UNSW Course Outline

CVEN9820 Computational Structural Mechanics - 2024

Published on the 29 Jan 2024

General Course Information

Course Code : CVEN9820
Year : 2024
Term : Term 1
Teaching Period : T1
Is a multi-term course? : No
Faculty : Faculty of Engineering
Academic Unit : School of Civil and Environmental 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

Introduction to finite elements using seepage analysis. Basis of finite elements: elasticity, variational theorems, constraint equations. Beam elements and frame analysis. Stress analysis using linear elements. Finite element modelling considerations. Isoparametric elements.

Course Aims

This course focuses on the practical aspects of applying the finite element method to structural analysis. The students will acquire appropriate and efficient finite element modelling techniques to produce a reasonably reliable predication of the response of a "real life" engineering problem and to identify and, if possible, estimate the error introduced by the modelling process. Selected underlying fundamental theory of the finite element method is provided to enable students to appreciate the advantages, limitations and possible pitfalls of the numerical methods as applied to engineering problems. Hands-on computer exercises will enable students to perform finite element analysis of structures using commercial software.

Course Learning Outcomes

Course Learning Outcomes
CLO1 : Define problems in mathematical terms that can be numerically modelled.
CLO2 : Explain the fundamental theory of the finite element method.
CLO3 : Create finite element models.
CLO4 : Write simple computer programs in MATLAB and use commercial numerical simulation software to perform finite element analysis; and interpret results for design purposes.
CLO5 : Evaluate the reliability and the accuracy of results.
CLO6 : Communicate analyses in written and graphical form.

Course Learning Outcomes	Assessment Item
CLO1 : Define problems in mathematical terms that can be numerically modelled.	• Quiz 1 • Quiz 2 • Assignment • Final Examination
CLO2 : Explain the fundamental theory of the finite element method.	• Quiz 1 • Quiz 2 • Assignment • Final Examination
CLO3 : Create finite element models.	• Quiz 1 • Quiz 2 • Assignment • Final Examination
CLO4 : Write simple computer programs in MATLAB and use commercial numerical simulation software to perform finite element analysis; and interpret results for design purposes.	• Assignment • Final Examination
CLO5 : Evaluate the reliability and the accuracy of results.	• Quiz 2 • Assignment • Final Examination
CLO6 : Communicate analyses in written and graphical form.	• Assignment • Final Examination

Learning and Teaching Technologies

Moodle - Learning Management System | Echo 360

Additional Course Information

You will study modern numerical methods and their applications to structures and other civil engineering problems by the use of commercial finite element software. The acquired knowledge

is applicable to the analysis and design of many types of civil engineering constructions such as buildings, foundations, dams, etc. You are expected to be familiar with the theories and concepts introduced in the previous structural engineering courses. This course lays the foundation for in-depth study on the numerical simulation, which is a rapidly evolving and multi-disciplinary field. The material covered in this course is essential in modern structural analysis and design.

Assessments

Assessment Structure

Assessment Item	Weight	Relevant Dates
Quiz 1 Assessment Format: Individual	15%	Start Date: 06/03/2024 04:50 PM Due Date: 06/03/2024 06:00 PM
Quiz 2 Assessment Format: Individual	15%	Start Date: 10/04/2024 04:45 PM Due Date: 10/04/2024 06:00 PM
Assignment Assessment Format: Individual	20%	Start Date: 12/03/2024 04:00 PM Due Date: 19/04/2024 05:00 PM Post Date: 19/04/2024 05:00 PM
Final Examination Assessment Format: Individual	50%	Start Date: Final Examination Period

Assessment Details

Quiz 1

Assessment Overview

Quiz covering the contents of Weeks 1-3

Course Learning Outcomes

- CLO1 : Define problems in mathematical terms that can be numerically modelled.
- CLO2 : Explain the fundamental theory of the finite element method.
- CLO3 : Create finite element models.

