



Course Outline

MATS2004

Mechanical Behaviour of Materials

Materials Science and Engineering

Science

T2, 2020

1. Staff

Position	Name	Email	Consultation times and locations	Contact Details
Course Convenor	Associate Professor Sam Chan	sli.chan@unsw.edu.au	Room 245, School of Materials Science and Engineering (Building E10) by appointment	Phone: 9385 4441
Lecturer	Professor Jianqiang Zhang	j.q.zhang@unsw.edu.au	Room 348, School of Materials Science and Engineering (Building E10) by appointment	Phone: 9385 5025
Laboratory Administrator	Dr. Pramod Koshy	koshy@unsw.edu.au	Room 120, School of Materials Science and Engineering (Building E10) by appointment	Phone: 9385 6038

2. Course information

Units of credit: 6

Pre-requisite(s): MATS1101 or MATS1192

Timetabling website: TBA

Teaching times:

	Lecture	Lecture	Lecture
Day	Wednesday	Thursday	Friday
Time	9:00-11:00	12:00-14:00	9:00-11:00
Location	Online	Online	Online
Weeks	1-5, 7-10	1-5, 7-10	1, 3, 5, 7, 8, 10

Lab classes run weeks 3-9 online

Week	Lab		Time slot 1	Time slot 2	Time slot 3	Time slot 4	Time slot 5
3	Tensile	1 st hour	Group 1	Group 3	Group 5	Group 7	Group 9
		2 nd hour	Group 2	Group 4	Group 6	Group 8	Group 10
5	Hardness	1 st hour	Group 1	Group 3	Group 5	Group 7	Group 9
		2 nd hour	Group 2	Group 4	Group 6	Group 8	Group 10
7	Charpy	1 st hour	Group 1	Group 3	Group 5	Group 7	Group 9

		2nd hour	Group 2	Group 4	Group 6	Group 8	Group 10
9	Strain rate	1st hour	Group 1	Group 3	Group 5	Group 7	Group 9
		2nd hour	Group 2	Group 4	Group 6	Group 8	Group 10

2.1 Course summary

Stress strain behaviour; atomic bonding and elastic modulus; dislocations and yielding; deformation behaviour of polymers; brittle fracture and Weibull modulus; creep.

Part 1: Quantitative Treatment of Mechanical Behaviour

- Principal stresses
- Transformation of stresses
- Complex stress and strain analysis
- Introduction on plasticity
- Failure criteria

Part 2: Description of Mechanical Behaviour

- Definitions of stress and strain, types of mechanical behaviour, atomic bonding and elastic modulus
- Stress-strain behaviour based on tension test
- Introduction to plastic deformation and yielding, including slip systems, dislocations, and twinning
- Creep deformation, fracture and fatigue, and mechanisms
- Factors affecting mechanical behaviour: stress state, temperature and strain rate

2.2 Course aims

The course is aimed to equip students with a wide-ranging knowledge of the response of solid materials to stress. The course acts as an introduction to quantitative solid mechanics and builds on the knowledge of structure of materials and its relationship to mechanical properties. Students will participate in a variety of mechanical testing measurements in the laboratory classes.

2.3 Course learning outcomes (CLO)

At the successful completion of this course you (the student) should be able to:

1. Use critical thinking and analytical problem-solving skills to solve material science and engineering problems
2. Understand the stress strain relationship and the application of these to mechanical behaviour of a broad range of materials

3. Identify relationships between mechanical behaviours and chemical compositions, crystal structures and microstructure of materials
4. Apply various mechanical tests and the analysis of data obtained in these tests

2.4 Relationship between course and program learning outcomes and assessments

Course Learning Outcome (CLO)	LO Statement	Program Learning Outcome (PLO)	Related Tasks & Assessment
CLO 1	Use...	1.1, 1.2, 1.3 1.4, 3.2 & 3.3	1 & 2
CLO 2	Understand...	1.3 1.4, 3.2 & 3.3	1, 2, 3 & 4
CLO 3	Identify...	1.1, 1.2, 1.3 1.4, 3.2 & 3.3	1, 2 ,3 & 4
CLO 4	Apply...	1.1, 1.2, 1.3 1.4, 3.2 & 3.3	2, 3 & 4

3. Strategies and approaches to learning

3.1 Learning and teaching activities

(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.

