CVEN9826

Advanced Mechanics of Structures and Materials

Term 2, 2023

Course Overview

Staff Contact Details

Convenors

Name	Email	Availability	Location	Phone
Wei Gao	w.gao@unsw.edu.au	1:00pm-2:00pm on Mondays	Room 608 Civil and Environmental Engineering Building (H20)	93854123

Lecturers

Name	Email	Availability	Location	Phone
Yuan Feng	yuan.feng1@unsw.edu.au		Room 603 Civil and Environmental Engineering Building (H20)	
Chongmin Song	c.song@unsw.edu.au		Room 717 Civil and Environmental Engineering Building (H20)	93855021

School Contact Information

Engineering Student Support Services – The Nucleus - enrolment, progression checks, clash requests, course issues or program-related queries

Engineering Industrial Training – Industrial training questions

UNSW Study Abroad – study abroad student enquiries (for inbound students)

UNSW Exchange – student exchange enquiries (for inbound students)

UNSW Future Students – potential student enquiries e.g. admissions, fees, programs, credit transfer

Phone

(+61 2) 9385 8500 – Nucleus Student Hub

(+61 2) 9385 7661 – Engineering Industrial Training

(+61 2) 9385 3179 – UNSW Study Abroad and UNSW Exchange (for inbound students)

Course Details

Units of Credit 6

Summary of the Course

A course in advanced mechanics of structures and materials for higher degree research students, and graduate students that require, or desire, a higher capability in the application of elasticity, plasticity and fracture to analysis of structures and structural materials. This subject is targeted to students desiring a greater understanding of structural mechanics and materials. The course includes lectures in the following: elasticity; plasticity; and fracture of brittle materials such as cementitious materials, fibre reinforced concrete and bond.

This course in intended for PhD and Masters by research students requiring higher level knowledge in Engineering Mechanics; it is available by application to the School of Civil and Environmental Engineering. Honours students and students undertaking a Masters by coursework degree in Civil Engineering that desire a higher level of knowledge of engineering mechanics may apply.

Course Aims

The aims of the course are:

- To reinforce a student's capability in structural mechanics with a view to and apply the concepts learned to the analysis of structures and structural materials.
- To introduce students to the fundamental concepts and principles applied by structural analysts and engineers in advanced computational modelling.
- To be able to carry out various engineering computations related to elasticity and plasticity and to fracture of cementitious materials.
- Provide a foundation in the advanced mechanics needed for higher degree studies in Structural Engineering or Mechanics of Structures and Materials.

Course Learning Outcomes

After successfully completing this course, you should be able to:

Learning Outcome	EA Stage 1 Competencies
1. Understand the fundamental concepts and principles applied by structural analysts and engineers in advanced computational modelling.	PE1.1, PE2.1, PE2.3
2. Carry out various engineering computations related to elasticity and plasticity and to fracture of cementitious materials.	PE1.2, PE1.3, PE1.4
3. Demonstrate skills in analysing elastic, plastic and fracture behaviour of structures and materials.	PE1.1, PE1.4, PE2.2

Learning Outcome	EA Stage 1 Competencies
4. Accomplish tasks that require the application of knowledge of advanced mechanics of structures and materials.	PE1.3, PE2.1
5. Improve capability for undertaking research in the discipline of structural engineering and mechanics.	PE1.4, PE2.1, PE3.3

Teaching Strategies

This course is designed for student-centred learning. Students are encouraged to think critically to solve engineering problems and to ask questions in order to best achieve the learning outcomes. The following teaching strategies are implemented in this course:

- **Lectures**

Focus on the development and application of generalised problem-solving processes for advanced engineering mechanics. Lectures will also emphasise the relationship of the content to practical engineering problems.

- **Workshops**

Help you to further develop and consolidate problem solving skills. You will be encouraged, from time to time, to work in small groups to solve problems.

- **Moodle Course Page**

Provides a step-by-step guide to complete the course.

