



THE UNIVERSITY OF  
NEW SOUTH WALES

SCHOOL OF MATERIALS SCIENCE AND ENGINEERING

**MATS1101**

# **Engineering Materials and Chemistry**

Course Outline

Session 2, 2009

## Course staff

Prof Alan Crosky (Materials Engineering) Course Coordinator & Lecturer	Room 213 School of Materials Science and Engineering (Building E8) Phone: 9385 4424 <a href="mailto:a.crosky@unsw.edu.au">a.crosky@unsw.edu.au</a>	Consultation hours: by appointment
Prof Roger Bishop (Chemistry) Lecturer	Room 226 Dalton Building (F12) Phone: 9385 4656 <a href="mailto:R.Bishop@unsw.edu.au">R.Bishop@unsw.edu.au</a>	Consultation hours: by appointment
Dr Kondo-Francois Aguey- Zinsou (Chemical Sciences and Engineering) Lecturer	Room 418 Chemical Sciences Building (F10) Phone: 9385 7970 <a href="mailto:f.aguey@unsw.edu.au">f.aguey@unsw.edu.au</a>	Consultation hours: by appointment
Dr Sean Li (Materials Engineering) Engineering Materials Laboratory Coordinator	Room 215 School of Materials Science and Engineering (Building E8) Phone: 9385 5986 <a href="mailto:sean.li@unsw.edu.au">sean.li@unsw.edu.au</a>	Consultation hours: by appointment
Ms Anne Jordan (Chemistry) Chemistry Tutorial and Laboratory Coordinator	Room 105 Dalton Building Phone: 9385 4666 e-mail <a href="mailto:firstyearadmin@chem.unsw.edu.au">firstyearadmin@chem.unsw.edu.au</a>	Consultation hours: Mon–Fri 9:30-12:30 2:00-4:00

## Timetable

### Lectures

Strand	Day	Time	Weeks	Location
Materials	Monday	12:00-1:00	Weeks 1-12	Clancy Auditorium
Materials	Wednesday	1:00-2:00	Weeks 1-6	Clancy Auditorium
Chemistry	Wednesday	1:00-2:00	Weeks 7-12	Clancy Auditorium
Chemistry	Thursday	9:00-10:00	Weeks 1-12	Central Lecture Block 7
Materials (Tute)*	Friday	3:00-4:00	Weeks 2-12	Central Lecture Block 7

\* not compulsory

### Tutorials and Laboratory Classes

As enrolled

## Course outline

The course consists of two strands, **Engineering Materials** and **Chemistry**

### Engineering Materials Strand

<b>OBJECTIVE</b>	To provide an understanding of engineering materials in terms of the factors which dictate their behaviour	
<b>COURSE OUTLINE</b>	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.	
<b>ASSIGNMENTS</b>	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.	
<b>LABORATORY WORK</b>	5 laboratories and 5 tutorials	
<b>ASSESSMENT</b> (% of assessment for Materials Strand)	Mid session quiz	17%
	End of session examination	33%
	Tutorial answers	10%
	Laboratory reports	10%
	Group project	30%
	<b>Total</b>	<b>100% (50% of the total course grade)</b>
<b>TEST / QUIZ</b>	Mid session quiz to be held Monday in Week 8 plus end of session examination to be held during exam period.	
<b>TEXTBOOKS</b>	Engineering Materials, Volumes 1 & 2 Ashby & Jones Butterworth Heinemann, 2005	
<b>ONLINE MATERIAL</b>	<a href="http://lms-blackboard.telt.unsw.edu.au">http://lms-blackboard.telt.unsw.edu.au</a>	
<b>DETAILED COURSE SCHEDULE</b>	The detailed course schedule including due dates for all tasks is given in the online material.	

**SYLLABUS**

<u>Week</u>	<u>Topic</u>	<u>Text Chapters</u>	<u>Lecturer</u>
1	Introduction, Bonding between atoms,	V1:4	Prof A Crosky
2	Packing of atoms in solids, Young's modulus, yield and tensile strength,	V1:3,5,6,8	"
3	Dislocations, strengthening methods Fast fracture, toughness, micromechanisms of fracture,	V1:9,10,13,14	"
4	Fatigue failure, fatigue mechanisms Creep, creep fracture and mechanisms, creep resistance,	V1:15,17,19	"
5	Oxidation Wet corrosion,	V1:21,23, 24	"
6	Metal structures, Phase diagrams, Kinetics of structural change,	V2:2,3,5,6,7,8	"
7	Light alloys,	V2:10	"
8	Steels, alloy steels	V2:11,12	"
9	Ceramics and glasses	V2:17,18	"
10	Public holiday		
11	Polymers	V2:22,23	"
12	Composites	V2:25	"

Coordinator: Dr Sean Li

Contact details: [sean.li@unsw.edu.au](mailto:sean.li@unsw.edu.au)

See Vista for further details

Location: Meet in Foyer (ground floor of glass tower) of Materials Science and Engineering Building

Timetable: Alternate weeks – **no Materials labs Week 1 or 2**

**LABORATORY CLASS  
DRESS  
REQUIREMENTS**

For safety reasons, students in materials labs must wear safety glasses (or prescription glasses of reasonable lens size) and must wear covered shoes. Lab coats are recommended.

**LABORATORY  
ASSESSMENT**

5 laboratory reports	10%
5 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

Suggested Text: Silberberg, 'Chemistry - The Molecular Nature of Matter & Change', McGraw Hill 2nd Edition or higher.

