UNSW Course Outline

MMAN4410 Finite Element Methods - 2024

Published on the 30 Aug 2024

General Course Information

Course Code : MMAN4410
Year : 2024
Term : Term 3
Teaching Period : T3
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

This course will train you to analyse real world structural mechanics problems using the finite element method. You will be introduced to the mathematical basis of finite element analysis, on which nearly all structural analysis software is built. You will learn how to apply commercially

available finite element software to solve real-world engineering problems. The course will cater to the specific challenges of engineers across different mechanical disciplines. Any student wishing to extend their structural analysis skills should take this course.

Course Aims

The primary aim of this course is to train you to solve complex engineering structural mechanics problems with finite element analysis. The course will provide deep insight into the operation of finite element analysis software by teaching you the underlying computational methods involved. You will be taught to execute a detailed finite element study including planning, modelling, meshing, solving, evaluating results and validating against real world data.

Course Learning Outcomes

Course Learning Outcomes
CLO1 : Apply fundamental finite element analysis techniques to solve simple engineering problems
CLO2 : Explain the underlying mathematics behind finite element analysis software solvers
CLO3 : Plan and execute appropriate finite element analyses to solve a range of solid mechanics and other engineering problems.
CLO4 : Perform a detailed finite element study to investigate a real world engineering problem

Course Learning Outcomes	Assessment Item
CLO1 : Apply fundamental finite element analysis techniques to solve simple engineering problems	• Online Quizzes • Group Assignment • Final Exam
CLO2 : Explain the underlying mathematics behind finite element analysis software solvers	• Online Quizzes
CLO3 : Plan and execute appropriate finite element analyses to solve a range of solid mechanics and other engineering problems.	• Major Project • Group Assignment
CLO4 : Perform a detailed finite element study to investigate a real world engineering problem	• Major Project • Final Exam • Group Assignment

Learning and Teaching Technologies

Moodle - Learning Management System | Microsoft Teams

Other Professional Outcomes

https://www.unsw.edu.au/engineering/student-life/student-resources/program-design

Additional Course Information

This course involves 4 hours per week (h/w) of face-to-face contact.

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 11 h/w on this course. The additional time should be spent in making sure that you understand the lecture material, completing the set assignments, further reading, and revising for any examinations.

Assessments

Assessment Structure

Assessment Item	Weight	Relevant Dates
Online Quizzes Assessment Format: Individual	15%	Start Date: Not Applicable Due Date: See "Additional Information"
Group Assignment Assessment Format: Group	15%	Start Date: Not Applicable Due Date: 04/10/2024 05:00 PM
Major Project Assessment Format: Individual	50%	Start Date: Not Applicable Due Date: See "Additional Information"
Final Exam Assessment Format: Individual	20%	Start Date: Not Applicable Due Date: Not Applicable

Assessment Details

Online Quizzes

Assessment Overview

Assessment length: 1.5 hours each

Class lecture material will be assessed through three online quizzes. Each quiz weighs 5%. Marking will be against specific criteria in a marking guide and formal feedback on your assessment task will be provided within one week of the relevant submission date.

Course Learning Outcomes

- CLO1 : Apply fundamental finite element analysis techniques to solve simple engineering

problems
- CLO2 : Explain the underlying mathematics behind finite element analysis software solvers

Detailed Assessment Description

This is an individual assessment.

See material provided on Moodle and/or Teams, including marking criteria.

No late submission allowed.

Assessment Length

Each quiz will require approximately 1.5 hours of time commitment (exact timing will be communicated for each quiz)

Submission notes

Moodle Quiz

Assessment information

The dates for these quizzes are as follows:
Quiz 1 - Friday Week 02 (20 September 2024)
Quiz 2 - Friday Week 05 (11 October 2024)
Quiz 3 - Friday Week 07 (25 October 2024)
You will only have one attempt at each quiz. You can start the attempt online any time between 9am and 5pm. Once you start, you will have a limited time to finish the quiz (exact time allowed will be communicated for each quiz). Quizzes require the use of ANSYS.

No late submission allowed.

Marks will be returned within one week from submission.

Assignment submission Turnitin type

Not Applicable

Generative AI Permission Level

No Assistance

This assessment is designed for you to complete without the use of any generative AI. You are not permitted to use any generative AI tools, software or service to search for or generate information or answers.
For more information on Generative AI and permitted use please see here.