Detailed Assessment Description

- CLOSED BOOK
- One single-sided A4 sheet with minimum font size of 12pt is allowed and must be handled in together with the quiz paper
- UNSW approved electronic calculator allowed

Assessment Length

50min

Quiz 2

Assessment Overview

Quiz covering the contents of Weeks 4-8

Course Learning Outcomes

- CLO1 : Define problems in mathematical terms that can be numerically modelled.
- CLO2 : Explain the fundamental theory of the finite element method.
- CLO3 : Create finite element models.
- CLO5 : Evaluate the reliability and the accuracy of results.

Detailed Assessment Description

- CLOSED BOOK
- One single-sided A4 sheet with minimum font size of 12pt is allowed and must be handled in together with the quiz paper
- UNSW approved electronic calculator allowed

Assessment Length

50min

Assignment

Assessment Overview

Assignment on finite element programming and on use of commercial finite element packages.

Course Learning Outcomes

- CLO1 : Define problems in mathematical terms that can be numerically modelled.
- CLO2 : Explain the fundamental theory of the finite element method.
- CLO3 : Create finite element models.
- CLO4 : Write simple computer programs in MATLAB and use commercial numerical simulation software to perform finite element analysis; and interpret results for design purposes.
- CLO5 : Evaluate the reliability and the accuracy of results.
- CLO6 : Communicate analyses in written and graphical form.

Detailed Assessment Description

Please refer to the Assignment section on the Moodle page of the course: https://moodle.telt.unsw.edu.au/course/view.php?id=81730

Submission notes

It is your responsibility to ensure that your assignment is properly submitted before the deadline for grading. The status of submission should be “Submitted for grading”. Assignments uploaded in draft form will NOT be graded.

Final Examination

Assessment Overview

The final exam may cover all content from the term.

Course Learning Outcomes

- CLO1 : Define problems in mathematical terms that can be numerically modelled.
- CLO2 : Explain the fundamental theory of the finite element method.
- CLO3 : Create finite element models.
- CLO4 : Write simple computer programs in MATLAB and use commercial numerical simulation software to perform finite element analysis; and interpret results for design purposes.
- CLO5 : Evaluate the reliability and the accuracy of results.
- CLO6 : Communicate analyses in written and graphical form.

Detailed Assessment Description

The final exam will be open-book and held during the final exam period.

Assessment Length

2 hours

Hurdle rules

A mark of at least 40% in the final examination is required before the class work is included in the final mark.

General Assessment Information

It is your responsibility to ensure that all the assessment materials are properly submitted, and that your submission is finalised for marking and recorded accordingly in the system.

Assessment criteria

The following criteria will be applied in grading of the quizzes, assignment and final exam, when appropriate:

- Correct interpretation of and compliance with assessment requirements
- Demonstration of understanding of subject matters and problem solving ability
- Clear and logic steps in problem solving
- Correctness of final and other numerical answers
- Appropriate use of engineering drawings, diagrams and figures
- Clarity of presentation
- Correct referencing and using of source materials
- Completeness of reports and solutions

- Neatness of assignment submissions

The Distance class is exclusively available to PG students who are onshore and reside more than 100km away from the UNSW Kensington campus.
Please refer to the External Exam Policy (https://intranet.civeng.unsw.edu.au/external-exam-policy) for your eligibility. Applications must be submitted by Week 4 as late submissions will NOT be accepted. If you do not meet the External Exam policy, please do not enrol in the distance class; you will need to attend in person.

