UNSW Course Outline

ZEIT3500 Engineering Structures - 2024

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General Course Information

Course Code : ZEIT3500
Year : 2024
Term : Semester 2
Teaching Period : Z2
Is a multi-term course? : No
Faculty : UNSW Canberra
Academic Unit : School of Engineering and Technology
Delivery Mode : In Person
Delivery Format : Standard
Delivery Location : UNSW Canberra at ADFA
Campus : UNSW Canberra
Study Level : Undergraduate
Units of Credit : 6

Useful Links

Handbook Class Timetable

Course Details & Outcomes

Course Description

This course extends the concepts of Mechanics of Solids to applications of Structural Mechanics in Aeronautical and Mechanical Engineering. The topics treated will include bending of indeterminate beams and unsymmetric beams, torsion and transverse loading of thin walled

and stiffened structures, energy methods of structural analysis, failure analysis of metallic structures, introduction to fracture mechanics and fatigue behaviour.

Course Aims

The course is designed to reinforce the fundamentals learnt in Mechanics of Solids (ZEIT2504) in the second year and extend this knowledge further, both in terms of theory as well as its application to engineering structural mechanics, with special emphasis on mechanical and aircraft structures. The problem-solving skills of the students will be extended with theoretical examples in the classroom environment as well as practical laboratory experiments.

Relationship to Other Courses

Mechanics of Solids (ZEIT2504) is the pre-requisite for this course. It is presumed that the students have a good grasp of the fundamentals covered in the course and are encouraged to revise its contents at the beginning of the session.

Course Learning Outcomes

Course Learning Outcomes	Engineers Australia - Professional Engineer (Stage 1)
CLO1 : On successful completion of this course, the student will be able to analyse the bending stresses and deformations of determinate and indeterminate beams with symmetric and unsymmetric cross sections.	• PEE1.1 : Comprehensive, theory based understanding of the underpinning natural and physical sciences and the engineering fundamentals applicable to the engineering discipline • PEE1.3 : In-depth understanding of specialist bodies of knowledge within the engineering discipline • PEE1.4 : Discernment of knowledge development and research directions within the engineering discipline • PEE2.1 : Application of established engineering methods to complex engineering problem solving • PEE2.2 : Fluent application of engineering techniques, tools and resources • PEE3.2 : Effective oral and written communication in professional and lay domains
CLO2 : On successful completion of this course, the student will be able to analyse the stresses and deformations caused by torsion in thin-walled beams with open and closed sections.	• PEE1.1 : Comprehensive, theory based understanding of the underpinning natural and physical sciences and the engineering fundamentals applicable to the engineering discipline • PEE1.3 : In-depth understanding of specialist bodies of knowledge within the engineering discipline • PEE1.4 : Discernment of knowledge development and research directions within the engineering discipline • PEE2.1 : Application of established engineering methods to complex engineering problem solving • PEE2.2 : Fluent application of engineering techniques, tools and resources • PEE3.2 : Effective oral and written communication in professional and lay domains
CLO3 : On successful completion of this course, the student will be able to analyse the stresses and deformations caused by shear loading in thin-walled beams with open and closed sections.	• PEE1.1 : Comprehensive, theory based understanding of the underpinning natural and physical sciences and the engineering fundamentals applicable to the engineering discipline • PEE1.3 : In-depth understanding of specialist bodies of knowledge within the engineering discipline • PEE1.4 : Discernment of knowledge development and research directions within

	the engineering discipline • PEE2.1 : Application of established engineering methods to complex engineering problem solving • PEE2.2 : Fluent application of engineering techniques, tools and resources • PEE3.2 : Effective oral and written communication in professional and lay domains
CLO4 : On successful completion of this course, the student will be able to apply the theoretical knowledge gained in class to experimentally evaluate and analyse deformations due to bending, torsion and shear of real beam-like structures.	• PEE1.1 : Comprehensive, theory based understanding of the underpinning natural and physical sciences and the engineering fundamentals applicable to the engineering discipline • PEE2.3 : Application of systematic engineering synthesis and design processes • PEE3.2 : Effective oral and written communication in professional and lay domains • PEE3.3 : Creative, innovative and pro-active demeanour • PEE3.6 : Effective team membership and team leadership

