School of Civil and Environmental Engineering

Trimester 2, 2021

CVEN2002 ENGINEERING COMPUTATIONS FOR CIVIL/ENV ENGINEERS

COURSE DETAILS

Units of Credit	6	
Contact hours	6 hours per week	
Lecture Classes	Monday 09:00 – 11:00 Numerics Wednesday 14:00 –16:00 Statistics	online online
Workshops	1-hour Numerics 1-hour Statistics	For details, see your enrolment timetable.
Course Coordinators and Lecturers	Dr Elena Atroshchenko email: e.atroshchenko@unsw.edu.au Office: H20-607 (Numerics) Dr. Zdravko Botev email: botev@unsw.edu.au Office: Red Centre Room 1034 (Statistics)	

INFORMATION ABOUT THE COURSE

This course teaches undergraduate civil and environmental engineering students about numerical methods in a Civil and Environmental Engineering context with industry examples. The School of Mathematics and Statistics teaches half the course and covers topics in statistical analysis.

The aims of the course are to enable students to apply the fundamentals of Numerical Methods and Statistics to Engineering problems in the fields of Civil and Environmental Engineering and Survey Engineering. This course is a core course for undergraduate students in Civil Engineering, Environmental Engineering, Surveying, and Geospatial Engineering degrees. Pre-requisites: MATH1231 or MATH1241.

HANDBOOK DESCRIPTION

An introduction to the application of advanced analytical, statistical and numerical techniques to the solution of engineering problems relevant to civil and environmental engineers and surveyors. Review of analytical techniques. Addressing issues of variability and uncertainty in engineering. Descriptive statistics. Foundations of Probability. Random variables. Special distributions (discrete and continuous). Normal distribution, sampling distributions. Confidence Intervals. Hypothesis testing. Inferences for proportions,

variances and means. Regression. ANOVA. Numerical solution of linear and non-linear equations; numerical differentiation and integration, finite differences; differential equations, boundary value problems, initial value problems and partial differential equations.

See link to the virtual handbook:
https://www.handbook.unsw.edu.au/undergraduate/courses/2021/CVEN2002

COURSE PROGRAM

Numerics Strand TERM 2, 2021

Date	Lecture Topic	Workshop / Lab
31 May Week 1	Introduction to Numerical Methods: Mathematical Modelling and Programming (Chapter 1 & 2) Approximations and Taylor Series (Chapter 3 & 4)	Workshop: Revision of matrix, vector operations, and derivatives
7 June Week 2	Bracketing Methods (Chapter 5) Open Methods (Chapter 6)	Computer Lab: Matlab basics
14 June Week 3	Roots of Equations (Chapter 8)	Workshop: Taylor series, solving roots of nonlinear equations using iterative methods
21 June Week 4	Gauss Elimination (Chapter 9) Matrix Inversion (Chapter 10)	Computer Lab: Root finding algorithms in Matlab
28 June Week 5	Numerical Integration (Chapter 21 & 22) Numerical Differentiation (Chapter 23 & 24)	Workshop: Matrix solutions of equations and iterative methods
5 July Week 6	No lecture	
12 July Week 7	Introduction to ordinary differential equations (ODE) (Chapter 25) Numerical solutions of ODEs: Part I (Chapter 25)	Computer Lab: Linear algebra in Matlab
19 July Week 8	Numerical solutions of ODEs: Part II (Chapter 26-27)	Workshop: Numerical integration, Numerical differentiation
26 July Week 9	Introduction to partial differential equations (PDE) (Chapter 29) Numerical solutions of PDEs: Part I (Chapter 29)	Computer Lab: Numerical integration in Matlab
2 August Week 10	Numerical solutions of PDEs: Part II (Chapter 30)	Workshop: ODEs and PDEs

