CVEN9522

Rock Engineering

Term 3, 2022

Course Overview

Staff Contact Details

Convenors

Name	Email	Availability	Location	Phone
Kurt Douglas	k.douglas@unsw.edu.au	Email initially	CE506	9385 5046

School Contact 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)

Course Details

Units of Credit 6

Summary of the Course

Introduction to rock engineering including the engineering description of rocks, discontinuities and rock mass; the strength of rock substance, defects and rock mass; laboratory testing of rock, defect surveys, data presentation and hemispherical projections; in-situ stress and its measurement; stresses about underground openings; classification systems and introductory tunnel support requirements. Investigation, design and construction of tunnels and other underground structures, rock and rock mass strength and deformability; In-situ stresses; stresses about underground openings by elastic and numerical methods; classification systems for prediction of support requirements, including NATM; design of support elements including bolts, dowels, mesh and anchors. Measurement of in-situ stresses; instrumentation and monitoring; squeezing and swelling ground. Tunnel excavation methods and their applicability, including drill and blast, heading and bench, tunnel boring machine, road headers.

Course Aims

To study the 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.

Course Learning Outcomes

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

Learning Outcome	EA Stage 1 Competencies
1. Describe the basic principles related to the theory and design of rock engineering including methods for describing, recording and presenting features of rock masses	PE1.1, PE1.3, PE1.4, PE2.1, PE2.4, PE3.2, PE3.4, PE3.6
2. Determine appropriate geotechnical properties for rock masses	PE1.1, PE1.2, PE1.3, PE1.5, PE2.1, PE2.2, PE2.3, PE3.4
3. Perform a geotechnical design of slopes and foundations and support systems for underground structures.	PE1.1, PE1.2, PE1.3, PE1.5, PE2.1, PE2.2, PE2.3
4. Apply software to assess stresses and displacements for tunnel design	PE1.2, PE1.5

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 in a one-week in-person block (Wednesday, Week 2 to Tuesday, Week 3). This year we will also live stream the short course due to COVID restrictions. We highly recommend doing the course in-person, where possible and safe to do so, due to the significantly better learning experience as well as peer and lecturer networking opportunities. You are expected to attend all the lectures as they

will greatly assist in understanding what is presented in the lecture notes. 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 and the rest of the semester. Workshop discussions will be held during the short course.

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 private study is very important. This includes pre-reading; the review and reflection of lecture material (very important where a lot of content is presented in a short period of time); 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.

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.

KEEP A COPY OF ALL SUBMITTED ASSIGNMENTS/EXAMS

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

Assessment task	Weight	Due Date	Course Learning Outcomes Assessed
1. Intro Rock Assignment	20%	03/10/2022 11:59 PM	1, 2, 3
2. Tunnel Assignment	30%	10/11/2022 11:59 PM	1, 2, 3, 4
3. Final Exam	50%	Not Applicable	1, 2, 3

Assessment 1: Intro Rock Assignment

Start date: 22/09/2022 05:00 PM
Submission notes: Submit electronically via the course Moodle page.
Due date: 03/10/2022 11:59 PM
Marks returned: Within two weeks where possible.

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.

Assessment 2: Tunnel Assignment

Start date: 27/09/2022 05:00 PM
Submission notes: Submit electronically online via course Moodle page
Due date: 10/11/2022 11:59 PM
Marks returned: Within two weeks where possible

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.

Assessment 3: Final Exam

The open book exam will cover all the elements of the course with a focus on design of underground excavations in rock. It will be held online during the formal UNSW examination period at the end of Term. You are expected to be available during this period.

Hurdle requirement

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

Attendance Requirements

Please note that lecture recordings are not available for this course. Students are strongly encouraged to attend all classes and contact the Course Authority to make alternative arrangements for classes missed.

Course Schedule

View class timetable

Timetable

Date/Module	Type	Content
Wednesday (Dr Kurt Douglas)	Lecture	Engineering description of rocks, discontinuities and rock mass
	Lecture	Measurement and estimation of rock substance, rock defects and rock mass characteristics
Thursday (Dr Kurt Douglas)	Lecture	Stereonets and rock slope stability
	Lecture	Rock foundations
	Workshop	
Friday (Dr Andrew de Ambrosis)	Lecture	Uses and abuses by classification systems
	Lecture	Stresses, displacements and linear elasticity
	Lecture	Techniques for estimating in-situ stresses and rock mass parameters for tunnel design
	Lecture	Tunnel support loading mechanisms and design approaches
	Workshop	
Monday (Dr Andrew de Ambrosis)	Lecture	Design for loosening pressures
	Lecture	Support components for rock tunnels
	Lecture	Support design for highly stressed ground
	Workshop	
Tuesday (Dr Andrew Merritt)	Lecture	Soft ground tunnel support
	Lecture	Excavation methods and productivity
	Lecture	Subsidence and settlement impacts
	Lecture	Tunnel monitoring and tunnel waterproofing
	Workshop	

Resources

Prescribed Resources

The texts for this course, Bertuzzi (2019 and 2020) are provided in Moodle. Additional references that may be useful will also be provided.

Recommended Resources

Texts/Books/Papers

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

Course Evaluation and Development

We continue to try and improve the course and value student feedback. Feel free to email Dr Kurt Douglas during the course for immediate consideration. We will also undertake a formal UNSW student survey at the end of Term.

Submission of Assessment Tasks

Please refer to the Moodle page of the course for further guidance on assessment submission.

UNSW has a standard late submission penalty of:

- 5% per day, for all assessments where a penalty applies, capped at five days (120 hours), after which a student cannot submit an assessment, and no permitted variation.

Academic Honesty and 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 Information

Final Examinations:

Final exams in T3 2022 will be held online between 25th November - 8th December 2022 inclusive, and supplementary exams between 9th - 13th January 2023 inclusive. You are required to be available on these dates. Please do not to make any personal or travel arrangements during this period.

ACADEMIC ADVICE

- 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
- Key UNSW Dates - eg. Census Date, exam dates, last day to drop a course without academic/financial liability etc.
- 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
- General and Program-Specific Questions: The Nucleus: Student Hub
- Book an Academic Advising session: https://app.acuityscheduling.com/schedule.php?owner=19024765

Disclaimer

This course outline sets out 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 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 (as updated in Moodle), the description in the Course Outline/Moodle applies.

Image Credit

Image Courtesy PSM.

CRICOS

CRICOS Provider Code: 00098G

Acknowledgement of Country

We acknowledge the Bedegal people who are the traditional custodians of the lands on which UNSW Kensington campus is located.

Appendix: Engineers Australia (EA) Professional Engineer Competency Standard

Program Intended Learning Outcomes	
Knowledge and skill base	
PE1.1 Comprehensive, theory based understanding of the underpinning natural and physical sciences and the engineering fundamentals applicable to the engineering discipline	✓
PE1.2 Conceptual understanding of the mathematics, numerical analysis, statistics, and computer and information sciences which underpin the engineering discipline	✓
PE1.3 In-depth understanding of specialist bodies of knowledge within the engineering discipline	✓
PE1.4 Discernment of knowledge development and research directions within the engineering discipline	✓
PE1.5 Knowledge of engineering design practice and contextual factors impacting the engineering discipline	✓
PE1.6 Understanding of the scope, principles, norms, accountabilities and bounds of sustainable engineering practice in the specific discipline	
Engineering application ability	
PE2.1 Application of established engineering methods to complex engineering 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	✓
Professional and personal attributes	
PE3.1 Ethical conduct and professional accountability	
PE3.2 Effective oral and written communication in 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	✓