

COURSE DETAILS

Units of Credit	6
Contact hours	CVEN9820: 4 hours per week
Class	Thursday 9:00 - 11:00, RC Theatre
Demonstration	Thursday 11:00 - 13:00
Course Coordinator and Lecturer	Professor Chongmin Song email: c.song@unsw.edu.au office: CE712 phone: (02) 9385 5021

INFORMATION ABOUT THE COURSE

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.

The flow chart in Figure 1 shows diagrammatically how this course relates to other courses in the Civil Engineering program.

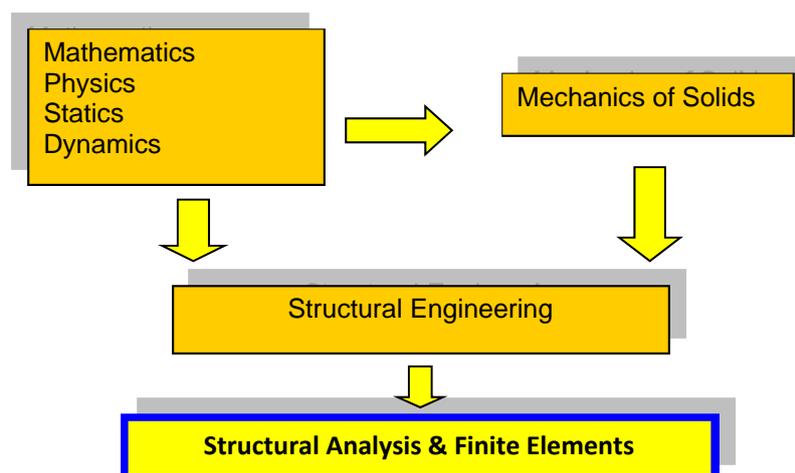


Figure 1. How this course relates to other courses in Civil Engineering.

HANDBOOK DESCRIPTION

Application of finite elements to structural problems. Topics will be selected from 2D membrane elements and their application to shear walls and panels subject to in-plane loading; plate elements and their application to floor slabs and panels subject to out-of-plane loading; buckling analysis using finite elements; output checking.

See link to virtual handbook:

<http://www.handbook.unsw.edu.au/postgraduate/courses/2016/CVEN9820.html>

OBJECTIVES

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 prediction of the response of a "real life" engineering problem and, if possible, to identify and 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 when applied to engineering problems. Students' understanding of fundamental theory will be enhanced by writing simple computer programs in MATLAB. Hands-on exercise at computers will enable students to perform finite element analysis of structures by using commercial software.

This course will also provide you with opportunities to develop the following generic **graduate attributes**:

- Capacity for analytical and critical thinking and for creative problem solving
- Ability to engage independent and reflective learning
- Information literacy
- Skills for collaborative and multi-disciplinary work
- Skills for effective communication

TEACHING STRATEGIES

This subject consists of a mixture of lectures, exercise classes and hands-on computer sessions. Both teaching and exercises concentrate on the use of advanced methods in civil engineering.

Lectures will introduce you to the basic theories on which the computer simulation techniques are based and the computer software used to accomplish your assignment. The emphasis will be placed on the application of the theories to formulate guidelines in the analysis of practical engineering problems.

The exercise classes provide you with the opportunity to discuss the lecture material with your demonstrators and to solve the set problems. In order to understand the subject matter well, it is essential to attend the exercise classes and solve the problems by yourself.

For each hour of contact it is expected that a student will put in at least 1.5 hours of private study. You are recommended to review the course materials weekly.

The teaching/learning activities are summarized in the following table:

Lectures	<ul style="list-style-type: none">• Cover material to be learned for assessment tasks• Follow worked examples• Hear announcements on course changes
Exercise classes	<ul style="list-style-type: none">• Practice solving set problems• Be guided by demonstrators• Ask questions
Computer Sessions	<ul style="list-style-type: none">• Hand on exercises using commercial finite element software• Familiarise with pre- and post-processors• Reflect and discuss on practical issues in numerical simulation
Private Study	<ul style="list-style-type: none">• Review lecture material and textbook• Preparation for the exercise classes and do set problems• Reflect on class problems• Study relevant references
Assessments (assignments, examinations)	<ul style="list-style-type: none">• Demonstrate your knowledge and skills• Demonstrate higher understanding and problem solving

SUGGESTED APPROACHES TO LEARNING IN THE COURSE

Suggested approaches to learning in this course include:

- Regular participation in lectures and exercise classes. *Review course material. Follow worked examples. Reflect on class problems and quizzes.*

- Weekly reading and recording of your learning.
- Appropriate preparation for exercise classes.
- Planning your time to achieve all assessment requirements (see assessment).
- We encourage you to work with your peers. A good way to learn the material is in small study groups. Such groups work best if members have attempted the problems individually before meeting as a group. A valued and honest collaboration occurs when, for example, you “get stuck” early on in attacking an exercise and go to your classmate with a relevant question. Your classmate has the opportunity to learn from your question as well as help you. You then bring something to the collaboration.
- Students who perform poorly in the assessment tasks are strongly encouraged to discuss their progress with the lecturer during the semester. Please do not suffer in silence – seek the help at an early stage! We would like you to make most of this learning process and receive a high grade in the course.