Statistics Strand TERM 2, 2021

Date	Lecture Topic	Text Reference	Tutorial / Lab
2 June Week 1	Probability, Descriptive Statistics	1.1-2, 2.1-3, Pre-recorded Lectures on Maple TA/Mobius	Tute/Lab
9 June Week 2	Random variables	Chapter 1.3, 5.4 and 3.6, Pre-recorded Lectures on Maple TA/Mobius	Tute/Lab

16 June Week 3	Special random variables	1.4, 1.5, 1.6, 2.4, see Maple TA/Mobius	Tute/Lab
23 June Week 4	Sampling distributions and the Central Limit Theorem	5.5-6, Lectures on Maple TA/Mobius	Tute/Lab
30 June Week 5	Confidence intervals for means and proportions	7.1-4, see Maple TA/Mobius	Tute/Lab
7 July Week 6	Self Study (Stats component only)		No Tute/Lab
14 July Week 7	Hypothesis testing	8.1, 8.2, 8.5, see Maple TA/Mobius	Tute/Lab
21 July Week 8	Inference concerning differences in means	7.5, 8.2, see Maple TA/Mobius	Tute/Lab
28 July Week 9	Regression analysis	3.1, Chapter 11, Maple TA/Mobius	Tute/Lab
4 August Week 10	Analysis of variance	Chapter 9, see Maple TA/Mobius	Tute/Lab

Note the **statistics tutorial/lab will only go for one hour**.

OBJECTIVES

This course's objectives are to enable students to apply numerical and statistical methods in an Engineering context, and to build foundations for future courses in their UG degree programs.
Later sections of this document describe the linking of the objectives with the program outcome attributes and the assessment strategies for this course.

TEACHING STRATEGIES

We believe that effective learning is best supported by a climate of inquiry, in which students are actively engaged in the learning process. Hence this course is structured with a strong emphasis on problem-solving tasks in lectures, in workshops and laboratories, and in assessment tasks. Students are expected to devote the majority of their class and study time to the solving of such tasks.

New ideas and skills are first introduced and demonstrated in lectures, and then students develop these skills by applying them to specific tasks in workshops and assessments. Computing skills are developed and practiced in computer laboratory sessions.

This course has a major focus on research, inquiry and analytical thinking as well as information literacy. We will also explore capacity and motivation for intellectual development through the solution of both simple and complex mathematical models of problems arising in engineering, and the interpretation and communication of the results.

Table 4. Some suggested approaches to learning in the course:

Private Study	• Review lecture material and textbook • Do set problems and assignments • Join Moodle discussions of problems • Reflect on class problems and assignments • Download materials from Moodle • Keep up with notices and find out marks via Moodle
Lectures	• Find out what you must learn • See methods that are not in the textbook • Follow worked examples • Hear announcements on course changes
Workshops	• Be guided by Demonstrators

	• Practice solving set problems • Ask questions
Assessments	• Demonstrate your knowledge and skills • Demonstrate higher understanding and problem solving
Laboratory Work	• Hands-on work, to set studies in context

EXPECTED LEARNING OUTCOMES

This course is designed to address the learning outcomes below and the corresponding Engineers Australia Stage 1 Competency Standards for Professional Engineers as shown. The full list of Stage 1 Competency Standards may be found in Appendix A.

Table 5. After successfully completing this course, you should be able to:

Learning Outcome		**EA Stage 1 Competencies**
1.	Apply the fundamentals of Numerical Methods and Statistics to Engineering problems in the fields of Civil and Environmental Engineering and Surveying and Geospatial Engineering and have practice with the associated calculations.	*PE1.1, PE1.2, PE1.3, PE2.1*
2.	Numerical Methods strand: At the end of this course, students should be familiar with the basic numerical techniques used in Engineering and understand their potential applications in Surveying, Civil and Environmental Engineering.	*PE1.1, PE1.2, PE1.3, PE2.1*
3.	Statistics strand: At the end of this course, students will understand the various ways in which random variation arises in engineering contexts and to develop facility at: applying various graphical and data analysis methods for summarizing and understanding data; applying various statistical models and methods for drawing conclusions and making decisions under uncertainty in engineering contexts; and, applying Matlab for graphical and statistical analysis.	*PE1.1, PE1.2, PE1.3, PE2.1*
4.	Students should be familiar with Matlab environment and programming, or similar, and be able to conduct in their future studies assignments based on Matlab programming.	*PE1.2, PE2.1, PE2.2*

The assessment tasks will determine how well you have achieved these learning outcomes. For each hour of contact it is expected that you will have to spend at least 1.5 hours of private study.

