW library website. Links are also provided in the course Moodle page.</td>
</tr>
<tr>
<td>Online material</td>
<td><a href="http://moodle.telt.unsw.edu.au/">http://moodle.telt.unsw.edu.au/</a></td>
</tr>
<tr>
<td>Week</td>
<td>Topic</td>
</tr>
<tr>
<td>------</td>
<td>----------------------------------------------------------------------</td>
</tr>
<tr>
<td>1</td>
<td>Introduction, bonding between atoms</td>
</tr>
<tr>
<td>2</td>
<td>Packing of atoms in solids, Young’s modulus, yield and tensile strength, dislocations</td>
</tr>
<tr>
<td>3</td>
<td>Strengthening methods, fracture, toughness, micromechanisms of fast fracture</td>
</tr>
<tr>
<td>4</td>
<td>Fatigue mechanisms, creep, creep fracture and mechanisms, creep resistance</td>
</tr>
<tr>
<td>5</td>
<td>Oxidation, wet corrosion</td>
</tr>
<tr>
<td>6</td>
<td>Metal structures, phase diagrams</td>
</tr>
<tr>
<td>7</td>
<td>Kinetics of structural change</td>
</tr>
<tr>
<td>8</td>
<td>Light alloys</td>
</tr>
<tr>
<td>9</td>
<td>Steels, alloy steels</td>
</tr>
<tr>
<td>10</td>
<td>Ceramics and glasses</td>
</tr>
<tr>
<td>11</td>
<td>Polymers</td>
</tr>
<tr>
<td>12</td>
<td>Composites</td>
</tr>
</tbody>
</table>

Laboratory Classes
- Coordinator: Dr Pramod Koshy
- Contact details: koshy@unsw.edu.au
- See Moodle page and laboratory manual for further details.
- Location: Meet in foyer at western end of Materials Science and Engineering Building
- Timetable: Alternate weeks – no Materials labs Weeks 1 or 2

Laboratory Class Dress Requirements
- For safety reasons, students in materials labs must wear safety glasses and must also wear covered shoes. Lab coats are recommended.

Laboratory Assessment
- 5 laboratory reports 10%
- 5 online tutorials 10%
- Total laboratory/tutorial mark 20%

Submission and return of reports
- Tutorial answers must be submitted online prior to the start of your scheduled laboratory class on same topic. Laboratory reports must be submitted at the start of your next scheduled laboratory class. Reports must contain a completed student declaration sheet. Late reports will not be accepted without adequate reason in writing. Medical certificates or other appropriate documents must be provided and the report submitted at the next laboratory session. All reports will be returned within 4 weeks.
**Chemistry Strand**


O-line material [http://moodle.telt.unsw.edu.au/](http://moodle.telt.unsw.edu.au/)

**Objective**

To introduce the chemistry necessary to understand the structure and properties of engineering materials.

**Syllabus Outline**

*Note that some topics will be covered in more depth than others. The detailed syllabus and expectations will be indicated by the lecturer for each topic. Chemistry covered during laboratory work is also included in the syllabus.*

**Overview**

Chemistry in engineering; understanding the properties of materials at an atomic and molecular level; relating macroscopic engineering properties to the underlying structure of the material. (in the following, ‘S’ refers to the text Silberberg 'Chemistry – The Molecular Nature of Matter and Change', 4th Edn).

1. **Introduction** (S Ch. 2, 3, 4) Elementary atomic structure, isotopes, nomenclature, the mole concept, atomic and molar mass, stoichiometry, formulae, equations; oxidation numbers, oxidation state; chemical reaction types; limiting reactants and product yields; redox chemistry.

2. **Structure and Bonding** (S Ch. 8, 9) Electronic configuration. Metallic, ionic and covalent bonding. Electronegativity, bond polarity, bond strength.

3. **States of Matter** (S Ch. 9, 12) Solids, liquids and gases; intermolecular forces; properties of liquids, melting and boiling points, solvent properties, water as a solvent; solubility of compounds in water and other solvents; Solids; ionic salts, covalent networks and molecular solids; chemical aspects of ceramics and glasses; chemical vapour deposition.

4. **Chemical Equilibrium in Aqueous Solution** (S Ch. 17, 18, 19) The equilibrium state, equilibrium constants, Le Chatelier's principle, quantitative calculations. Acid-base equilibria, pH of strong acids and bases, pH of weak acids and bases; buffers.

