# Materials Science and Engineering

## MATS1101

### Engineering Materials and Chemistry

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Course Staff

<table>
<thead>
<tr>
<th>Name</th>
<th>Location</th>
<th>Phone Number</th>
<th>Email Address</th>
<th>Consultation hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prof. Nagarajan Valanoor</td>
<td>Room 247, School of Materials Science and Engineering (Building E10)</td>
<td>9385 4263</td>
<td><a href="mailto:j.Valanoor@unsw.edu.au">j.Valanoor@unsw.edu.au</a></td>
<td>by appointment</td>
</tr>
<tr>
<td>(Materials) Course Coordinator &amp; Lecturer</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dr Danyang Wang (Materials)</td>
<td>Room 239, School of Materials Science and Engineering (Building E10)</td>
<td>9385 57170</td>
<td><a href="mailto:damia.Wang@unsw.edu.au">damia.Wang@unsw.edu.au</a></td>
<td>by appointment</td>
</tr>
<tr>
<td>Lecturer</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dr Hongxu Lu (Chemistry)</td>
<td>Room 512B Chemical Sciences Building (F10)</td>
<td></td>
<td><a href="mailto:hongxu.lu@unsw.edu.au">hongxu.lu@unsw.edu.au</a></td>
<td>by appointment</td>
</tr>
<tr>
<td>Lecturer</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Dr Pu Xiao (Chemistry)</td>
<td>Room 512B Chemical Sciences Building (F10)</td>
<td></td>
<td><a href="mailto:p.xiao@unsw.edu.au">p.xiao@unsw.edu.au</a></td>
<td>by appointment</td>
</tr>
<tr>
<td>Lecturer</td>
<td></td>
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</tr>
<tr>
<td>Dr Pramod Koshy (Materials)</td>
<td>Room 220 School of Materials Science and Engineering (Building E10)</td>
<td>9385 6038</td>
<td><a href="mailto:koshy@unsw.edu.au">koshy@unsw.edu.au</a></td>
<td>by appointment</td>
</tr>
<tr>
<td>Engineering Materials</td>
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</tr>
<tr>
<td>Laboratory Administrator</td>
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</tr>
<tr>
<td>Ms Anne Ayres (Chemistry)</td>
<td>Room 105 Dalton Building</td>
<td>9385 4666</td>
<td><a href="mailto:firstyearchem@unsw.edu.au">firstyearchem@unsw.edu.au</a></td>
<td>Mon–Fri 9:30-12:30</td>
</tr>
<tr>
<td>Chemistry Tutorial and</td>
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<tr>
<td>Laboratory Administrator</td>
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<td>2:00-4:00</td>
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</tbody>
</table>

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>Monday</td>
<td>11:00 – 12:00</td>
<td>Law Theatre G04</td>
</tr>
<tr>
<td>Wednesday</td>
<td>09:00 – 10:00</td>
<td>Ainsworth G03</td>
</tr>
<tr>
<td>Friday</td>
<td>14:00 – 15:00</td>
<td>Law Theatre G04</td>
</tr>
</tbody>
</table>

General tutorial for Materials strand:

<table>
<thead>
<tr>
<th>Day</th>
<th>Time</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thursday</td>
<td>12:00-13:00</td>
<td>Ainsworth G03</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 Content

The course consists of two strands, Engineering Materials and Chemistry

Assessment

The course assessment is broken down into three main areas. Each of these three are contributed to from Materials and Chemistry components.

- Mid-semester test 30%
- Laboratory work 30%
- Final exam 40%

The midsession exam is to be held on Friday of Week 8. This will be a 2 hour exam. Details of time and venue will be made available closer to the exam date.

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

NOTE: Students who fail to achieve a score of at least 40% for the overall exam component (i.e., mid-session exam and final exam marks combined), but achieve a final mark >50% for the course, will be awarded a UF (Unsatisfactory Fail) for the course.

Please refer to the UNSW guide to grades: [https://student.unsw.edu.au/grades](https://student.unsw.edu.au/grades)

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>Laboratory Work</td>
<td>4 laboratories are scheduled throughout the semester. You must enroll in a lab group through myUNSW. Further details are given on the course Moodle page at <a href="http://moodle.telt.unsw.edu.au/">http://moodle.telt.unsw.edu.au/</a></td>
</tr>
</tbody>
</table>
| Textbooks | Engineering Materials, Volumes 1 & 2
Ashby & 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. |
<p>| Online material | <a href="http://moodle.telt.unsw.edu.au/">http://moodle.telt.unsw.edu.au/</a> |
| Syllabus | |
| Week | Topic | Text Chapters | Lecturer |
| 1 | Introduction, bonding between atoms | V1: 4,5 | Wang |
| 2 | Packing of atoms in solids, Young’s modulus, yield and | V1: 5,6,8,9 | Wang |</p>
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<tbody>
<tr>
<td>3</td>
<td>tensile strength, dislocations</td>
<td>V1: 10,13-15 Wang</td>
</tr>
<tr>
<td></td>
<td>Strengthening methods, fracture, toughness, micromechanisms of fast fracture</td>
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<tr>
<td>4</td>
<td>Fatigue mechanisms, creep, creep fracture and mechanisms, creep resistance</td>
<td>V1: 17-19 Wang</td>
</tr>
<tr>
<td>5</td>
<td>Oxidation, wet corrosion</td>
<td>V1: 24-27 Wang</td>
</tr>
<tr>
<td>6</td>
<td>Metal structures, phase diagrams</td>
<td>V2: 2,3 Valanoor</td>
</tr>
<tr>
<td>7</td>
<td>Kinetics of structural change</td>
<td>V2: 6,7,8 Valanoor</td>
</tr>
<tr>
<td>8</td>
<td>Light alloys</td>
<td>V2: 10 Valanoor</td>
</tr>
<tr>
<td>9</td>
<td>Steels, alloy steels</td>
<td>V2: 11,12 Valanoor</td>
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<tr>
<td>10</td>
<td>Ceramics and glasses</td>
<td>V2: 15-17 Valanoor</td>
</tr>
<tr>
<td>11</td>
<td>Polymers</td>
<td>V2: 21-23 Valanoor</td>
</tr>
<tr>
<td>12</td>
<td>Composites</td>
<td>V2: 25 Valanoor</td>
</tr>
</tbody>
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Materials Laboratory Classes
Coordinator: Dr Pramod Koshy
Contact details: koshy@unsw.edu.au
See Moodle page and laboratory manual and location details.

