ENGG2400

Mechanics of Solids 1

Term Two // 2021

School of Civil and Environmental Engineering // UNSW Engineering

Course Overview

Staff Contact Details

Convenors

Name	Email	Availability	Location	Phone
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School Contact Information

Course Details

Credit Points 6

Summary of the Course

This course provides an introduction to the fundamentals to the mechanics of solids. The topics include properties of plane cross-sectional shapes including centroid & principal second moment of area; concepts of stress and strain; 2D transformation of stresses and strains under axis rotation; principal stresses and strains; Mohr's circle of stress and strain; stress-strain relationships; elasticity, thermal strain, Poisson's ratio and Hooke's Law; bars under axial force; Indeterminate axial force systems; elastic bending stress formula; composite beams; deflections due to bending; step functions; simple indeterminate beams; shear flow; shear centre; torsion of circular shafts and box sections.

Course Aims

The objectives of this course are:

To reinforce knowledge of statics and to expand this knowledge in the areas of strain and stress analysis, thus enabling student to deal with more complex and integrated engineering problems involving Mechanics of Solids;
To introduce students to the basic principles and laws underlying Mechanics of Solids;
To familiarize students with the modelling and analysis techniques when formulating and solving problems for predicting the states of stress and strain for bodies in static equilibrium;
To give students an opportunity to develop and reflect on graduate attributes such as critical thinking and problem solving, lifelong learning skills and collaborative skills.

Course Learning Outcomes

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

Learning Outcome	EA Stage 1 Competencies
1. Demonstrate a comprehension of the basic concepts and the role of Mechanics of Solids in the analysis and design of structures	PE1.1, PE1.2
2. Demonstrate a comprehension of the theoretical background to the concept of stresses and strains;	PE1.3
3. Be able to understand and apply the concepts of stresses and strains to formulate and evaluate the stresses and deformations within axial force and bending moment problems;	PE1.3, PE1.5
4. Be able to evaluate stresses due to axial force, bending moment, shear and torsion in symmetrical and unsymmetrical cross-sections;be able to calculate and evaluate beam deflections for statically determinate and indeterminate beams by using integration methods and step functions;	PE1.3, PE1.5, PE2.1
5. Be able to calculate shear and torsion stresses due to shear and torsion forces respectively;	PE1.2, PE1.3

Learning Outcome	EA Stage 1 Competencies
6. Be able to calculate principal stresses, strains and combined stresses and draw Mohr's circle;	PE1.2, PE1.3, PE2.2

Teaching Strategies

The teaching strategies that will be used include:

- **Lectures** that will focus on the development and application of generalised problem-solving processes for the stress, strain and deformation analysis of structures. Lectures will also emphasise the relationship of the content to engineering practice and will provide an opportunity for reflection on learning. The lectures are recorded and should be available on the Moodle course page.
- **Problem** classes will concentrate on strategies for solving such problems. Students will be encouraged, from time to time, to work in small groups to solve problems.
- **Moodle Course Page** provides a step by step guide on the course. There is a discussion forum to help provide interaction and help from peers. Links to video recordings and learning modules to help students learn the solution techniques for many of the subject areas.

Suggested approaches to learning in this course include:

- Regular participation in lectures and class problem sessions. *Review lecture and class problem material. Follow worked examples. Reflect on class problems and quizzes.*
- Complete all the required tasks in the weekly Teams To Do pages for this course.
- Weekly reading and recording of your learning.
- Appropriate preparation for class problem activities.
- Planning time to achieve all assessment requirements (see assessment).
- Students who perform poorly in the quizzes are strongly encouraged to discuss their progress with the lecturers during the semester.

Assessment

Assessment Tasks

Assessment task	Weight	Due Date	Student Learning Outcomes Assessed
Weekly Tasks	19%	Weekly	3, 4, 5, 6
Block Tests	27%	Weeks 4, 7, 10 Thurs 6pm	2, 3, 4, 5, 6
Labs	18%	Week 5 and Week 9	3, 4, 5, 6
Final Examination	36%	See Exam Timetable	3, 4, 5, 6

Assessment Details

Assessment 1: Weekly Tasks

Length: 1 week

Details:

PSS Hand-ins and weekly quiz.

Assessment criteria for full marks in PSS hand-ins is only that you make a reasonable attempt in your own handwriting for each of the 'Hand-in' problems.

PSS returned within two weeks. Moodle Quiz is instant. 0.5/1 mark for PSS one week late, 0/1 marks for two weeks late. Submit as PDF or photos uploaded via Teams Assignments. Total 9 PSS Hand ins.

Moodle Quiz must be done withing the one week period. Moodle quizzes will be pinned as tabs for each topic channel in Teams. Total 9 Moodle Quizzes.

