UNSW Course Outline

# MMAN3400 Mechanics of Solids 2 - 2024

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## General Course Information

**Course Code :** MMAN3400
**Year :** 2024
**Term :** Term 1
**Teaching Period :** T1
**Is a multi-term course? :** No
**Faculty :** Faculty of Engineering
**Academic Unit :** School of Mechanical and Manufacturing Engineering
**Delivery Mode :** In Person
**Delivery Format :** Standard
**Delivery Location :** Kensington
**Campus :** Sydney
**Study Level :** Postgraduate, Undergraduate
**Units of Credit :** 6

**Useful Links**

Handbook Class Timetable

## Course Details & Outcomes

### Course Description

Membrane stresses in axisymmetric shells, simple bending, bending of composite and reinforced concrete beams, principal and cross moments of area, unsymmetrical bending, transverse shear stresses in beams, shear centre, column buckling, theory of elasticity:

compatibility - equilibrium - constitutive equations - plane stress/strain, st Venant's principal, application of theory of elasticity to axisymmetric problems, torsion of prismatic bars, torsion of multiply connected thin-walled sections, deflection analysis based on the principle of virtual work, fatigue and fracture.

## Course Aims

The course is intended to develop a more advanced understanding of solid mechanics and elasticity theory, and develop skills in applying these theories to solve practical engineering problems.

## Course Learning Outcomes

| Course Learning Outcomes |
|---|
| CLO1 : determine stresses in axisymmetric shells/vessels, unsymmetrical bending, shear and column buckling |
| CLO2 : analyze deflection of trusses and beams using principle of virtual work |
| CLO3 : Apply acquired knowledge to conduct a systematic analysis of a real-world system |
| CLO4 : Write reports to communicate information at a professional engineering standard |

| Course Learning Outcomes | Assessment Item |
|---|---|
| CLO1 : determine stresses in axisymmetric shells/vessels, unsymmetrical bending, shear and column buckling | • Quizzes<br>• Lab Assignments<br>• Case Study Project<br>• Final Exam |
| CLO2 : analyze deflection of trusses and beams using principle of virtual work | • Quizzes<br>• Lab Assignments<br>• Case Study Project<br>• Final Exam |
| CLO3 : Apply acquired knowledge to conduct a systematic analysis of a real-world system | • Quizzes<br>• Lab Assignments<br>• Case Study Project<br>• Final Exam |
| CLO4 : Write reports to communicate information at a professional engineering standard | • Quizzes<br>• Lab Assignments<br>• Case Study Project<br>• Final Exam |

## Additional Course Information

This is a 6 unit-of-credit (UoC) course and involves 4 hours per week (h/w) of scheduled contact.

The lectures in this course are conducted in person on campus.

The normal workload expectations of a student are approximately 25 hours per term for each UOC, including class contact hours, other learning activities, preparation and time spent on all assessable work. You should aim to spend about 15 h/w on this course. The additional time should be spent in making sure that you understand the lecture material, completing the exercise questions and set assignments, further reading, and revising for any tests and examinations.

# Assessments

## Assessment Structure

| Assessment Item | Weight | Relevant Dates |
|---|---|---|
| Quizzes<br>Assessment Format: Individual | 40% | Due Date: Thursday 6-7pm in weeks 3, 5, 7 and 9 |
| Lab Assignments<br>Assessment Format: Individual | 20% | Due Date: Friday 11:55pm in Weeks 7 and 8. |
| Case Study Project<br>Assessment Format: Individual | 20% | Due Date: Friday 10:55pm Week 10 |
| Final Exam<br>Assessment Format: Individual | 20% | Due Date: Exam period |

## Assessment Details

### Quizzes

#### Assessment Overview

These are individual online tests to be held on Moodle. The quizzes will assess your understanding of the lecture materials covered to date in the course.

#### Course Learning Outcomes

- CLO1 : determine stresses in axisymmetric shells/vessels, unsymmetrical bending, shear and column buckling
- CLO2 : analyze deflection of trusses and beams using principle of virtual work
- CLO3 : Apply acquired knowledge to conduct a systematic analysis of a real-world system
- CLO4 : Write reports to communicate information at a professional engineering standard

#### Detailed Assessment Description

There are four quizzes of equal value 10%. You'll have 1 hour for each quiz, held on Moodle.