Course Learning Outcomes	Assessment Item
CLO1 : On successful completion of this course, the student will be able to analyse the bending stresses and deformations of determinate and indeterminate beams with symmetric and unsymmetric cross sections.	• Class tests x 3 • Final Examination 3 hours
CLO2 : On successful completion of this course, the student will be able to analyse the stresses and deformations caused by torsion in thin-walled beams with open and closed sections.	• Class tests x 3 • Final Examination 3 hours
CLO3 : On successful completion of this course, the student will be able to analyse the stresses and deformations caused by shear loading in thin-walled beams with open and closed sections.	• Class tests x 3 • Final Examination 3 hours
CLO4 : On successful completion of this course, the student will be able to apply the theoretical knowledge gained in class to experimentally evaluate and analyse deformations due to bending, torsion and shear of real beam-like structures.	• Laboratory Report x2 • Laboratory Reports • Final Examination 3 hours

Learning and Teaching Technologies

Moodle - Learning Management System

Learning and Teaching in this course

This course will be primarily taught through face-to-face sessions, which include lectures, tutorials and laboratories. The lectures are designed to enhance your theoretical knowledge and demonstrate the application of the theory to problem solving in structural analysis through worked examples. The tutorials allow the opportunity to practice and self-assess solving several problems on each topic. The laboratory experiments are aimed at reinforcing the theory covered in lectures. Some lectures will cover the computational modelling and analysis of beams using CATIA, which will also help in visualization and relating the observations with the theory.

The Learning Management System

Moodle is the Learning Management System used at UNSW Canberra. All courses have a Moodle site which will become available to students at least one week before the start of semester. Please find all help and documentation (including Blackboard Collaborate) at the Moodle Support page.

UNSW Moodle supports the following web browsers:

» Google Chrome 50+
» Safari 10+
** Internet Explorer is not recommended

** Addons and Toolbars can affect any browser's performance.

Operating systems recommended are:

Windows 7, 10, Mac OSX Sierra, iPad IOS10

For further details about system requirements click here.

Log in to Moodle here.

If you need further assistance with Moodle:

For enrolment and login issues please contact:

IT Service Centre
Email: itservicecentre@unsw.edu.au
Phone: (02) 9385-1333
International: +61 2 9385 1333

For all other Moodle issues please contact:
External TELT Support
Email: externalteltsupport@unsw.edu.au
Phone: (02) 9385-3331
International: +61 2 938 53331

Opening hours:
Monday – Friday 7:30am – 9:30 pm
Saturday & Sunday 8:30 am – 4:30pm

Additional Course Information

Academic Integrity and Plagiarism

UNSW has an ongoing commitment to fostering a culture of learning informed by academic integrity. All UNSW staff and students have a responsibility to adhere to this principle of academic integrity. All students are expected to adhere to UNSW's Student Code of Conduct https://www.gs.unsw.edu.au/policy/documents/studentcodepolicy.pdf

Plagiarism undermines academic integrity and is not tolerated at UNSW. *It is defined as using the words or ideas of others and passing them off as your own, and* can take many forms, from deliberate cheating to accidental copying from a source without acknowledgement.

For more information, please refer to the following:

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

Referencing

In this course, students are required to reference following the APA 7 / Chicago NB referencing style. Information about referencing styles is available at: https://guides.lib.unsw.adfa.edu.au/c.php?g=472948&p=3246720

Study at UNSW Canberra

https://www.unsw.adfa.edu.au/study

Study at UNSW Canberra has lots of useful information regarding:

- Where to get help
- Administrative matters
- Getting your passwords set up
- How to log on to Moodle
- Accessing the Library and other areas.

Additional Information as required

CRICOS Provider no. 00098G

The University of New South Wales Canberra.

Assessments

Assessment Structure

Assessment Item	Weight	Relevant Dates
Class tests x 3 Assessment Format: Individual	40%	Due Date: Week 4: 05 August - 09 August, Week 8: 16 September - 20 September, Week 11: 07 October - 11 October
Laboratory Report x2 Assessment Format: Group	10%	Due Date: Group reports to be submitted 2 weeks from the date of the experiment (mid-session break excluded)
Laboratory Reports Assessment Format: Individual	5%	Due Date: Individual report to be submitted 2 weeks from the date of the experiment (mid-session break excluded))
Final Examination 3 hours Assessment Format: Individual	45%	Due Date: Exam week

Assessment Details

Class tests x 3

Assessment Overview

The tests would cover knowledge of a limited set of topics (one or two chapters at a time) during the session. Individual feedback would be provided on the answerbooks as well as collective feedback in class.

Course Learning Outcomes

- CLO1 : On successful completion of this course, the student will be able to analyse the bending stresses and deformations of determinate and indeterminate beams with symmetric

and unsymmetric cross sections.
- CLO2 : On successful completion of this course, the student will be able to analyse the stresses and deformations caused by torsion in thin-walled beams with open and closed sections.
- CLO3 : On successful completion of this course, the student will be able to analyse the stresses and deformations caused by shear loading in thin-walled beams with open and closed sections.