Grading Basis

Standard

Course Schedule

Teaching Week/Module	Activity Type	Content
Week 1 : 12 February - 18 February	Lecture	Introduction. Mathematical modelling of diffusion: Laplace equation and boundary conditions. Finite- element method for 1D potential problem – shape functions and element stiffness matrix.
Week 2 : 19 February - 25 February	Lecture	Finite-element method for 1D potential problem (using seepage flow as example) – assembly of global stiffness matrix, boundary conditions and solutions. Finite element analysis of spring and bar systems.
	Workshop	As above
Week 3 : 26 February - 3 March	Lecture	Triangular elements. Assembly of global stiffness matrix, boundary conditions and solutions. Introduction to programming finite element analysis using MATLAB.
	Workshop	As above
Week 4 : 4 March - 10 March	Lecture	Theory of elasticity – Stress versus strain laws and boundary conditions. Energy methods: Spring and bar elements and beam elements.
	Workshop	As above
	Assessment	Quiz 1
Week 5 : 11 March - 17 March	Lecture	Introduction to a commercial finite-element program ANSYS: frame analysis. Constant strain triangular elements.
	Workshop	As above
	Assessment	Assignment set
	Laboratory	Computer Lab session on programming finite element analysis using MATLAB and frame analysis.
Week 6 : 18 March - 24 March	Lecture	Flexibility week for all courses (non-teaching)
Week 7 : 25 March - 31 March	Lecture	Modelling issues in finite element method. Programming finite element stress analysis using MATLAB.
	Workshop	As above
Week 8 : 1 April - 7 April	Lecture	Element quality for stress analysis and shear locking and volumetric locking. Rectangular elements.
	Workshop	As above
	Laboratory	Computer lab session on commercial finite- element package ANSYS.
Week 9 : 8 April - 14 April	Lecture	Isoparametric representation and isoparametric quadrilateral elements.
	Workshop	As above
	Assessment	Quiz 2
Week 10 : 15 April - 21 April	Lecture	Isoparametric representation and isoparametric quadrilateral elements (continued).
	Workshop	As above
	Assessment	Assignment due

Attendance Requirements

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

Undergraduate students must attend at least 80% of the workshop/lab in which they are enrolled for the duration of the session.

Course Resources

Recommended Resources

RECOMMENDED READINGS

- Logan, D. L. (2011), “A First Course in the Finite Element Method”, Brooks/Cole, 5th edition.Print:https://www.bookshop.unsw.edu.au/details.cgi?ITEMNO=9780357676431 Digital:https://unswbookshop.vitalsource.com/products/-v9780357676646
- Moaveni,S. (2014) "Finite Element Analysis Theory and Application with ANSYS" Prentice Hall, 4th edition. Print: https://www.bookshop.unsw.edu.au/details.cgi?ITEMNO=9780273774303 Digital: https://unswbookshop.vitalsource.com/products/-v9780273774334
- Cook, R. D., et. al, (2002), “Concepts and Applications of Finite Element Analysis”, Wiley, 4th edition. Print: https://www.bookshop.unsw.edu.au/details.cgi?ITEMNO=9780471356059

ADDITIONAL READINGS

- Felippa, Carlos, “Intro. to Finite Element Methods (ASEN 5007) Course Material.” http://caswww.colorado.edu/courses.d/IFEM.d/Home.html
- Zienkiewicz, O.C. and Taylor, R.L. (2000), “The Finite Element Method”, Volumes 1&2, 5th edition, Butterworth-Heinemann.
- Bathe, K. J. (1996), “Finite Element Procedures”, Prentice Hall.

A vast amount of various learning resources on the finite element method are available online. You are encouraged to explore and find resources suitable to your needs and learning style. Online manuals, engineering methodology books (Kranh J. 2004, “Stress and Deformation Modeling with SIGMA/W: An Engineering Methodology”, Geo-Slope International Ltd, available as PDF file) and additional workshop examples of ANSYS can be viewed and printed directly from the software.

Staff Details

Position	Name	Email	Location	Phone	Availability	Equitable Learning Services Contact	Primary Contact
Convenor	Chongmin Song		CE717B	55021	Tuesday 10AM-12PM; Wednesday 10AM-12PM	Yes	Yes
Lecturer	Chongmin Song		CE717B	55021	Tuesday 10AM-12PM; Wednesday 10AM-12PM	Yes	No

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

Final Examinations

Final Exams in T1 2024 will be held on campus between the 26th April and 9th May, and Supplementary Exams between the 20th - 24th May 2024. You are required to be available on these dates. Please do not to make any personal or travel arrangements during this period.

School Contact Information

For assistance with enrolment, class registration, progression checks and other administrative matters, please see the Nucleus: Student Hub. They are located inside the Library – first right as you enter the main library entrance. You can also contact them via http://unsw.to/webforms or reserve a place in the face-to-face queue using the UniVerse app.

For course administration matters, please contact the Course Coordinator.

Questions about the this course should normally be asked during the scheduled class so that everyone can benefit from the answer and discussion.