**On-line material** <http://lms-blackboard.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 ...', 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

Overview	Dr Kondo-Francois Aguey-Zinsou
Topics 1-4	Prof. Roger Bishop
Topic 5	Dr Kondo-Francois Aguey-Zinsou

## Chemistry Strand - General Information

### Chemistry admin. and enquiries

Chemistry Student Centre – Dalton 105

(Enquiries re chem. tutorials, chem. labs, making up missed chem. labs)

### Chemistry Tutorials (5)

Chemistry tutorials start in Week 4 (even week students) or Week 5 (odd week students).

Times and locations are shown on your enrolment on MyUNSW.

Tutorial notes are in the MATS1101 Chemistry Manual (from University Bookshop).

### Chemistry Labs (5)

The laboratory notes are part of the MATS1101 Chemistry Manual that can be purchased from the University 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 begin in week 4 for students enrolled in the even week labs (Weeks 4, 6, 8, 10, 12).

Chemistry labs begin in week 5 for students enrolled in the odd week labs (Weeks 5, 7, 9, 11, 13).

Your chemistry lab location is on your timetable on MyUNSW – Chemical Sciences133. Find out how to get to your lab - before your first lab day!

Before your first lab, complete the 'Safety in the Chemical Laboratory' computer exercise that begins on page 7 of the Chemistry Manual. Use the Chemistry computers (in the Gibson Chemistry Computer lab, ground floor, North end of Dalton building) to log on and complete this exercise. Bring the completed exercise to be marked in your first lab.

Students also need to do a pre-lab chemical safety exercise before each lab. Use the Chemistry computer lab (ground floor, North end of Dalton building) for this, any time before your experiment. The answers must be written in the spaces provided in the lab notes of the experiment. This exercise will be marked at the start of each lab class.

For safety reasons, students in chemistry labs must have a lab coat, safety eyewear and must wear shoes that cover their feet. No exceptions can be made. If you need to wear prescription glasses in the lab, then you must have ASA-approved safety eyewear to wear over them.

Safety eyewear can be purchased:

- Optometry Clinic, Rupert Myers Building, 10am-12pm and 2-4pm.

Lab coats can be purchased from several shops on campus:

(Choose a proper fabric lab coat – not a disposable one!)

- ARC – Central Lecture Block, or ARC - ground floor Blockhouse.
- "Graduations & Gifts" top of the Basser Steps, underneath Blue Stone Café.

### Assessment of the Chemistry Strand

Mid-session test      20%

Laboratory work      30%

Final exam            50%

**Chemistry total      100% (50% of the total course grade)**

*Note that there will be one mid-session 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

Units of credit	6
Parallel teaching involved in this course	The course consists of two strands, Materials Engineering and Chemistry. Each of these strands is of equal value.
How the course relates to other course offerings and overall program(s) in the discipline	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.
Course aims	To provide an understanding of engineering materials in terms of the factors which dictate their behaviour
Graduate attributes which will be gained through the course	<ul style="list-style-type: none"> <li>• Research, inquiry and analytical thinking abilities</li> <li>• Capability and motivation for intellectual development</li> <li>• Communication</li> <li>• Information literacy</li> <li>• Group work</li> <li>• Research skills</li> <li>• Peer review</li> <li>• Technology use</li> <li>• Communication skills in discipline specific content</li> </ul>
Expected learning outcomes	<p>In doing this course, you will learn to:</p> <ul style="list-style-type: none"> <li>• Describe relationships between materials structures, properties and processes</li> <li>• Make informed decisions in materials selection for engineering design</li> </ul> <p>You will also learn to:</p> <ul style="list-style-type: none"> <li>• Think critically in decision making and problem-solving</li> <li>• Communicate with correct terminology</li> <li>• Conduct online research</li> <li>• Work effectively in a team to solve problems</li> </ul>
Teaching strategies	<ul style="list-style-type: none"> <li>• Core concepts, theories and approaches will be covered in lectures.</li> <li>• Laboratories and on-line tutorials will be provided to illustrate the concepts. These will also provide a part of the course assessment.</li> <li>• 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.</li> </ul>

## 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.

## **Recommended Reference Materials**

- Engineering Materials, Volumes 1 & 2  
MF Ashby & DRH Jones  
Butterworth Heinemann, 2005
- Silberberg, 'Chemistry - The Molecular Nature of Matter & Change', McGraw Hill  
2nd Edition or higher.

## **Continual course improvement**

- We welcome feedback at all times on presentation of course materials and any other course-related matters, and will be happy to discuss any issues raised in the lectures.
- You will be asked to provide evaluative feedback through the UNSW's Course and Teaching Evaluation and Improvement (CATEI) Process in Week 12.
- There are also online evaluations for each of the assessable Materials Tutorials which we would ask you to complete after each tutorial.
- An online course evaluation will be available in Week 12 for the Materials Strand. We would also appreciate you completing this.
- Feedback from prior assessments will be discussed in Lecture 1.

## **Administrative Matters**

- You must attend at least 80% of all classes.
- Assignments must be submitted by the due date.
- If you are unable to submit work, attend laboratory classes, or attend either the mid-session or final exam on health grounds, you should make a request for special consideration by submitting the form available from the Student Desk in the Chancellery. Medical certificates or other appropriate documents must be included. You should also advise your lecturer.
- If you have a disability that requires some adjustment in your teaching or learning environment you are encouraged to discuss your study needs with the course convener prior to, or at the commencement of, your course, or with the Equity Officer (Disability) in the Equity and Diversity Unit (9385 4734 or [www.equity.unsw.edu.au/disabil.html](http://www.equity.unsw.edu.au/disabil.html)). Early notification is essential to enable any necessary adjustments to be made.