Self-centred and self-directed learning (expectations of the students):

In addition to the class problem sessions, you are expected to commit **at least 6 hours per week** to independent learning and general problem solving.

Assessment

Assessment task	Weight	Due Date	Course Learning Outcomes Assessed
1. Quiz	5%	4pm Wednesday Week 3	1, 2
2. Assignments	95%	Wednesday in Weeks 4, 8 and 11	1, 2, 3, 4, 5

Assessment 1: Quiz

Start date: 4pm Wednesday Week 2
Assessment length: One week
Due date: 4pm Wednesday Week 3
Deadline for absolute fail: No late submission
Marks returned: Within one week

Elasticity quiz

Assessment criteria

Demonstrate understanding of concepts by applying problem solving and critical thinking

Assessment 2: Assignments

Start date: Wednesday in Weeks 3, 7 and 10
Assessment length: One week
Due date: Wednesday in Weeks 4, 8 and 11
Marks returned: Within one week

Three assignments for Elasticity (29%), Plasticity (33%) and Fracture Mechanics (33%) respectively.

Assessment criteria

Demonstrate understanding of concepts by applying problem solving and critical thinking

Attendance Requirements

Please note that lecture recordings are not available for this course. Students are strongly encouraged to attend all classes and contact the Course Authority to make alternative arrangements for classes missed.

Course Schedule

Please note the schedule of Topics covered in each week is a guide only and subject to change based on time constraints. Please attend the lectures each week to ensure you are up to date with the content and know which material to revise prior to the upcoming class

View class timetable

Timetable

Date	Type	Content
O-Week: 22 May - 26 May		
Week 1: 29 May - 2 June	Topic	**Elasticity 1:** Introduction of elasticity, basic concepts, basic assumptions, plane stress and plane strain
Week 2: 5 June - 9 June	Topic	**Elasticity 2:** Differential equations of equilibrium, boundary conditions, compatibility equations
	Assessment	Elasticity quiz
Week 3: 12 June - 16 June	Topic	**Elasticity 3:** Two-dimensional problems in rectangular coordinates, analysis of stress and strain in 3D, principal stresses, stress invariants
	Assessment	Elasticity assignment
Week 4: 19 June - 23 June	Topic	**Fracture 1:** Introduction to Fracture Mechanics: Lamé and Kirsch plate, basic failure concepts, micro and macro phenomena of fracture
Week 5: 26 June - 30 June	Topic	**Fracture 2:** Linear Fracture Mechanics I: crack-tip field, K-concept and K-factors, fracture toughness
Week 6: 3 July - 7 July		**No classes (lecture or workshop)**
Week 7: 10 July - 14 July	Topic	**Fracture 3:** Linear Fracture Mechanics II: energy release rate, J-integral, small-scale yielding
	Assessment	Fracture assignment
Week 8: 17 July - 21 July	Topic	**Plasticity 1:** Concept of elastoplasticity using 1D model, plastic strain, strain hardening and softening, unloading and reloading, path

		dependence
Week 9: 24 July - 28 July	Topic	**Plasticity 2**: Stress invariants, yield criteria and yield surfaces: Tresca, von Mises; associate flow rule; explicit and implicit integrations
Week 10: 31 July - 4 August	Topic	**Plasticity 3:** Mohr-Coulomb; Drucker Prager; non-associate flow rule
	Assessment	Plasticity assignment

Resources

Prescribed Resources

Class and Workshop Wednesday 14:00 – 18:00

Recommended Resources

- Theory of Elasticity, S. Timoshenko and J. N. Goodier
- Plasticity for Structural Engineers, Wai-Fah Chen and Da-Jian Han
- Fracture Mechanics: With an Introduction to Micromechanics, Dietmar Gross and Thomas Seelig
- Additional materials provided on Moodle.

Submission of Assessment Tasks

Please refer to the Moodle page of the course for further guidance on assessment submission.

