School of Civil and Environmental Engineering

Term 2, 2020

CVEN9826 ADVANCED MECHANICS OF STRUCTURES AND MATERIALS

COURSE DETAILS

Units of Credit	6
Contact hours	4 hours per week
Class and Workshop	Tuesday, 13:00 – 17:00 online
Course Coordinator	Prof. Wei Gao email: w.gao@unsw.edu.au office: Room 608 Civil and Environmental Engineering Building (H20)
Lecturers	Prof. Wei Gao (Weeks 1-3) email: w.gao@unsw.edu.au Dr. Johanna Eisenträger (Weeks 4-5, 7) email: j.eisentraeger@unsw.edu.au Prof. Chongmin Song (Weeks 8-10) email: c.song@unsw.edu.au

INFORMATION ABOUT THE COURSE

- This subject is targeted to students desiring a greater understanding of structural mechanics and materials.
- To reinforce a student's capability in structural mechanics with a view to and apply the concepts learned to the analysis of structures and structural materials.
- To introduce students to the fundamental concepts and principles applied by structural analysts and engineers in advanced computational modelling.
- To be able to carry out various engineering computations related to elasticity, plasticity and fracture.
- To equip research students with tools needed for their studies in the field of Structural Engineering and Materials.

HANDBOOK DESCRIPTION

See link to virtual handbook:

https://www.handbook.unsw.edu.au/undergraduate/courses/2020/CVEN9826/

OBJECTIVES

The objectives of this course are to:

- advance your knowledge of mechanics for deeply understanding structures and materials
- introduce you to thinking over real-world engineering problems

- give you opportunities to develop high-level analysis skills

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

- high level knowledge of structural engineering mechanics
- skills in advanced computational modelling, linear, non-linear and fracture
- application of fundamental knowledge to design with structural materials
- development of core capabilities for undertaking of higher degree research in Structural Engineering

TEACHING STRATEGIES

This course is designed for student-centred learning. Students are encouraged to think critically to solve engineering problems and to ask questions in order to best achieve the learning outcomes

Private Study	• Review lecture material and textbook • Do set problems and assignments • Join online discussions of problems • Reflect on class problems and assignments • Download materials from 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 Lectures • Practice solving set problems • Ask questions
Assessments	• Demonstrate your knowledge and skills • Demonstrate higher understanding and problem solving

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.

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

	Learning Outcome	**EA Stage 1 Competencies**
1.	Interpret and understand the application of advanced structural mechanics in engineering problems	PE1.1, PE2.1, PE2.3
2.	Demonstrate skills in analysing elastic, plastic and fracture behaviour of structures and materials	PE1.2, PE1.3, PE1.4
3.	Improve capability for undertaking research in the discipline of structural engineering and mechanics	PE1.4, PE2.1, PE2.2
4.	Accomplish tasks that require the application of knowledge of advanced mechanics of structures and materials	PE1.3, PE2.3, PE3.3

COURSE PROGRAM

Term 2 2020

Date	Topic	Lecture and Demonstration Content
02/06/2020 (Week 1)	**Elasticity 1** (Gao)	Introduction of elasticity, basic concepts, basic assumptions, plane stress and plane strain
09/06/2020 (Week 2)	**Elasticity 2** (Gao)	Differential equations of equilibrium, boundary conditions, compatibility equations, Saint-Venant's principle
16/06/2020 (Week 3)	**Elasticity 3** (Gao)	Two-dimensional problems in rectangular coordinates, analysis of stress and strain in 3D, principal stresses, stress invariants
23/06/2020 (Week 4)	**Fracture 1** (Eisenträger)	Introduction to Fracture Mechanics: Lamé and Kirsch plate, basic failure concepts, micro and macro phenomena of fracture
30/06/2020 (Week 5)	**Fracture 2** (Eisenträger)	Linear Fracture Mechanics I: crack-tip field, K-concept and K-factors, fracture toughness
07/07/2020 (Week 6)	***Flexibility week for all courses (non-teaching)***	
14/07/2020 (Week 7)	**Fracture 3** (Eisenträger)	Linear Fracture Mechanics II: energy release rate, J-integral, small-scale yielding
21/07/2020 (Week 8)	**Plasticity 1** (Song)	Concept of elastoplasticity using 1D model, plastic strain, strain hardening and softening, unloading and reloading, path dependence
28/07/2020 (Week 9)	**Plasticity 2** (Song)	Stress invariants, yield criteria and yield surfaces: Tresca, von Mises; associate flow rule; explicit and implicit integrations.
04/08/2020 (Week 10)	**Plasticity 3** (Song)	Mohr - Coulomb; Drucker Prager; non - associate flow rule; Classical engineering applications; Introduction to computer applications

For each hour of contact it is expected that you will put in at least 1.5 hours of private study.

ASSESSMENT

Overall rationale for assessment components and their association with course objectives.

Item	Weighting	Learning outcomes assessed	Assessment Criteria	Online submission deadline (Sydney Time)	Deadline for absolute fail (Sydney Time)	Marks returned
Quiz (Online)	5%	Elasticity	Demonstrate understanding of concepts by applying problem solving and critical thinking	5PM 16/06/2020	5PM 16/06/2020	23/06/2020
Assignment 1	29%	Elasticity		5PM 30/06/2020	5PM 06/07/2020	07/07/2020
Assignment 2	33%	Fracture		5PM 21/07/2020	5PM 27/07/2020	28/07/2020
Assignment 3	33%	Plasticity		5PM 14/08/2020	5PM 20/08/2020	21/08/2020

PENALTIES

Late work will be penalised at the rate of 15% per day after the online submission deadline.

RELEVANT RESOURCES

- Theory of Elasticity, S. Timoshenko and J. N. Goodier
- Plasticity for Structural Engineers, Wai-Fah Chen and Da-Jian Han
- Fracture Mechanics: With an Introduction to Micromechanics, Dietmar Gross and Thomas Seelig
- Additional materials provided on Moodle.

DATES TO NOTE

Refer to MyUNSW for Important Dates available at:

https://student.unsw.edu.au/dates

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;
- Special Considerations: student.unsw.edu.au/special-consideration;
- General and Program-specific questions: The Nucleus: Student Hub
- Year Managers and Grievance Officer of Teaching and Learning Committee, and
- CEVSOC/SURVSOC/CEPCA

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