School of Civil and Environmental Engineering

Term 3, 2021

CVEN9522 ROCK ENGINEERING

COURSE DETAILS

Units of Credit	6UOC	
Contact Hours	3 hours per week	
Class	Thursday 3:00 – 6:00pm	Online (Access via Moodle)
Course Coordinator and Lecturer	Dr Kurt Douglas email: k.douglas@unsw.edu.au office: CE 506 (currently in his attic at home)	
Lecturer	Robert Bertuzzi Pells Sullivan Meynink Contact: to be advised in class	

INFORMATION ABOUT THE COURSE

This course has been developed for Geotechnical Engineers and Engineering Geologists. The first four weeks of the course covers an introduction to rock mechanics and identification and estimation of design parameters. This then leads into the remainder of the course which focuses on design for underground structures.

HANDBOOK DESCRIPTION

See: **https://www.handbook.unsw.edu.au/postgraduate/courses/2021/CVEN9522/**

OBJECTIVES

To introduce students to the fundamentals of rock mechanics including data collection, data assessment and basic principles related to the theory and design of structures in rock. To study the analysis and design of tunnels and underground structures in rock.

Some of the program outcome attributes are listed in the table below together with how you may expect to achieve them.

An in-depth engagement with the relevant disciplinary knowledge in its inter-disciplinary context	This course focuses on the fundamentals of rock mechanics for practical application to engineering.
Capacity for analytical and critical thinking and for creative problem solving The skills to locate, evaluate and use relevant information (Information literacy)	Much of rock mechanics requires the development of a geotechnical model created from a range of sources and the use of this model to estimate relevant parameters for design. There is no one answer so an ability to critically assess the design is also important.
Ability to engage independent and reflective learning	You are expected to do pre and post course reading and study. Much of the notes provide references for further independent study to increase the depth and breadth of your knowledge.
Skills for effective communication	Assignments should be presented in a professional 'report style' manner (unless stated otherwise).

TEACHING STRATEGIES

The content of this subject will be presented to you in a number of formats. Each of these are explained below together with our expectations of you.

Lectures: Formal lectures will be presented to discuss the basic principles of rock engineering. Lectures will be presented weekly live-online due to COVID restrictions. You are expected to attend all the lectures as they will greatly assist in understanding what is presented in the lecture notes. The intention is to record the lectures for review purposes. The lectures will also be a primary point of communication between the class and lecturers. Further communication will be via your student email and Moodle. It is very important that you frequently check your messages.

Workshops: Problems will be assigned throughout the course and you are expected to work through them during the week. Workshop discussions will be held during the lecture period.

Flexibility Week: We will use this week to plan and work through early parts of Assignment 2.

A*ssignments*: The assignments have been developed to cover the different aspects of rock engineering presented and therefore provide you with a good facility for reviewing and learning the course content. It is expected that you will have to do additional reading and research to complete the assignments. You may approach us for guidance when doing your assignments.

Private study: There is a limited period for lectures to be presented. Therefore your weekly private study between lectures is very important. This includes the review and reflection of lecture material as well as further reading of the texts/papers on Moodle. Your private study should also include: workshop and assignment problems; accessing provided links and supplementary material on Moodle and performing your own literature research. For each hour of contact it is expected that you will put in at least 1.5 hours of private study.

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.	*Describe, record and present features of rock masses that can be used as an input to geotechnical design.*	PE1.1, PE1.3, PE1.4, PE2.1, PE2.4, PE3.2, PE3.4, PE3.6
2.	*Assign appropriate geotechnical properties to rock masses*	PE1.1, PE1.2, PE1.3, PE1.5, PE2.1, PE2.2, PE2.3, PE3.4
3.	*Perform geotechnical design of slopes, foundations and, in particular, tunnels*	PE1.1, PE1.2, PE1.3, PE1.5, PE2.1, PE2.2, PE2.3
4.	*Use software to assess stresses and displacements for tunnel design*	PE1.2, PE1.5

ASSESSMENT

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 50% of the Final Mark if class work is included and 100% if class work is not included. The class work is worth 50% of the Final Mark if included. A mark of at least 40% in the final examination is required before the class work is included in the final mark. The formal exam scripts will not be returned. Students who perform poorly in the assessment tasks and workshops are recommended to discuss progress with the lecturer during the term. Note: The co-ordinator reserves the right to adjust the final scores by scaling if agreed by the Head of School.

Details of each assessment component, the marks assigned to it, and the dates of submission are provided below.

KEEP A COPY OF ALL SUBMITTED ASSIGNMENTS

Please keep a copy of written assignments (in case your assignment is misplaced).