Lectures: The core concepts will be taught in lectures, students will have access to the lectures notes before class for annotation during the lecture. Students will be engaged in the learning process through class discussions and problem-solving questions independently and working together with partners and groups.

Labs: Experimental techniques and procedures will be taught through laboratories classes and laboratory reports following the class. Students will watch a lab demonstrator conduct the lab and be actively engaged through discussion and short answer questions with the lab demonstrator and the collection of data throughout the experiments. Students will be able to reflect on the experiments and learn to process data through the lab reports after class.

3.2 Expectations of students

- Students should attend at least 80% of all classes with the expectation that students only miss classes due to illness or unforeseen circumstances
- Students must read through lecture notes and lab sheets prior to class
- During class, students are expected to engage actively in class discussions
- Students should work through lecture, tutorial and textbook questions
- Students should read through the relevant chapters of the prescribed textbook.
- Students should complete all assessment tasks and submit them on time.
- Students are expected to participate in online discussions through the Moodle page

4. Course schedule and structure

This course consists of 56 hours of online contact hours per term. You are expected to take an additional 94 hours of non-class contact hours to complete assessments, readings and exam preparation spread over the term.

Week	Topic		Activity
	Part 1		
1	Principle stresses Transformation of stresses	Transformation of stresses	
2	Complex stress and strain analysis	Complex stress and strain analysis	
3	Yield criteria	Yield criteria	Assignment 1a
4	Yield criteria/Introduction to Plasticity	Ductile failure, brittle fracture and an introduction to the Weibull modulus	
5	Revision		Assignment 1b
	Part 2		
5		Stress strain & types of mechanical properties	
7	Tension test & origin of mechanical properties	Tension test & origin of mechanical properties	Mid-term exam on Part 1
8	Dislocation & yielding	Dislocation & yielding	
9	Fracture and fatigue	Creep deformation & mechanisms	Assignment 2
10	Effects of temperature & strain rate on mechanical properties	Revision	

5. Assessment

5.1 Assessment tasks

Assessment task	Description	Weight	Due date
Assignments:	Part 1: (a) Stress transformation, principal stresses, 2-D and 3-D stress and strain analysis	20% (10% each)	Week 3
	(b) Yield criteria; applications of yield criteria		Week 5
	Part 2: Creep deformation, fracture and fatigue		Week 9
Laboratory reports:	1) Tensile testing: Modulus, strength and ductility 2) Impact test: Charpy 3) Hardness Tests: Microhardness, Vickers 4) Strain rate effects	20% (5% each)	1 week after the lab is held
Mid-term exam:	Covers the content taught in the first half of the course (Part 1)	30%	Week 7
Final Exam:	Covers all contents taught in the second half of the course (Part 2)	30%	Final exam period

Further information

UNSW grading system: <https://student.unsw.edu.au/grades>

UNSW assessment policy: <https://student.unsw.edu.au/assessment>

5.2 Assessment criteria and standards

Assignment and exam criteria and standards will be available on the course Moodle page.

The course contains 4 laboratory classes. Each takes approximately 1 to 2 hours to complete. Attendance at laboratory classes is compulsory. Students will be allocated into laboratory groups and a detailed timetable will be posted on Moodle prior to the first lab class.

Guidelines for laboratory reports

- Reports should be as concise as possible.
- The work performed should be communicated in a manner that enables another worker in the same discipline to repeat the experiment.
- References must be acknowledged with citations; either as footnotes or endnotes.
- Use the following as a guide:
 - Abstract: A summary of 50-100 words summarizing what was done, the techniques used, the materials studied, the test methods used, and the main conclusions reached.
 - Introduction: This establishes the background to why the work was done. It is usually theoretically based, and summarizes the previous work published to date.

- Experimental method: Refer if possible to the standard test method (e.g. AS1391) and note any departures from standard practice.
- Results: Provide 1 set of complete sample calculations, and summarise all of the results by means of tables and / or graphs. Where possible, indicate the experimental errors, and discuss their implication for the probable errors on the final results.
- Discussion. Briefly discuss the significance of the results. This should be done with reference to the background established in the Introduction.
- Conclusions. A summary of findings, usually written as a numbered series of statements.
- References. These should contain sufficient information to enable others to find the sources used (author/editor, title, page, year, publisher/journal name).
- Appendices (optional). Numbered appendices are used for any material which is too detailed to include in the main report because it would disrupt the flow of the report.

