School of Engineering

MECH4410: Mechanics of Solids 2 and FEA

Singapore PSB

Trimester 2 - 2024 (Singapore)

COURSE OUTLINE

OVERVIEW

Course Description

This course follows on from Mechanics of Solids 1 to provide a more advanced treatment of solids mechanics and elasticity theory. This material is covered alongside a practical introduction to the Finite Element Method and instruction in a commercial software package. Comparisons between analytical and computational approaches will be drawn.

Academic Progress Requirements

Nil

Assumed Knowledge

MECH2430 Mechanics of Solids 1 MATH2310 Calculus of Science and Engineering

Contact Hours

Singapore PSB

Computer Lab
Face to Face On Campus
1 hour(s) per week(s) for 13 week(s) starting Week 1

Lecture
Face to Face On Campus
1 hour(s) per week(s) for 13 week(s) starting Week 1
2 x 1 hour lecture

Lecture
Face to Face On Campus
1 hour(s) per week(s) for 13 week(s) starting Week 1
2 x 1 hour lecture

Tutorial
Face to Face On Campus
2 hour(s) per week(s) for 13 week(s) starting Week 1

Unit Weighting

10

Workload

Students are required to spend on average 120-140 hours of effort (contact and non-contact) including assessments per 10 unit course.

CONTACTS

Course Coordinator

Singapore PSB
Associate Professor Yuen Yong
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Consultation: via email.

Teaching Staff

Other teaching staff will be advised on the course Canvas site.

School Office

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SYLLABUS

Course Content

1. 3D stress fields, transformation of stress and stress invariants.
2. 2D and 3D Mohr circle.
3. Torsion of thin-wall non-circular cross-sections.
4. Shear centres of beams.
5. Introduction to the finite element method including solving linear static problems with spring and bar-element systems.
6. Theoretical linear static behaviour of bar, beam and two-dimensional elements and predictions using the finite element method.
7. Natural frequency analysis using the finite element method
8. Introduction to a commercially available finite element package to solve linear static problems and determine natural frequencies of vibration.

Course Learning Outcomes

On successful completion of this course, students will be able to:

1. Demonstrate a sound understanding of the transformation of stress.

2. Apply analysis techniques to determine stress in thin-walled non-circular sections subject to torsion and to locate the shear centre in thin-walled beams.

3. Demonstrate an understanding of elasticity theory for beams and plates and the respective finite element approximation.

4. Demonstrate a sound understanding of the Finite Element Method as applied to linear static analysis and natural frequencies of vibration.

5. Successfully build finite element models using a commercially-available finite element software package, undertake linear static and natural frequency analyses and interpret the results.

Course Materials

Lecture Materials:

- Lecture material available on Canvas.

Recommended text:

- Cook, R. D. "Finite element modeling for Stress Analysis, Wiley, 1995.

ASSESSMENTS

This course has 5 assessments. Each assessment is described in more detail in the sections below.

	Assessment Name	Due Date	Involvement	Weighting	Learning Outcomes
1	Assignment 1	Week 5	Individual	15%	1, 3, 4
2	Assignment 2	Week 9	Individual	15%	3, 4, 5
3	Quiz 1	Week 7	Individual	15%	1, 2, 3, 4
4	Quiz 2	Week 12	Individual	15%	4, 5
5	Final Examination	Exam Period	Individual	40%	1, 2, 3, 4, 5

Late Submissions The mark for an assessment item submitted after the designated time on the due date, without an approved extension of time, will be reduced by 10% of the possible maximum mark for that assessment item for each day or part day that the assessment item is late. Note: this applies equally to week and weekend days.

Assessment 1 - Assignment 1

Assessment Type Written Assignment
Purpose Written assessments meet the course objectives of knowledge acquisition and demonstrated assimilation of data, upon reflection and analysis, to produce articulate and concise documents which convey evidence-based understanding of the concepts and topics.
Description Written assignment, answering specific questions.
Weighting 15%
Due Date Week 5
Submission Method Online
Assessment Criteria To be provided in Canvas.
Return Method In Class
Feedback Provided In Class
Opportunity to Reattempt Students WILL NOT be given the opportunity to reattempt this assessment.

Assessment 2 - Assignment 2

Assessment Type Written Assignment
Description Written assessments meet the course objectives of knowledge acquisition and demonstrated assimilation of data, upon reflection and analysis, to produce articulate and concise documents which convey evidence-based understanding of the concepts and topics.
Weighting 15%
Due Date Week 9
Submission Method Online
Assessment Criteria To be provided in Canvas.
Return Method Online
Feedback Provided In Class
Opportunity to Reattempt Students WILL NOT be given the opportunity to reattempt this assessment.

Assessment 3 - Quiz 1

Assessment Type Quiz
Purpose The purpose and benefit of the class quiz is to provide the students with feedback on student learning. These tests highlight areas of concern and may stimulate discussion with tutors and lecturers
Description Asking specific questions on coursework material.
Weighting 15%
Due Date Week 7
Submission Method In Class
Assessment Criteria To be provided in Canvas.
Return Method Online
Feedback Provided In Class
Opportunity to Reattempt Students WILL NOT be given the opportunity to reattempt this assessment.

Assessment 4 - Quiz 2

Assessment Type	Quiz
Purpose	The purpose and benefit of the class quiz is to provide the students with feedback on student learning. These tests highlight areas of concern and may stimulate discussion with tutors and lecturers.
Description	Build detailed finite element models and interpretation of the results.
Weighting	15%
Due Date	Week 12
Submission Method	Online
Assessment Criteria	To be provided in Canvas.
Return Method	Online
Feedback Provided	In Class
Opportunity to Reattempt	Students WILL NOT be given the opportunity to reattempt this assessment.