5. **Organic Chemistry and Polymers** (S Ch. 15) The systematic chemistry of carbon compounds; nomenclature and properties of common organic functional groups. Oxidation, reduction, addition, substitution, elimination. The application of selected reactions to make familiar and commodity materials including polymers used in coatings, fibres and tyres.

**Lecturers**

Topics 1–4 A/Prof. Steve Colbran
Topic 5 A/Prof. Kondo-Francois Aguey-Zinsou
Chemistry Strand – General Information

Chemistry administration and enquiries
Chemistry Student Centre – Dalton 105
(Enquiries regarding chemistry tutorials, chemistry labs, making up missed chemistry labs)

Chemistry Tutorials
General times and locations are shown on your enrolment timetable on MyUNSW. Be aware that the rooms may have been changed in response to changes in student numbers, so download a fresh timetable often from MyUNSW.

The Chemistry Manual containing tutorial sets and the laboratory manual can be purchased from the UNSW Bookshop. **Make sure you get your copy well before your first lab – as there is no guarantee that the bookshop will be able to supply a copy at short notice.**

Chemistry Labs
Attendance at labs is compulsory. You must READ THE INTRODUCTION IN THE LABORATORY MANUAL to be aware of all the requirements for passing the laboratory component of this course. Here are some of the main points regarding laboratory classes:

Depending on the lab stream you have enrolled in you will carry out your chemistry labs either in odd numbered semester weeks or even numbered semester weeks. You will do the experiments in the order they are listed in the laboratory manual.

Before the first lab, complete the general ‘Safety in the Chemical Laboratory’ pre-lab, AND the specific safety pre-lab for Experiment 1. Use the link provided in ‘Laboratory’ folder in the ‘Chemistry Strand’ section on Moodle to log on and complete these two tasks. You will need to do a specific safety pre-lab before each subsequent lab.

For your timetabled lab, go to lab 133 or 165 (as allocated) in the Chemical Sciences Building, bringing your lab coat and safety glasses (see details below) and wearing enclosed footwear. Students must bring their chemistry lab notes with them to each lab class. The lab manual contains details of requirements for submission of lab reports.

Safety
You need to do a pre-lab safety exercise for each chemistry experiment. This must be done online via the link provided in Moodle, any time before your experiment. The answers should be written in the spaces provided in the lab notes of the experiment.

You must provide your own safety eyewear and laboratory coat, and wear enclosed footwear in the laboratory. No exceptions can be made. Currently safety glasses and lab coats suitable for chemistry labs can be purchased from WH Smith (Quadrangle building), or the student ARC shop ‘Graduations and Gifts’ (top of Basser Steps), or the adjacent WH Smith shop. The Optometry Clinic (in the Rupert Myers Building; between the hours of 10–12 and 2–4 weekdays) also sells safety glasses, and provides expert fittings.
Assessment of the Chemistry Strand

Mid-semester test 20%
Laboratory work 30%
Final exam 50%
Chemistry total 100% (this constitutes 50% of the total course mark)

A net attendance of chemistry labs of at least 80% is required for eligibility to pass the course.

Note that there will be one mid-semester quiz for the course, with a materials and a chemistry section.

Learning and teaching philosophy underpinning the course

The course is designed for students to actively engage in the learning process and analyse and synthesise the content in a real world environment.

Course Information

<table>
<thead>
<tr>
<th>Units of credit</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parallel teaching involved in this course</td>
<td>The course consists of two strands, Materials Engineering and Chemistry. Each of these strands is of equal value.</td>
</tr>
<tr>
<td>How the course relates to other course offerings and overall program(s) in the discipline</td>
<td>An understanding of engineering materials is required for all engineering disciplines since it provides a rationale for materials selection when designing a component or structure. Chemistry underpins the understanding of engineering materials.</td>
</tr>
<tr>
<td>Course aims</td>
<td>To provide an understanding of engineering materials in terms of the factors which dictate their behaviour</td>
</tr>
<tr>
<td>Graduate attributes which will be gained through the course</td>
<td>• Research, inquiry and analytical thinking abilities • Capability and motivation for intellectual development • Communication • Information literacy • Group work • Research skills • Peer review • Technology use • Communication skills in discipline specific content</td>
</tr>
<tr>
<td>Expected learning outcomes</td>
<td>In doing this course, you will learn to: • Describe relationships between materials structures, properties and processes • Make informed decisions in materials selection for engineering design You will also learn to: • Think critically in decision making and problem-solving • Communicate with correct terminology • Conduct online research • Work effectively in a team to solve problems</td>
</tr>
<tr>
<td>Teaching strategies</td>
<td>• Core concepts, theories and approaches will be covered in lectures. • Laboratories and on-line tutorials will be provided to illustrate the concepts. These will also provide a part of the course assessment. • An on-line group project will be provided to give you the opportunity to synthesise the course content. The group project will provide a part of your assessment.</td>
</tr>
</tbody>
</table>
# Academic honesty and plagiarism