ASSESSMENT

The overall rationale for assessment components and their association with course objectives is given in Table 6 below. Details of each assessment component, the marks assigned to it, the criteria by which marks will be assigned, and the dates of submission are also set out in Table 6 below.

The final grade for this course will normally be based on the sum of the scores from each of the assessment tasks. The Final Examination is worth 60% of the Final Mark. The formal exam scripts will not be returned but you are permitted to view the marked script. The final examination will be held in the UNSW exam period, will be 2 hours long, and will contain equal content and marks for the two components of the course: Numerical Methods and Statistics. Students will receive feedback in the usual way after exam marking.

Assessments will be conducted separately in Numerics and Statistics strands. There will be several tests and quizzes spread through the semester. These will be marked promptly, and students given their results via Moodle. All Statistics assessments (*i.e.* quizzes and mid-semester test, but not the final exam) will be administered via Maple TA/Mobius. Matlab will be available during these assessments and you are encouraged to use it! Marks will be made available on Maple TA/Mobius soon after test completion. Students who perform poorly in the tests, quizzes and workshops are recommended to discuss progress with the lecturer during the semester.

There will be a small amount of assessable computer lab work. This will be marked promptly, and students given their results via Moodle.

At least one assessment plus feedback will be completed before the census date of 27 June, 2021. There is no group work assessment in this course.

PENALTIES

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

ASSESSMENT OVERVIEW

Table 6.

Item	Length	Weight	Learning outcomes assessed	Assessment Criteria	Due date and submission requirements	Deadline for absolute fail	Marks returned
1. Final Exam	2 hours	60%	1, 2, 3 (see table 5)	Students are expected to demonstrate their ability to apply the methods taught in this course. Equal halves for numerics and statistics.	In formal exam period	See UNSW rules	As part of UNSW course results
2.Quizzes							
Numerics Online Quiz 1	40 mins	5%	1, 2 (see table 5)	Students are expected to demonstrate their ability to apply the methods taught in the numerics part of this course. Covers material from previous week's lectures. Full marks for correct numerical answers, reduced marks for partial solutions.	Wednesday 5 pm in week 5 (June 30)	NA	Within 1 week of quiz, via Moodle
Numerics Online Quiz 2	60 mins	10%	1, 2 (see table 5)	Students are expected to demonstrate their ability to apply the methods taught in the numerics part of this course. Covers material from previous week's lectures and since Quiz 1. Full marks for correct numerical answers, reduced marks for partial solutions.	Wednesday 5 pm in week 9 (28 July)	NA	Within 1 week of quiz, via Moodle
Numerics 5 online quizzes for 1% each	as indicated in Moodle	5%	4 (see table 5)	Students are expected to demonstrate their ability to apply the methods taught in the numerics part of this course, using Matlab	By the end of each of weeks 2, 4, 7, 9, 10 as indicated in Moodle.	NA	Within 1 week of quiz, via Moodle
Statistics 10 online lectures and quizzes for 1% each	dates as indicated on Maple TA/Mobius	10%	1, 3, 4 (see table 5)	Students are expected to demonstrate their ability to apply the methods taught in the statistics part of this course.	By the end of each of weeks 2-5, 7-10 as indicated by Maple TA/Mobius.	NA	Within 1 week of quiz, on Maple TA/Mobius
3. Other Assessments							
Statistics Mid-term Test	40 mins	10%	1, 3, 4 (see table 5)	Students are expected to demonstrate their ability to apply the methods taught in the statistics part of this course, using Matlab, where appropriate.	Weeks 6-7 (sign up for a time)	NA	Within 1 week of test, on Maple TA/Mobius