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
4 laboratory reports
4 online preparation tutorials

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

On-line material 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).

- 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.
- Structure and Bonding (S Ch. 8, 9) Electronic configuration. Metallic, ionic and covalent bonding. Electronegativity, bond polarity, bond strength.
- 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.
- 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.
- Organic Chemistry and Polymers. The systematic chemistry of carbon compounds; nomenclature and properties of common organic functional groups. Oxidation, reduction, addition, substitution, elimination; fundamentals of polymer chemistry and photopolymerisation technology.

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.

Learning and Teaching Philosophy Underpinning the Course

(based on UNSW Learning Guidelines)

- **Students are actively engaged in the learning process.**
  
  It is expected that, in addition to attending classes, students will read, write, discuss, and engage in analysing the course content.

- **Effective learning is supported by a climate of inquiry where students feel appropriately challenged.**

  Students are expected to be challenged by the course content and to challenge their own preconceptions, knowledge, and understanding by questioning information, concepts, and approaches during class and study.

- **Learning is more effective when students’ prior experience and knowledge are recognised and built on.**

  Coursework, tutorials, assignments, laboratories, examinations, and other forms of learning and assessment are intended to provide students with the opportunity to cross-reference these activities in a meaningful way with their own experience and knowledge.

- **Students become more engaged in the learning process if they can see the relevance of their studies to professional and disciplinary contexts**

  The course content is designed to incorporate both theoretical and practical concepts, where the latter is intended to be applicable to real-world situations and contexts.
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>Graduate attributes which will be gained through the course</td>
<td>To provide an understanding of engineering materials in terms of the factors which dictate their behaviour</td>
</tr>
</tbody>
</table>
| Expected learning outcomes | • Research, inquiry and analytical thinking abilities  
• Capability and motivation for intellectual development  
• Communication  
• Information literacy  
• Research skills  
• Technology use  
• Communication skills in discipline specific content |
| Teaching strategies | 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 |

1 Based on the professional attributes given in Engineers Australia National Generic Competency Standards - Stage 1 Competency Standard for Professional Engineers and UNSW Graduate Attributes.

Academic Honesty and Plagiarism

What is Plagiarism?

All details regarding plagiarism can be found here: https://student.unsw.edu.au/plagiarism

It is important to understand what plagiarism is. The general concept is plagiarism is using the words or ideas of others and passing them off as your own. Examples of plagiarism, including self-plagiarism, are:

- **Copying**
  
  Using the same or very similar words to the original text or idea without acknowledging the source or using quotation marks. This includes copying materials, ideas or concepts from a book, article, report or other written document, presentation, composition, artwork, design, drawing, circuitry, computer program or software, website, internet, other electronic resource, or another person’s assignment, without appropriate acknowledgement.

- **Inappropriate paraphrasing**
Changing a few words and phrases while mostly retaining the original structure and/or progression of ideas of the original, and information without acknowledgement. This also applies in presentations where someone paraphrases another’s ideas or words without credit and to piecing together quotes and paraphrases into a new whole, without appropriate referencing.

- **Collusion**
  Presenting work as independent work when it has been produced in whole or part in collusion with other people. Collusion includes,
  - students providing their work to another student before the due date, or for the purpose of them plagiarising at any time
  - paying another person to perform an academic task and passing it off as your own
  - stealing or acquiring another person’s academic work and copying it
  - offering to complete another person’s work or seeking payment for completing academic work.

This should not be confused with academic collaboration.

- **Inappropriate citation**
  Citing sources which have not been read, without acknowledging the ‘secondary’ source from which knowledge of them has been obtained.

- **Self-plagiarism**
  ‘Self-plagiarism’ occurs where an author republishes their own previously written work and presents it as new findings without referencing the earlier work, either in its entirety or partially.

Self-plagiarism is also referred to as ‘recycling’, ‘duplication’, or ‘multiple submissions of research findings’ without disclosure. In the student context, self-plagiarism includes re-using parts of, or all of, a body of work that has already been submitted for assessment without proper citation.

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.

**Continual Course Improvement**

- At the end of the course, students will be asked to provide evaluative feedback through myExperience, the University’s course and teaching evaluation and improvement process
- 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://student.unsw.edu.au/special-consideration. Medical certificates or other appropriate documents must be included. Students should also advise the lecturer of the situation.
• Unless otherwise specified in the task criteria, all assignments must be uploaded via Moodle prior to the due date for submission.
• Assignments/lab reports submitted after the due date for submission 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: https://student.unsw.edu.au/disability. Early notification is essential to enable any necessary adjustments to be made.

**Rules for Exams**

Rules governing conduct during exams are given at: https://student.unsw.edu.au/exam-rules