The quizzes will assess the lecture materials covered to date in the course.

Marks will be returned in three weeks following the assessment.

This is an individual assessment.

Instructions will be published on Moodle.

**Assessment Length**

1 hour

**Submission notes**

Quizzes will be conducted through Moodle.

**Assignment submission Turnitin type**

This is not a Turnitin assignment

## Lab Assignments

**Assessment Overview**

There are two lab experiments in this course. Students should attend the Undergraduate Teaching Lab to complete these experiments and submit a lab report for each experiment.

**Course Learning Outcomes**

- CLO1 : determine stresses in axisymmetric shells/vessels, unsymmetrical bending, shear and column buckling
- CLO2 : analyze deflection of trusses and beams using principle of virtual work
- CLO3 : Apply acquired knowledge to conduct a systematic analysis of a real-world system
- CLO4 : Write reports to communicate information at a professional engineering standard

**Detailed Assessment Description**

This is an individual assessment.

Marks will be returned in three weeks following the assessment.

**Submission notes**

Submit pdf lab reports on Moodle.

**Assessment information**

Penalty: Standard UNSW Late Policy. Work submitted after five days (120 hours) will not be accepted. Please refer to the Late Policy section in this course outline.

**Assignment submission Turnitin type**

This assignment is submitted through Turnitin and students do not see Turnitin similarity reports.

## Case Study Project

### Assessment Overview

You will be required to conduct a structural analysis of a real-life system based on the concepts covered in this course.

### Course Learning Outcomes

- CLO1 : determine stresses in axisymmetric shells/vessels, unsymmetrical bending, shear and column buckling
- CLO2 : analyze deflection of trusses and beams using principle of virtual work
- CLO3 : Apply acquired knowledge to conduct a systematic analysis of a real-world system
- CLO4 : Write reports to communicate information at a professional engineering standard

### Detailed Assessment Description

This is an individual assessment.

Marks will be returned upon the release of the final grades.

### Submission notes

Submit a pdf report via Moodle.

### Assessment information

Penalty: Standard UNSW Late Policy. Work submitted after five days (120 hours) will not be accepted. Please refer to the Late Policy section in this course outline.

### Assignment submission Turnitin type

This assignment is submitted through Turnitin and students do not see Turnitin similarity reports.

## Final Exam

### Assessment Overview

This is a scheduled final exam. Final exam covers all the topics taught in the course. Further information will be provided before the exam.

### Course Learning Outcomes

- CLO1 : determine stresses in axisymmetric shells/vessels, unsymmetrical bending, shear and column buckling
- CLO2 : analyze deflection of trusses and beams using principle of virtual work
- CLO3 : Apply acquired knowledge to conduct a systematic analysis of a real-world system
- CLO4 : Write reports to communicate information at a professional engineering standard

**Detailed Assessment Description**

This is an individual assessment.

Marks will be returned upon the release of the final grades.