Group Assignment

Assessment Overview

Assessment length: 20 pages max.

You will work in a group of students to design and analyse a practical engineering system. A report based on this activity will be required. In the flexibility week, you will have the opportunity (optional) to 3D print and test your design. Feedback given on this report is intended to assist you in understanding the expectations of the Major Project draft and final reports. Detailed submission guidelines and marking rubrics will be provided.

As in the professional practice of engineering, you will not choose the team that you work with; however, you may assign the different elements of the task among team members as you see fit. A group 'peer assessment' tool will be used to measure team member contribution and marks adjusted accordingly.

Marking will be against specific criteria in a marking guide and formal feedback on your assessment task will be provided within two weeks of the relevant submission date.

Course Learning Outcomes

- CLO1 : Apply fundamental finite element analysis techniques to solve simple engineering problems
- CLO3 : Plan and execute appropriate finite element analyses to solve a range of solid mechanics and other engineering problems.
- CLO4 : Perform a detailed finite element study to investigate a real world engineering problem

Detailed Assessment Description

See material provided on Moodle and/or Teams, including marking criteria.

This is a group assignment. Each group will be composed of about 3-6 students.

Standard late-penalty rules apply, including deadline for absolute fail.

Assessment Length

20 pages max

Submission notes

See material provided on Moodle and/or Teams

Assessment information

See material provided on Moodle and/or Teams.

Assignment submission Turnitin type

This is not a Turnitin assignment

Generative AI Permission Level

No Assistance

This assessment is designed for you to complete without the use of any generative AI. You are not permitted to use any generative AI tools, software or service to search for or generate information or answers.
For more information on Generative AI and permitted use please see here.

Major Project

Assessment Overview

Assessment length: Final Report: 30 pages

You will complete a flexible major project which will form the largest component of the assessment for the course. The assessment will be broken into pieces to ensure that adequate progress is being made throughout the term:

- Mentor/topic selection – 0%
  - Each mentor will supervise one (or a few) projects related to their expertise
- Project proposal – 0%
  - A detailed summary of what you plan to do to address the topic problem
- Portfolio – 10%
  - A portfolio of work completed towards your project.
  - In addition to the project work, it can (and should) include class examples that have helped you to define your project
- Peer Evaluation and Reflection – 10%
  - Review the work of others conducting different analyses. Provide constructive feedback and review your own work critically.
- Final Report – 30%
  - The final report of your work
  - Detailed submission guidelines and marking rubrics will be provided.

Marking of each component will be against specific criteria in a marking guide and formal feedback on your assessment task will be provided within two weeks of the relevant submission dates.

Course Learning Outcomes

- CLO3 : Plan and execute appropriate finite element analyses to solve a range of solid mechanics and other engineering problems.
- CLO4 : Perform a detailed finite element study to investigate a real world engineering problem

Detailed Assessment Description

This is an individual assessment.

See material provided on Moodle and/or Teams, including marking criteria.

Standard late-penalty rules apply, including deadline for absolute fail.

Assessment Length

Proposal: max 2 pages, Progress Report: max 20 pages, Final Report: max 30 pages

Submission notes

See material provided on Moodle and/or Teams

Assessment information

Due dates for each components as follows:

- Mentor/topic selection – 5pm, Monday Week 03 (23 September 2024)
- Project proposal – 5pm, Friday Week 03 (27 September 2024)
- Portfolio – 5pm, Friday Week 08 (1 November 2024, No late submission allowed for this assessment item)
- Peer Evaluation and Reflection – 5pm, Thursday Week 09 (7 November 2024)
- Final Report – 5pm, Friday Week 10 (15 November 2024)

Standard late-penalty rules apply, including deadline for absolute fail.

The 50% weight of this assessment item is divided as follows:

- Portfolio (Progress Report) 10%
- Peer Evaluation and Reflection 10%
- Final Report 30%

Students are also required to demonstrate their familiarity with their model to a member of the teaching team during one of the demonstration classes after week 6. Details will be communicated at the release of the Major Project assignment.

Assignment submission Turnitin type

This assignment is submitted through Turnitin and students can see Turnitin similarity reports.