RELEVANT RESOURCES

For the Numerical Methods strand of CVEN2002/2702:

- Recommended: "Numerical Methods for Engineers": Steven C. Chapra, Raymond P. Canale; McGraw Hill, 7th Ed (2015) ISBN 978 0 07 339792 4 or the equivalent ebook:
- www.mheducation.com.au/9781308573083-aus-ebook-numerical-methods-for-engineers-7e
- Any other Numerical Methods / for engineers book eg "Numerical Methods", Author: Robert W. Hornbeck, Publisher: Prentice-Hall (1975), or "An Introduction to Numerical Methods and Analysis", Author: James Epperson, Publisher: John Wiley & Sons, Second Edition (2013), or "Elementary Numerical Analysis", Authors: Kendall Atkinson, Weimin Han, Publisher: John Wiley & Sons, Third Edition (2004)
- CVEN2002/CVEN2702 class notes R. Lawther, W. Peirson, B. Cathers, X. Barthelemy, July 2015 (a pdf file on our Moodle site)

For the Statistics strand of CVEN2002/2702:

Recommended textbook:

- "Applied Statistics for Engineers and Scientists", Authors: J. Devore and N. Farnum, Publisher: Duxburry Press, 2nd Edition
- "Applied Statistics for Engineers and Scientists", Authors: J. Devore, N. Farnum and J. Doi, Publisher: Cengage Learning, 3rd Edition

Additional references:

- "Probability and Statistics for Engineers and the Sciences", Author: J. Devore, Publisher: Duxburry, 7th Edition
- "Applied Statistics and Probability for Engineers", Authors: D. Montgomery and G. Runger, Publisher: Wiley, 5th Edition
- CVEN2002/CVEN2702 class notes R. Lawther, W. Peirson, B. Cathers, X. Barthelemy, July 2015 (a pdf file on our Moodle site)

DATES TO NOTE

Refer to MyUNSW for Important Dates available at: 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: student.unsw.edu.au/plagiarism

ACADEMIC ADVICE

(Formerly known as Common School Information)

For information about:

- Notes on assessments and plagiarism,
- School policy on Supplementary exams,
- Special Considerations: student.unsw.edu.au/special-consideration
- 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:

https://www.engineering.unsw.edu.au/civil-engineering/student-resources/policies-procedures-and-forms/academic-advice

Appendix A: Engineers Australia (EA) Competencies
Stage 1 Competencies for Professional Engineers

	Program Intended Learning Outcomes
PE1: Knowledge and Skill Base	PE1.1 Comprehensive, theory-based understanding of underpinning fundamentals
	PE1.2 Conceptual understanding of underpinning maths, analysis, statistics, computing
	PE1.3 In-depth understanding of specialist bodies of knowledge
	PE1.4 Discernment of knowledge development and research directions
	PE1.5 Knowledge of engineering design practice
	PE1.6 Understanding of scope, principles, norms, accountabilities of sustainable engineering practice
PE2: Engineering Application Ability	PE2.1 Application of established engineering methods to complex problem solving
	PE2.2 Fluent application of engineering techniques, tools and resources
	PE2.3 Application of systematic engineering synthesis and design processes
	PE2.4 Application of systematic approaches to the conduct and management of engineering projects
PE3: Professional and Personal Attributes	PE3.1 Ethical conduct and professional accountability
	PE3.2 Effective oral and written communication (professional and lay domains)
	PE3.3 Creative, innovative and pro-active demeanour
	PE3.4 Professional use and management of information
	PE3.5 Orderly management of self, and professional conduct
	PE3.6 Effective team membership and team leadership