**Assessment Length**

2 hours

**Assignment submission Turnitin type**

This is not a Turnitin assignment

# General Assessment Information

**Grading Basis**

Standard

# Course Schedule

| Teaching Week/Module | Activity Type | Content |
|---|---|---|
| Week 1 : 12 February - 18 February | Lecture | Theory of Elasticity<br>• Stress/Strain tensors<br>• Stress and strain transformations in 2D and 3D<br>• Stress invariants<br>• Constitutive laws<br>• Theories of failure |
| | Workshop | Demonstration of sample problems related to the lecture content. |
| Week 2 : 19 February - 25 February | Lecture | Classical Bending of Beam Sections<br>• Products of inertia and area<br>• Simple and unsymmetrical bending<br>• Composite beams |
| | Workshop | Demonstration of sample problems related to the lecture content. |
| Week 3 : 26 February - 3 March | Lecture | Shear and Torque of Beam Sections<br>• Torsion of solid sections (revision)<br>• Shear flow<br>• Shear flow in Open Sections<br>• Shear centre |
| | Workshop | Demonstration of sample problems related to the lecture content. |
| Week 4 : 4 March - 10 March | Lecture | Sehar of Beam Sections Cont. |
| | Workshop | Demonstration of sample problems related to the lecture content. |
| Week 5 : 11 March - 17 March | Lecture | Membrane Stress in Thin Axisymmetric Shells<br>• Thin-walled cylindrical and spherical pressure vessels (revision)<br>• General axisymmetric shells<br>• Case studies: Toroidal shells Torispherical shells |
| | Workshop | Demonstration of sample problems related to the lecture content. |
| Week 7 : 25 March - 31 March | Lecture | Buckling of columns<br>• Euler buckling of columns<br>• Effect of boundary conditions<br>• Non-idealised buckling of columns |
| | Workshop | Demonstration of sample problems related to the lecture content. |
| Week 8 : 1 April - 7 April | Lecture | Principles of Virtual Work<br>• Strain energy<br>• Work<br>• Unit load method for truss deflection<br>• Deflection of beams |
| | Workshop | Demonstration of sample problems related to the lecture content. |
| Week 9 : 8 April - 14 April | Lecture | Statically Indeterminate Structures<br>• Determine redundant reaction forces<br>• Elastic foundations |
| | Workshop | Demonstration of sample problems related to the lecture content. |
| Week 10 : 15 April - 21 April | Lecture | Introduction to Fracture and Fatigue<br>Consultation |
| | Workshop | Demonstration of sample problems related to the lecture content.<br>Consultation. |

## Attendance Requirements

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

# Course Resources

## Prescribed Resources

R. C. Hibbeler, “Mechanics of Materials”, 10th Ed, in SI Units, 2019, Pearson.

Discount details from Pearson:

• Mechanics of Materials in SI Units, ISBN: 9781292178202 - Buy here: https://bit.ly/41C4fWT

Your unique 5% discount code: **BTUNSW** (valid from 15 January to 31 March, 2024).

**Students can save up to 30%**
From 15 January to 31 March, 2024, students can save up to 30% on their resource purchases through the Pearson website, combining an up to 25% website offer with the additional 5% discount code.

## Recommended Resources

Engineering Core Courses - Solid Mechanics II

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

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

## Course Evaluation and Development

Feedback on the course is gathered periodically using various means, including the UNSW myExperience process, informal discussion in the final class for the course, and the School's Student/Staff meetings. Your feedback is taken seriously, and continual improvements are made to the course based, in part, on such feedback.

In this course, recent improvements resulting from student feedback include:

- more interactive learning with practical examples
- refined assessment structure.

# Staff Details

| Position | Name | Email | Location | Phone | Availability | Equitable Learning Services Contact | Primary Contact |
|---|---|---|---|---|---|---|---|
| Convenor | Liya Zhao | | Ainsworth Building 301B | | Appointments via email. | No | Yes |

# Other Useful Information

## Academic Information

### I. Special consideration and supplementary assessment

If you have experienced an illness or misadventure beyond your control that will interfere with your assessment performance, you are eligible to apply for Special Consideration prior to, or within 3 working days of, submitting an assessment or sitting an exam.

Please note that UNSW has a Fit to Sit rule, which means that if you sit an exam, you are declaring yourself fit enough to do so and cannot later apply for Special Consideration.

For details of applying for Special Consideration and conditions for the award of supplementary assessment, please see the information on UNSW's Special Consideration page.

### II. Administrative matters and links

All students are expected to read and be familiar with UNSW guidelines and polices. In particular, students should be familiar with the following:

- Attendance
- UNSW Email Address
- Special Consideration
- Exams
- Approved Calculators
- Academic Honesty and Plagiarism
- Equitable Learning Services

### III. Equity and diversity

Those 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 convener prior to, or at the commencement of, their course, or with the Equity Officer (Disability) in the Equitable Learning Services. Issues to be discussed may include access to materials, signers or note-takers, the provision of services and additional exam and assessment arrangements. Early notification is essential to enable any necessary adjustments to be made.

### IV. Professional Outcomes and Program Design

Students are able to review the relevant professional outcomes and program designs for their streams by going to the following link: https://www.unsw.edu.au/engineering/student-life/student-resources/program-design.