Generative AI Permission Level

No Assistance

This assessment is designed for you to complete without the use of any generative AI. You are not permitted to use any generative AI tools, software or service to search for or generate information or answers.
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Final Exam

Assessment Overview

Assessment length: 2 hours
Due date: Exam period

A practical and theoretical final exam to assess individual competence using finite element analysis to solve simple engineering problems

Course Learning Outcomes

- CLO1 : Apply fundamental finite element analysis techniques to solve simple engineering problems
- CLO4 : Perform a detailed finite element study to investigate a real world engineering problem

Detailed Assessment Description

This is an individual assessment.

Assessment Length

2 hours

Assignment submission Turnitin type

Not Applicable

Generative AI Permission Level

No Assistance

This assessment is designed for you to complete without the use of any generative AI. You are not permitted to use any generative AI tools, software or service to search for or generate information or answers.
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General Assessment Information

Grading Basis

Standard

Requirements to pass course

Achieve a total mark of 50 out of 100.

Course Schedule

Teaching Week/Module	Activity Type	Content
Week 0 : 2 September - 8 September	Online Activity	Read the course outline; Login and access the course Teams and Moodle pages
Week 1 : 9 September - 15 September	Lecture	Introduction to FEM and its mathematics
	Laboratory	ANSYS computer lab Week 1
Week 2 : 16 September - 22 September	Lecture	The finite element library - Choosing elements and discretisation (mesh)
	Laboratory	ANSYS computer lab Week 2
Week 3 : 23 September - 29 September	Lecture	FEA best practices
	Laboratory	ANSYS computer lab Week 3
Week 4 : 30 September - 6 October	Lecture	Nonlinear and buckling FEM analysis
	Laboratory	ANSYS computer lab Week 4
Week 5 : 7 October - 13 October	Online Activity	Students to complete online tasks as communicated through Teams
Week 6 : 14 October - 20 October	Fieldwork	3D printing and testing of your design for the group assignment. This is an optional activity.
Week 7 : 21 October - 27 October	Lecture	Vibration analysis with FEM
	Laboratory	ANSYS computer lab Week 7
Week 8 : 28 October - 3 November	Lecture	Composite analysis with FEM
	Laboratory	ANSYS computer lab Week 8
Week 9 : 4 November - 10 November	Lecture	Advanced topic or Industry guest-lecture
	Laboratory	ANSYS computer lab 9
Week 10 : 11 November - 17 November	Lecture	Final Exam Preparation
	Laboratory	ANSYS computer lab 10

Attendance Requirements

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

General Schedule Information

The course is organised schedule mostly consistsof formal weekly classes (lectures + computer labs)

In addition, in O-week students are expected to read the course outline, and login and access the course Teams and Moodle pages.

An optional fieldwork will be organised in week 6, where students will be given the opportunity

to 3D print and test of their group assignment design.

Please note that there is no class on week 5 (Monday and Tuesday 7-8 October 2024) due to a public holiday on Monday which prevents the lecture and one of the demonstration classes.

Course Resources

Prescribed Resources

Microsoft Teams

Microsoft Teams will be used for most communication in this course. It has native apps for Windows, Android, iOS and more.

myAccess and ANSYS

UNSW myAccess provides access to your engineering software from many different devices. We will use ANSYS extensively. It is available in the computer labs where computer lab classes are held.

Learning Management System

The Moodle LMS, https://moodle.telt.unsw.edu.au/ will also be used for this course

Recommended Resources

UNSW Library

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

Suggested textbooks

- Madier, D. (2022) Practical Finite Element Analysis for Mechanical Engineers, FEA Academy. An electronic version of this book available at https://www.fea-academy.com/index.php/book-store.
- Chandrupatla, T. R., Belegundu, A. D. (2011) Introduction to Finite Elements in Engineering, 4th Ed, Prentice Hall (Pearson)
- Cook, R. D., Malkus, D. S., Plesha, M. E., Witt, R. J. (2002). Concepts and Applications of Finite Element Analysis, 4th Ed, John Wiley & Sons.

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.

Staff Details

Position	Name	Email	Location	Phone	Availability	Equitable Learning Services Contact	Primary Contact
Convenor	Pietro Borghesani		Ainsworth (J17) 408H	contact via Teams	Usual working hours	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

If you believe that there has been a marking error, you can request a review of results. Review of results cannot be used to get feedback.

If you would like feedback for assessments, you are welcome to contact the course convenor directly.

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.

Final Exam in Exam Period

For courses with a centrally timetabled final exam, students must be available for the entire exam period from Mon-Sat until your exact exam date is confirmed.

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