UNSW has a standard late submission penalty of:

- 5% per day, for all assessments where a penalty applies, capped at five days (120 hours), after which a student cannot submit an assessment, and no permitted variation.

Academic Honesty and Plagiarism

Beware! An assignment that includes plagiarised material will receive a 0 fail, and students who plagiarise may fail the course. Students who plagiarise are also liable to disciplinary action, including exclusion from enrolment.

Plagiarism is the use of another person's work or ideas as if they were your own. When it is necessary or desirable to use other people's material you should adequately acknowledge whose words or ideas they are and where you found them (giving the complete reference details, including page number(s)). The Learning Centre provides further information on what constitutes Plagiarism at:

https://student.unsw.edu.au/plagiarism

Academic Information

Final Examinations:

Final Exams in T2 2023 will be held on campus between Friday 11th and Thursday 24th August (inclusive), and Supplementary Exams between Monday 4th and Friday 8th September (inclusive). You are required to be available on these dates. Please do not to make any personal or travel arrangements during this period.

For students enrolled in the distance offering of a postgraduate course, and who reside further than 100km from UNSW Kensington campus, will be contacted regarding sitting an external exam. The school's External Exam Policy can be found on the Intranet.

ACADEMIC ADVICE

- Key Staff to Contact for Academic Advice (log in with your zID and password): https://intranet.civeng.unsw.edu.au/key-staff-to-contact-during-your-studies-at-unsw
- Key UNSW Dates - eg. Census Date, exam dates, last day to drop a course without academic/financial liability etc.
- CVEN Student Intranet (log in with your zID and password): https://intranet.civeng.unsw.edu.au/student-intranet
- Student Life at CVEN, including Student Societies: https://www.unsw.edu.au/engineering/civil-and-environmental-engineering/student-life
- Special Consideration: https://student.unsw.edu.au/special-consideration
- General and Program-Specific Questions: The Nucleus: Student Hub
- Book an Academic Advising session: https://unswengacademicadvising.as.me/schedule.php

Disclaimer

This course outline sets out description of classes at the date the Course Outline is published. The nature of classes may change during the Term after the Course Outline is published. Moodle should be consulted for the up to date class descriptions. If there is any inconsistency in the description of activities between the University timetable and the Course Outline (as updated in Moodle), the description in the Course Outline/Moodle applies.

Image Credit

Mike Gal.

CRICOS

CRICOS Provider Code: 00098G

Acknowledgement of Country

We acknowledge the Bedegal people who are the traditional custodians of the lands on which UNSW Kensington campus is located.

Appendix: Engineers Australia (EA) Professional Engineer Competency Standard

Program Intended Learning Outcomes	
Knowledge and skill base	
PE1.1 Comprehensive, theory based understanding of the underpinning natural and physical sciences and the engineering fundamentals applicable to the engineering discipline	✓
PE1.2 Conceptual understanding of the mathematics, numerical analysis, statistics, and computer and information sciences which underpin the engineering discipline	✓
PE1.3 In-depth understanding of specialist bodies of knowledge within the engineering discipline	✓
PE1.4 Discernment of knowledge development and research directions within the engineering discipline	✓
PE1.5 Knowledge of engineering design practice and contextual factors impacting the engineering discipline	
PE1.6 Understanding of the scope, principles, norms, accountabilities and bounds of sustainable engineering practice in the specific discipline	
Engineering application ability	
PE2.1 Application of established engineering methods to complex engineering problem solving	✓
PE2.2 Fluent application of engineering techniques, tools and resources	✓
PE2.3 Application of systematic engineering synthesis and design processes	✓
PE2.4 Application of systematic approaches to the conduct and management of engineering projects	
Professional and personal attributes	
PE3.1 Ethical conduct and professional accountability	
PE3.2 Effective oral and written communication in professional and lay domains	
PE3.3 Creative, innovative and pro-active demeanour	✓
PE3.4 Professional use and management of information	
PE3.5 Orderly management of self, and professional conduct	
PE3.6 Effective team membership and team leadership	