SUBMITTING ASSIGNMENTS

Digital submission of assignments will be facilitated via Moodle.

Supplementary Examinations for Term 3 2021 will be held on Monday 10th January – Friday 14th January 2022 (inclusive) should you be required to sit one. You are required to be available during these dates. Please do not make any personal or travel arrangements during this period.

Details of each assessment component, the marks assigned to it, the criteria by which marks will be assigned, and the dates of submission are set out below.

ASSIGNMENTS

Assignment	Assignment Details		Value
Intro Rock Assignment	This assignment aims to introduce you to rock engineering. It includes calculations as well as a requirement for you to read through the notes and summarise various aspects of importance to rock engineering. Assessment will not only consider whether your calculations are correct but will also consider your choice of, and discussion of, assumptions and input parameter selection. (Learning Outcomes 1,2,3)	Due: **Monday 4th October**	20%
Tunnel Assignment	This assignment will require you to consider a design for a tunnel. Assessment will consider your choice of parameters, your assumptions, your calculations and your discussion of results. (Learning Outcomes 1,2,3,4)	Due: **Friday 19th November**	30%
Exam	The exam will cover all the elements of the course with a focus on design of underground excavations in rock. (Learning Outcomes 1-4)	**UNSW Exam period** *Online due to COVID restrictions*	50%

Note: Late work will be penalised at the rate of 10% per day after the due time and date have expired.
It is expected that assignment marking will take 2 weeks from date of receipt.

COURSE PROGRAM

TERM 3, 2021 (Indicative only, subject to change)

Lecture	Day	Weekly Topics (subject to change)	Lecturer
1	16/9	Engineering description of rocks, discontinuities and rock mass	KD
2	23/9	Measurement and estimation of rock substance, rock defects and rock mass characteristics	KD
3	30/9	Stereonets and rock slope stability	KD
4	7/10	Rock foundations	KD
5	14/10	Support components for rock tunnels. Design for loosening pressures	RB
6	21/10	*Flexibility Week*	RB
7	28/10	Support design for highly stressed rock. Excavation methods and productivities	RB
8	4/11	Soft ground tunnel support	RB
9	11/11	Tunnel monitoring and tunnel waterproofing	RB
10	18/11	Hard rock tabular mining and open stopes; Coal mine tunnels pillars and subsidence	RB

RELEVANT RESOURCES

Texts/Books/Papers

The texts for this course, Bertuzzi (2019 and 2020) are provided in Moodle. Additional references that may be useful will also be provided. If you would like to purchase a book for further pre or post understanding, the following is recommended:

Brady and Brown (2004) Rock Mechanics for Underground Mining (3rd edition), Springer Verlag, ISBN: 1402020643 [Available from the UNSW Bookshop for approximately $105] [E-book Available Online through library].

Other texts, you may be interested in:

Hoek, E. (2007) Practical Rock Engineering. FREE DOWNLOAD: https://www.rocscience.com/learning/hoek-s-corner

Wyllie, D.C. and Ma, C.W. (2004) Rock Slope Engineering, 4th Edition. Spon Press:New York. [Note: continues Hoek, E. and Bray, E.W. (1981) Rock Slope Engineering, 3rd Edition. The Institute of Mining and Metallurgy, London.] [E-book Available Online through library]

Hoek E. and Brown E.T. (1982) Underground Excavation in Rock, The Institution of Mining and Metallurgy, London.

Hoek, E., Kaiser, P.K. and Bawden, W.F. (1995) Support of Underground Excavations in Hard Rock.

Hudson, J.A. and Harrison, J.P. (2005) Engineering Rock Mechanics. 3rd Impression. Permagon. [E-book Available Online through library]

Software

You are required to use *Rocscience* software to complete this course. You can access the software for the purposes of this course via: *Access Anytime Anywhere*: https://www.myaccess.unsw.edu.au/applications/rocscience-suite

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

Useful information and resources:

- Key Staff to Contact for Academic Advice (log in with your zID and password): **https://intranet.civeng.unsw.edu.au/key-staff-to-contact-during-your-studies-at-unsw**
- CVEN Student Intranet (log in with your zID and password): **https://intranet.civeng.unsw.edu.au/student-intranet**
- Student Life at CVEN, including Student Societies: **https://www.unsw.edu.au/engineering/civil-and-environmental-engineering/student-life**
- Special Consideration: **https://student.unsw.edu.au/special-consideration**

SPECIFIC MENGSC ADVICE

For advice on course selection and other academic matters, email: **k.douglas@unsw.edu.au**

For enrolment advice, requests for credit transfer or pre-approval of external courses or any other administrative request, please contact The Nucleus: Student Hub: **https://nucleus.unsw.edu.au/en**

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