Submission notes: Submit quiz via Moodle Quiz and PSS via Teams Assignments.

Turnitin setting: This is not a Turnitin assignment

Assessment 2: Block Tests

Start date: Weeks 4, 7, 10 Thurs 5pm

Length: 45 minutes + 15 mins tech buffer + 15 minute scan and upload times.

Details:

Three Block Tests covering three questions each, one for each of the weekly topics, test taken online via Teams.

Assessment criteria for full marks includes correct and clear mathematical working, reasoning and diagrams to support the correct numerical answer.

Block test duration is 45 minutes nominally plus 15 minutes buffer for technical issues and then 15 mins upload time after final answer responses have closed. There are no late block tests, alternative times and no supplementary block tests. Special considerations will only offer for the weighting to be added to the final exam.

Marks will be returned within three weeks.

Additional details:

Criteria

Submission notes: Submit final answers into Forms and written working as PDF upload into Teams Assignments.

Turnitin setting: This is not a Turnitin assignment

Assessment 3: Labs

Start date: Week 3 and Week 7

Length: 8 pages maximum

Details:

Two lab reports / practical assignments.

Assignments will be marked according to a criteria of correctness, completeness, and professionalism of report. We expect to see your personal insights and reasoning reflected in your written reports.

Absolute fail will be given to reports handed in later than 5pm on the Monday following the submission deadline from the week before.

Marks will be returned within three weeks of the submission deadline.

Submission notes: Submit via Teams Assignments

Turnitin setting: This is not a Turnitin assignment

Assessment 4: Final Examination

Start date: See Exam Timetable

Length: 2 hours plus technical buffer and upload time.

Details:

The final exam is nine questions long and nominally 2 hours in duration plus upload time. A small

amount of additional time may be given to allow for any potential technical difficulties. It is given because the course learning outcomes include a significant level of technical learning that can be effectively assessed in an exam environment.

Assessment criteria for full marks includes correct and clear mathematical working, reasoning and diagrams to support the correct numerical answer.

Deadline for absolute fail is anything submitted after the examination end time.

Marks are returned in the form of central return of results at the end of trimester.

Submission notes: Submit final numerical answers via Forms and written work as PDFs from images via Teams assignments.

Turnitin setting: This is not a Turnitin assignment

Attendance Requirements

Students are strongly encouraged to attend all classes and review lecture recordings.

Course Schedule

View class timetable

Timetable

Date	Type	Content
Week 1: 31 May - 4 June	Topic	Stress and Strain: Equilibrium of deformable bodies. Normal and shear stress and strain
Week 2: 7 June - 11 June	Topic	Mechanical properties of materials and geometric properties
Week 3: 14 June - 18 June	Topic	Axial loading, statically indeterminate loading
Week 4: 21 June - 25 June	Topic	Torsion, angular deformation, torque
	Assessment	Block Test 1
Week 5: 28 June - 2 July	Topic	Beam bending, flexural rigidity of beams
	Assessment	Lab report 1 due
Week 6: 5 July - 9 July	Topic	Transverse shear and shear flow Combined loading, thin-walled pressure vessels recorded live to be viewed in Week 7.
Week 7: 12 July - 16 July	Topic	Stress and strain transformation, plane stress/strain, Mohr's circle, rosettes
	Assessment	Block Test 2
Week 8: 19 July - 23 July	Topic	Deflection of beams, statically indeterminate beam bending
Week 9: 26 July - 30 July	Topic	Energy Methods, strain energy functions
	Assessment	Lab report 2 due
Week 10: 2 August - 6 August	Topic	Exam revision
	Assessment	Block Test 3

Resources

Prescribed Resources

Textbook: "Mechanics of Materials: Tenth Edition in SI Units" - RC Hibbeler, Pearson Education.

UNSW Library website: https://www.library.unsw.edu.au/

Moodle: https://moodle.telt.unsw.edu.au/login/index.php

Microsoft Teams: https://teams.microsoft.com

Recommended Resources

Other resources are provided digitally. You may choose to get additional textbooks.

Course Evaluation and Development

The Faculty of Engineering evaluates each course each time it is run through (i) the MyExperience Surveys, and (ii) Focus Group Meetings. As part of the MyExperience process, your student evaluations on various aspects of the course are graded; the Course Coordinator prepares a summary report for the Head of School. Any problem areas are identified for remedial action, and ideas for making improvements to the course are noted for action the next time that the course is run. Focus Group Meetings are conducted by the four-Year Managers (academic staff) for any students who wish to attend, in each year of the civil and/or environmental engineering programs. Student comments on each course are collected and disseminated to the Lecturers concerned, noting any points which can help improve the course.

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Academic Information

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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	