## What is Plagiarism?
Plagiarism is the presentation of the thoughts or work of another as one’s own. Examples include:

- direct duplication of the thoughts or work of another, including by copying material, ideas or concepts from a book, article, report or other written document (whether published or unpublished), composition, artwork, design, drawing, circuitry, computer program or software, web site, Internet, other electronic resource, or another person’s assignment without appropriate acknowledgement;
- paraphrasing another person’s work with very minor changes keeping the meaning, form and/or progression of ideas of the original;
- piecing together sections of the work of others into a new whole;
- presenting an assessment item as independent work when it has been produced in whole or part in collusion with other people, for example, another student or a tutor; and
- claiming credit for a proportion a work contributed to a group assessment item that is greater than that actually contributed.†

For the purposes of this policy, submitting an assessment item that has already been submitted for academic credit elsewhere may be considered plagiarism.

Knowingly permitting your work to be copied by another student may also be considered to be plagiarism.

Note that an assessment item produced in oral, not written, form, or involving live presentation, may similarly contain plagiarised material.

The inclusion of the thoughts or work of another with attribution appropriate to the academic discipline does not amount to plagiarism.

The Learning Centre website is main repository for resources for staff and students on plagiarism and academic honesty. These resources can be located via:

[www.lc.unsw.edu.au/plagiarism](http://www.lc.unsw.edu.au/plagiarism)

The Learning Centre also provides substantial educational written materials, workshops, and tutorials to aid students, for example, in:

- correct referencing practices;
- paraphrasing, summarising, essay writing, and time management;
- appropriate use of, and attribution for, a range of materials including text, images, formulae and concepts.

Individual assistance is available on request from The Learning Centre.

Students are also reminded that careful time management is an important part of study and one of the identified causes of plagiarism is poor time management. Students should allow sufficient time for research, drafting, and the proper referencing of sources in preparing all assessment items.

* Based on that proposed to the University of Newcastle by the St James Ethics Centre. Used with kind permission from the University of Newcastle

† Adapted with kind permission from the University of Melbourne.

## Continual course improvement

- Students will be asked to provide evaluative feedback through the UNSW’s Course and Teaching Evaluation and Improvement (CATEI) process at the end of the course
- Students are encouraged to address any problems regarding teaching of this course at the annual staff-student meeting
• Student comments on teaching during the session are welcome and will be appreciated.
  At times students may be asked to answer a short questionnaire for feedback on the course.

Administrative Matters

• Students should attend at least 80% of all classes.
• Students unable to submit assignments on time or attend the mid-session quizzes or final exams on health grounds should make a request for special consideration. Information on this process can be found here (https://my.unsw.edu.au/student/atoz/SpecialConsideration.html). Medical certificates or other appropriate documents must be included. Students should also advise the lecturer of the situation.
• Assignments/lab reports submitted after the deadline will receive a 10% of maximum grade penalty for every day late, or part thereof.
• Students who have a disability that requires some adjustment in their teaching or learning environment are encouraged to discuss their study needs with the course coordinator prior to, or at the commencement of, their course, or with the Equity Officer (Disability) in the Equity and Diversity Unit (www.studentequity.unsw.edu.au). Early notification is essential to enable any necessary adjustments to be made.

Rules for Exams

Rules governing conduct during exams are given at: https://my.unsw.edu.au/student/academiclife/assessment/examinations/examinationrules.html - Rulesfortheconductofexaminations

Note that the use of mobile phones or music players in an exam room will constitute Academic Misconduct.