EXPECTED LEARNING OUTCOMES

This subject is intended to present numerical methods and modelling techniques that are sound and commonly used in engineering practice. The theory necessary for the application of the numerical simulation techniques is presented. After completing this course, you are expected to be able to:

- Define problems (mathematical models) on which numerical modelling is based.
- Create finite element models.
- Understand the fundamental theory of the finite element method.
- Write simple computer programs in MATLAB for finite element analysis.
- Calculate and interpret results necessary for design purpose.
- Evaluate the reliability and the accuracy of results.
- Use commercial software for finite element analysis.
- Communicate your analysis in written and graphical form.

ASSESSMENT

The final grade for this course will normally be based on the sum of the scores from each of the assessment tasks. The assessment breakdown and dates are as follows:

1.	Assignment 1	set: Week 4	due: 4:00pm, Friday, Week 7	value: 5%
2.	Assignment 2	set: Week 8	due: 4:00pm, Friday, Week 10	value: 5%
3.	Assignment 3	set: Week 10	due: 4:00pm, Friday, Week 13	value: 12%
4.	Quiz 1		held: Week 4, close book	value: 14%
5.	Quiz 2		held: Week 11, close book	value: 14%
6.	Exam		held: Final exam period, open book	value: 50%
				Total 100%

An average mark of at least 40% in the examination components (quizzes and final examination) is required before the marks for the assignments are included in the final mark.

Please note that late work will be penalised at the rate of 10% per day after the due time and date have expired.

Students who perform poorly in the quizzes are recommended to discuss progress with the lecturer during the semester.

The computer software packages required to complete the hand-in and assignment are installed on the PCs in Computer Labs CE201 and CE611.

Please keep a copy of all your submissions in case that they are misplaced.

When an assignment is to be submitted on Moodle, it is your responsibility to ensure that all the electronic files are submitted (you may zip multiple files into one) and your submission is recorded in the system.

ATTENDANCE

The minimum attendance requirement is 80% of all classes, including lectures, exercise classes and computer sessions. You may fail the course if more than 20% absences are recorded.

COURSE PROGRAM

SEMESTER 1, 2016

Week	Date	Topic	Assessments
1	3 March	Introduction to computer simulation techniques and numerical methods; Mathematical modelling of diffusion: Laplace equation and boundary conditions.	
2	10 March	Introduction to finite element method. Finite-element method for 1D potential problem (using seepage flow as example) – shape functions, element stiffness matrix.	
3	17 March	Triangular elements. Assemblage of global stiffness matrix, boundary conditions, solutions.	
4	24 March	Introduction to programming finite element analysis using MATLAB.	Assignment 1 set. Quiz 1
Break			
5	7 April	No class	
6	14 April	Theory of elasticity – Stress versus strain laws, Boundary conditions. Energy methods	
Break			
7	21 April	Energy methods, Bar element, Plane beam element.	Assignment 1 due
8	28 April	Energy methods, Bar element, Plane beam element. Introduction to a commercial finite-element program ANSYS: frame analysis. Computer session on frame analysis (Computer Lab CE201 & CE611).	Assignment 2 set
9	5 May	Constant strain triangular elements	
10	13 May	Programming finite element stress analysis using MATLAB. Modelling issues in finite element method. Computer session on commercial finite-element package ANSYS (Computer Lab CE201 & CE611).	Assignment 2 due Assignment 3 set
11	19 May	Element quality for stress analysis, shear locking and volumetric locking. Rectangular elements.	Quiz 2
12	26 May	Isoparametric representation & isoparametric quadrilateral elements.	
13	2 June	Isoparametric representation & isoparametric quadrilateral elements.	Assignment 3 due

RELEVANT RESOURCES

COURSE MATERIALS

The course materials consist of

- Lecture notes provided on selected topics,
- Kranh J. (2004), "Stress and Deformation Modeling with SIGMA/W: An Engineering Methodology", Geo-Slope International Ltd (available as PDF file).
- Tutorial examples of SIGMA/W and ANSYS.

Online manuals, engineering methodology books (Kranh J. 2004) and additional tutorial examples of SIGMA/W and ANSYS can be viewed and printed directly from the software.

ADDITIONAL READINGS

- Moaveni, S. (2007) "Finite Element Analysis Theory and Application with ANSYS" Prentice Hall, 3rd edition.
- Logan, D. L. (2011), "A First Course in the Finite Element Method", Brooks/Cole, 5th edition
- Cook, R. D., *et. al*, (2002), "Concepts and Applications of Finite Element Analysis", Wiley, 4th edition.
- 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.

DATES TO NOTE

Refer to MyUNSW for Important Dates available at:

<https://my.unsw.edu.au/student/resources/KeyDates.html>

PLAGIARISM

Beware! An assignment that includes plagiarised material will receive a 0% Fail, and students who plagiarise may fail the course. Students who plagiarise are also liable to disciplinary action, including exclusion from enrolment.

Plagiarism is the use of another person's work or ideas as if they were your own. When it is necessary or desirable to use other people's material you should adequately acknowledge whose words or ideas they are and where you found them (giving the complete reference details, including page number(s)). The Learning Centre provides further information on what constitutes Plagiarism at:

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

ACADEMIC ADVICE

For information about:

- Notes on assessments and plagiarism,
- School policy on Supplementary exams,
- Special Considerations,
- Solutions to Problems,
- Year Managers and Grievance Officer of Teaching and Learning Committee, and
- CEVSOC.

Refer to Academic Advice on the School website available at:

<http://www.engineering.unsw.edu.au/civil-engineering/resources/academic-advice>