5.3 Submission of assessment tasks

There will be two assignments in the course. Assignment for the first part of the course will be given in week 4 (Part 1a), and week 7 (Part 1b). Assignment for part 2 will be given in Week 8. The assignments will be due two weeks after being given. Late submission without appropriate documentation will receive a penalty of 2 marks per day late (out of 10 maximum). Work that is more than 5 days late will not be accepted and will receive zero mark.

Laboratory reports are compulsory and must be submitted within two weeks after completion of the laboratory. They must be submitted with a completed student declaration sheet. If reports are submitted late, a penalty of 10% per day will be applied to the mark to a maximum of 5 days, after which the report will not be accepted.

UNSW operates under a Fit to Sit/ Submit rule for all assessments. If a student wishes to submit an application for special consideration for an exam or assessment, the application must be submitted prior to the start of the exam or before an assessment is submitted. If a student sits the exam/ submits an assignment, they are declaring themselves well enough to do so. 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.

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.

5.4. Feedback on assessment

Assignments: Feedback will be given two weeks after submission of the assignment and take the form of the mark for the assignment, overall comments on how the class performed, any common areas that were not answered correctly. Additionally, personal feedback and how each student performed may be given.

Lab reports: Students will receive their mark and individualised feedback on the areas they excelled at and which areas of the reports that were not answered correctly. Feedback will be provided through Moodle, two weeks after submission.

Midsession exams: Students will receive their marked exams indicating what questions were answered correctly and incorrectly. Overall comments and worked solutions may be provided to the class.

Final exam: Students will receive their final mark.

6. Academic integrity, referencing and plagiarism

Referencing is a way of acknowledging the sources of information that you use to research your assignments. You need to provide a reference whenever you draw on someone else's words, ideas or research. Not referencing other people's work can constitute plagiarism.

Further information about referencing styles can be located at <https://student.unsw.edu.au/referencing>

Academic integrity is fundamental to success at university. Academic integrity can be defined as a commitment to six fundamental values in academic pursuits: honesty, trust, fairness, respect, responsibility and courage.¹ At UNSW, this means that your work must be your own, and others' ideas should be appropriately acknowledged. If you don't follow these rules, plagiarism may be detected in your work.

Further information about academic integrity and **plagiarism** can be located at:

- The *Current Students* site <https://student.unsw.edu.au/plagiarism>, and
- The *ELISE* training site <http://subjectguides.library.unsw.edu.au/elise/presenting>

The *Conduct and Integrity Unit* provides further resources to assist you to understand your conduct obligations as a student: <https://student.unsw.edu.au/conduct>.

7. Readings and resources

- N.E. Dowling, *Mechanical Behavior of Materials*, 2nd Edition, Prentice Hall, 1999.
- K. Bowman, *Mechanical Behavior of Materials*, John Wiley, 2003
- M.F. Ashby, *Materials Selection in Mechanical Design*, Butterworth-Heinemann, 1999.
- G. Dieter, *Mechanical Metallurgy* SI Edition, McGraw Hill, 1988.
- I M Ward, *Mechanical Properties of Solid Polymers*, Wiley Interscience, 2nd Edition, 2005

8. Administrative matters

School Office: Room 137, Building E10 School of Materials Science and Engineering

School Website: <http://www.materials.unsw.edu.au/>

Faculty Office: Robert Webster Building, Room 128

Faculty Website: <http://www.science.unsw.edu.au/>

¹ International Center for Academic Integrity, 'The Fundamental Values of Academic Integrity', T. Fishman (ed), Clemson University, 2013.

9. Additional support for students

- The Current Students Gateway: <https://student.unsw.edu.au/>
- Academic Skills and Support: <https://student.unsw.edu.au/academic-skills>
- Student Wellbeing, Health and Safety: <https://student.unsw.edu.au/wellbeing>
- Disability Support Services: <https://student.unsw.edu.au/disability-services>
- UNSW IT Service Centre: <https://www.it.unsw.edu.au/students/index.html>
- Assessment Implementation Procedure:
<https://www.gs.unsw.edu.au/policy/documents/assessmentimplementationprocedure.pdf>
- Special Consideration: <https://student.unsw.edu.au/special-consideration>