Assessment 5 - Final Examination

Assessment Type	Formal Examination
Purpose	The final formal examination is designed to test the individual student's knowledge of the course material and their ability to describe, analyse and hypothesise from this material.
Description	An exam asking specific questions on coursework material.
Weighting	40%
Due Date	Exam Period
Submission Method	Formal Exam
Assessment Criteria	Specified with the exam.
Return Method	Not returned
Feedback Provided	No Feedback Provided
Opportunity to Reattempt	Students WILL NOT be given the opportunity to reattempt this assessment.

ADDITIONAL INFORMATION

Grading Scheme

This course is graded as follows:

Range of Marks	Grade	Description
85-100	High Distinction (HD)	Outstanding standard indicating comprehensive knowledge and understanding of the relevant materials; demonstration of an outstanding level of academic achievement; mastery of skills*; and achievement of all assessment objectives.
75-84	Distinction (D)	Excellent standard indicating a very high level of knowledge and understanding of the relevant materials; demonstration of a very high level of academic ability; sound development of skills*; and achievement of all assessment objectives.
65-74	Credit (C)	Good standard indicating a high level of knowledge and understanding of the relevant materials; demonstration of a high level of academic achievement; reasonable development of skills*; and achievement of all learning outcomes.
50-64	Pass (P)	Satisfactory standard indicating an adequate knowledge and understanding of the relevant materials; demonstration of an adequate level of academic achievement; satisfactory development of skills*; and achievement of all learning outcomes.
0-49	Fail (FF)	Failure to satisfactorily achieve learning outcomes. If all compulsory course components are not completed the mark will be zero. A fail grade may also be awarded following disciplinary action.

*Skills are those identified for the purposes of assessment task(s).

Communication Methods	Communication methods used in this course include: - Canvas Course Site: Students will receive communications via the posting of content or announcements on the Canvas course site. - Email: Students will receive communications via their student email account.
Course Evaluation	Each year feedback is sought from students and other stakeholders about the courses offered in the University for the purposes of identifying areas of excellence and potential improvement.
Oral Interviews (Vivas)	As part of the evaluation process of any assessment item in this course an oral examination (viva) may be conducted. The purpose of the oral examination is to verify the authorship of the material submitted in response to the assessment task. The oral examination will be conducted in accordance with the principles set out in the Oral Examination (viva) Procedure. In cases where the oral examination reveals the assessment item may not be the student's own work the case will be dealt with under the Student Conduct Rule.
Academic Misconduct	All students are required to meet the academic integrity standards of the University. These standards reinforce the importance of integrity and honesty in an academic environment. Academic Integrity policies apply to all students of the University in all modes of study and in all locations. For the Student Academic Integrity Policy, refer to https://policies.newcastle.edu.au/document/view-current.php?id=35 .
Adverse Circumstances	The University acknowledges the right of students to seek consideration for the impact of allowable adverse circumstances that may affect their performance in assessment item(s). Applications for special consideration due to adverse circumstances will be made using the online Adverse Circumstances system where: 1. the assessment item is a major assessment item; or 2. the assessment item is a minor assessment item and the Course Co-ordinator has specified in the Course Outline that students may apply the online Adverse Circumstances system; 3. you are requesting a change of placement; or 4. the course has a compulsory attendance requirement. Before applying you must refer to the Adverse Circumstance Affecting Assessment Items Procedure available at: https://policies.newcastle.edu.au/document/view-current.php?id=236
Important Policy Information	The Help button in the Canvas Navigation menu contains helpful information for using the Learning Management System. Students should familiarise themselves with the policies and procedures at https://www.newcastle.edu.au/current-students/respect-at-uni/policies-and-procedures that support a safe and respectful environment at the University.

Graduate Profile Statements

This course builds students' capacity in the following University of Newcastle Bachelor of Engineering Graduate Profile Statements (based on 2011 Engineers Australia revised Stage 1 Competency Standards for Professional Engineers):

UON Att.	University of Newcastle Bachelor of Engineering Graduate Profile Statements/ Engineers Australia Stage 1 competency statements	Taught	Practised	Assessed	Skill Level (1-4)
	Professional Attributes				
11	3.1. Ethical conduct and professional accountability				
12	3.2. Effective oral and written communication in professional and lay domains.		X	X	4
13	3.3. Creative, innovative and pro-active demeanour.				
14	3.4. Professional use and management of information.				
15	3.5. Orderly management of self, and professional conduct.		X	X	4
16	3.6. Effective team membership and team leadership.				
	Engineering Ability				
7	2.1. Application of established engineering methods to complex engineering problem solving.	X	X	X	4
8	2.2. Fluent application of engineering techniques, tools and resources.	X	X	X	4
9	2.3. Application of systematic engineering synthesis and design processes.		X	X	4
10	2.4. Application of systematic approaches to the conduct and management of engineering projects.				
	Knowledge Base				
1	1.1. Comprehensive, theory based understanding of the underpinning natural and physical sciences and the engineering fundamentals applicable to the engineering discipline.	X	X	X	4
2	1.2. Conceptual understanding of the, mathematics, numerical analysis, statistics, and computer and information sciences which underpin the engineering discipline.	X	X	X	4
3	1.3. In-depth understanding of specialist bodies of knowledge within the engineering discipline.	X	X	X	4
4	1.4. Discernment of knowledge development and research directions within the engineering discipline.				
5	1.5. Knowledge of contextual factors impacting the engineering discipline.				
6	1.6. Understanding of the scope, principles, norms, accountabilities and bounds of contemporary engineering practice in the specific discipline.				

This course outline was approved by the Head of School on 5th April, 2024. No alteration of this course outline is permitted without Head of School approval. If a change is approved, students will be notified and an amended course outline will be provided in the same manner as the original.