*Note: This course outline sets out the 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 or your primary learning management system (LMS) 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/Moodle/LMS, the description in the Course Outline/Moodle/LMS applies.*

## Academic Honesty and Plagarism

UNSW has an ongoing commitment to fostering a culture of learning informed by academic integrity. All UNSW students have a responsibility to adhere to this principle of academic integrity. Plagiarism undermines academic integrity and is not tolerated at UNSW. *Plagiarism at UNSW is defined as using the words or ideas of others and passing them off as your own.*

Plagiarism is a type of intellectual theft. It can take many forms, from deliberate cheating to accidentally copying from a source without acknowledgement. UNSW has produced a website with a wealth of resources to support students to understand and avoid plagiarism, visit: student.unsw.edu.au/plagiarism. The Learning Centre assists students with understanding academic integrity and how not to plagiarise. They also hold workshops and can help students one-on-one.

You 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 tasks.

Repeated plagiarism (even in first year), plagiarism after first year, or serious instances, may also be investigated under the Student Misconduct Procedures. The penalties under the procedures can include a reduction in marks, failing a course or for the most serious matters (like plagiarism in an honours thesis or contract cheating) even suspension from the university. The Student Misconduct Procedures are available here:

www.gs.unsw.edu.au/policy/documents/studentmisconductprocedures.pdf

## Submission of Assessment Tasks

Work submitted late without an approved extension by the course coordinator or delegated authority is subject to a late penalty of five percent (5%) of the maximum mark possible for that assessment item, per calendar day.

The late penalty is applied per calendar day (including weekends and public holidays) that the assessment is overdue. There is no pro-rata of the late penalty for submissions made part way through a day. This is for all assessments where a penalty applies.

Work submitted after five days (120 hours) will not be accepted and a mark of zero will be awarded for that assessment item.

For some assessment items, a late penalty may not be appropriate. These will be clearly indicated in the course outline, and such assessments will receive a mark of zero if not completed by the specified date. Examples include:

- Weekly online tests or laboratory work worth a small proportion of the subject mark;
- Exams, peer feedback and team evaluation surveys;
- Online quizzes where answers are released to students on completion;
- Professional assessment tasks, where the intention is to create an authentic assessment that has an absolute submission date; and,
- Pass/Fail assessment tasks.

## Faculty-specific 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)

## School-specific Information

### Short Extensions

Short extensions are not currently applicable to Mechanical and Manufacturing Engineering Courses.

### Review of Results

The purpose of a review of results is if there was a marking error. Review of results is for when you have cause to believe that there is a marking error. Review of Results cannot be used to get feedback. If you would like feedback for assessments prior to the final exam, you are welcome to contact the course convenor directly. No feedback will be provided on final exams.

### Use of AI

The use of AI is prohibited unless explicitly permitted by the course convenor. Please respect this and be aware that penalties will apply when unauthorised use is detected, such as through Turnitin. If the use of generative AI, such as ChatGPT, is allowed in a specific assessment, they must be properly credited, and your submissions must be substantially your own work.

## School Contact Information

### Location

UNSW Mechanical and Manufacturing Engineering

Ainsworth building J17, Level 1

Above Coffee on Campus

### Hours

9:00–5:00pm, Monday–Friday*

*Closed on public holidays, School scheduled events and University Shutdown

**Web**

School of Mechanical and Manufacturing Engineering

Engineering Student Support Services

Engineering Industrial Training

UNSW Study Abroad and Exchange (for inbound students)

UNSW Future Students

**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)

(+61 2) 9385 4097 – School Office**

**Please note that the School Office will not know when/if your course convenor is on campus or available

**Email**

Engineering Student Support Services – current student enquiries

- e.g. enrolment, progression, 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

School Office – School general office administration enquiries

- NB: the relevant teams listed above must be contacted for all student enquiries. The School will only be able to refer students on to the relevant team if contacted

**Important Links**

- Student Wellbeing
- Urgent Mental Health & Support
- Equitable Learning Services
- Faculty Transitional Arrangements for COVID-19
- Moodle
- Lab Access
- Computing Facilities
- Student Resources
- Course Outlines
- Makerspace
- UNSW Timetable
- UNSW Handbook