Detailed Assessment Description

The three tests will be weighed 10%, 20%, and 10% respectively, and will be conducted in the Tutorial session during Weeks 4, 8, 11 respectively.

Assessment information

There will be 3 in-class (closed-book, in-person) tests over the session (approx. week 4, 8 and 11), with total weightage of 40%. The split across the tests will be 10%, 20% and 10%, respectively.

Assignment submission Turnitin type

Not Applicable

Laboratory Report x2

Assessment Overview

In a group, students will undertake the two labs worth 5% each: ST2 (Shear Center) and ST3 (Bending and Torsion). Feedback will be provided via Moodle. All group members will receive the same grade.

Course Learning Outcomes

- CLO4 : On successful completion of this course, the student will be able to apply the theoretical knowledge gained in class to experimentally evaluate and analyse deformations due to bending, torsion and shear of real beam-like structures.

Detailed Assessment Description

The objective of ST2 is to understand the concepts of shear centre and centre of twist. The shear centre for a thin-walled open sections will be determined experimentally.

The objective of ST3 is to develop an understanding of the stresses produced in a thin-walled cantilever beam due to bending and torsional loads. The stress distribution in a cantilever beam of thin rectangular cross-section under bending and torsional loads will be determined experimentally by strain measurement.

Both the labs are completed over one (3hr) afternoon lab session.

Laboratory Reports

Assessment Overview

Student will individually undertake the lab: ST1 (Strain Gauges), Feedback will be provided via Moodle.

Course Learning Outcomes

- CLO4 : On successful completion of this course, the student will be able to apply the theoretical knowledge gained in class to experimentally evaluate and analyse deformations due to bending, torsion and shear of real beam-like structures.

Detailed Assessment Description

The objective of this experiment is to familiarise students with the installation and use of electrical strain gauges. The gauges will be installed on a tip-loaded cantilever beam and the measured strains will then be used to determine the modulus of elasticity of the beam material.

Final Examination 3 hours

Assessment Overview

A closed book final exam covering all topics.

Course Learning Outcomes

- CLO1 : On successful completion of this course, the student will be able to analyse the bending stresses and deformations of determinate and indeterminate beams with symmetric and unsymmetric cross sections.
- CLO2 : On successful completion of this course, the student will be able to analyse the stresses and deformations caused by torsion in thin-walled beams with open and closed sections.
- CLO3 : On successful completion of this course, the student will be able to analyse the stresses and deformations caused by shear loading in thin-walled beams with open and closed sections.
- CLO4 : On successful completion of this course, the student will be able to apply the theoretical knowledge gained in class to experimentally evaluate and analyse deformations due to bending, torsion and shear of real beam-like structures.

Detailed Assessment Description

A closed-book, in-person, final exam covering all topics.

General Assessment Information

Class test 1 will be held in week 4 during tutorial hour (8 Aug); Feedback and grades will be given

to students by the census date (11 Aug).

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Marking criteria for quizzes and exam:
• Working (correct application of the concepts, formulation and manipulation of the equations etc.): 60% (+/-5%)
• Presentation (clarity of diagrams, axes systems, units etc): 10% (+/-5%)
• Correct numerical answers: 30% (+/-5%)
Note that above may be slightly varied for the individual assessments. For example, if a problem is of higher difficulty level in concept, then fewer marks may be assigned to obtaining correct answer; whereas if concepts are simple then slightly higher marks may be assigned to getting the correct answer.

Marking criteria for lab reports: The following criteria will be applied.
• Accurate graphs and tables – 20%
• Results/calculations – 30%
• Discussion and error analysis – 30%
• Conclusions – 20%

The feedback and outcomes for quizzes will be typically released within 2 weeks of the assessment. For the labs, these will be released after all batches have completed and submitted (close to the end of the semester).

Generative AI: The use of generative AI software such as ChatGPT is not permitted for the assessments in this course.

Late submission: Unless prior arrangement is made with the lecturer or a formal application for special consideration is submitted, a penalty of 5% of the total available mark for the assessment will apply for each day that a take-home assessment item (lab report) is late up to a maximum of 5 days (120 hours) after which an assessment can no longer be submitted and a grade of 0 will be applied.

Grading Basis

Standard

Requirements to pass course

A minimum of 50% overall is required to pass the course.

Course Schedule

Teaching Week/Module	Activity Type	Content
Week 1 : 15 July - 19 July	Lecture	Introduction / Review of solid mechanics
	Tutorial	
Week 2 : 22 July - 26 July	Lecture	Statically indeterminate beams
	Tutorial	
Week 3 : 29 July - 2 August	Lecture	Singularity functions
	Tutorial	
Week 4 : 5 August - 9 August	Lecture	Unsymmetric bending
	Tutorial	
	Assessment	In-class test
	Laboratory	ST1
Week 5 : 12 August - 16 August	Lecture	Unsymmetric bending
	Tutorial	
	Laboratory	ST1
Week 6 : 19 August - 23 August	Lecture	Torsion
	Tutorial	
	Laboratory	ST1
Week 7 : 9 September - 13 September	Lecture	Torsion
	Tutorial	
	Laboratory	ST1
Week 8 : 16 September - 20 September	Lecture	Shear
	Tutorial	
	Assessment	In-class test
	Laboratory	ST1, ST2, ST3
Week 9 : 23 September - 27 September	Lecture	Shear
	Tutorial	
	Laboratory	ST1, ST2, ST3
Week 10 : 30 September - 4 October	Lecture	Energy methods
	Tutorial	
	Laboratory	ST1, ST2, ST3
Week 11 : 7 October - 11 October	Lecture	Energy methods
	Tutorial	
	Assessment	In-class test
	Laboratory	ST1, ST2, ST3
Week 12 : 14 October - 18 October	Lecture	Intro to failure criteria (TBC)
	Tutorial	
Week 13 : 21 October - 25 October	Lecture	Revision/self-study
	Tutorial	

Attendance Requirements

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

General Schedule Information

Schedule updates due to compensation/military days:

Military Training Day: Fri 18 Aug: Compensation Day: Friday 16 August classes to be delivered on Tuesday 13 August. Tuesday 13 August lost.

Military Training Day: Wed 18 Sep - Wednesday lost

Military Training Day: Thu 10 Oct - Thursday lost

Military Training Day: Fri 11 Oct - Friday lost

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The lab reports will be due 2 weeks from the day the lab is conducted (mid-semester break excluded).

Course Resources

Prescribed Resources

Beer, F.P., DeWolf, J.T., Johnston, E.R. and Mazurek, D.F., Mechanics of Materials, 7th Edition (or newer) in SI Units, McGraw-Hill, 2015, ISBN: 9780073398235.

Recommended Resources

• Hibbeler, R.C., Mechanics of Materials, 8th Edition, Prentice Hall, 2010, ISBN: 9780136022305.
• Dowling, N.E., Mechanical Behaviour of Materials, 4th Edition or newer; Prentice Hall, 2012, ISBN: 9780131395060
• Vable, M., Mechanics of Materials, Oxford University Press, 2002, ISBN: 9780195133370
• Craig, R.R., Jr., Mechanics of Materials, John Wiley and Sons, 1999, ISBN: 9780471331766.
• Timoshenko, S.P. and Gere, J.M., Mechanics of Materials, Wadsworth International, 1985.
• Allen, D.H. and Haisler W.E., Introduction to Aerospace Structural Analysis, J.Wiley and Sons, 1985, ISBN: 9780471888390.
• Young W.C., Roark's Formulas For Stress and strain, McGraw-Hill

Course Notes and Laboratory Instruction Sheets will be provided through UNSW Canberra Moodle, which cover the material in good detail. The prescribed and recommended texts below could be used by the students to supplement the knowledge and delve deeper in certain topics.

Course Evaluation and Development

One of the key priorities in the 2025 Strategy for UNSW is a drive for academic excellence in education. One of the ways of determining how well UNSW is progressing towards this goal is by listening to our own students. Students will be asked to complete the myExperience survey towards the end of this course.

Students can also provide feedback during the semester via: direct contact with the lecturer, the "On-going Student Feedback" link in Moodle, Student-Staff Liaison Committee meetings in schools, informal feedback conducted by staff, and focus groups. Student opinions really do make a difference. Refer to the Moodle site for this course to see how the feedback from previous students has contributed to the course development.

Important note: Students are reminded that any feedback provided should be constructive and professional and that they are bound by the Student Code of Conduct Policy

https://www.gs.unsw.edu.au/policy/documents/studentcodepolicy.pdf

Staff Details

Position	Name	Email	Location	Phone	Availability	Equitable Learning Services Contact	Primary Contact
Convenor	Hemant Singh		B20 R103	+61 2 5114 520	By prior appointment during business hours.	Yes	Yes
Lecturer	John Young		B20, R134	+61 2 5114 520	By prior appointment during business hours.	No	No
	Hongxu Wang		B16, R227	+61 2 5114 5217	By prior appointment during business hours.	No	No
Demonstrator	Umesh Kaini					No	No
	Hari Dura					No	No