School of Civil and Environmental Engineering

Term 1, 2020

CVEN4201 ROCK AND SLOPE ENGINEERING

COURSE DETAILS

Units of Credit	6UOC
Contact hours	5 hours per week
Class	Wednesday, 1:00 – 6:00 TETB LG05
Fieldtrip	Mon 23rd & Tues 24th March, Week 6 (Note this may vary due to unforeseen site issues)
Course Coordinator and Lecturer	Dr Kurt Douglas email: k.douglas@unsw.edu.au office: CE 506

INFORMATION ABOUT THE COURSE

The course will consist of 9 five hour lecture/workshops. Generally where there is a workshop/demonstration it will be held in the last hour or two. There will also be 2 days of field trips in Week 6.

Up until now you have studied soil properties in second year and geology and basic geotechnical design in soils in third year. Part of this course will teach you the basics of rock mechanics and introduce you to design techniques for rock masses. The other part of this course covers slope stability that will use your existing knowledge of soil mechanics and what you learnt about rock mechanics in the first part of this course. The geology you studied in earlier courses will be very important in this course for developing geotechnical models that can be used to develop good engineering designs.

The course will begin by examining methods of describing, recording and presenting features of rock masses. This will be followed by learning about methods for determining the engineering properties of rock masses. This initial work will then be used to perform basic foundation, slope stability and tunnel designs.

The second part of the course will begin by examining the different types of slope instability and how to characterise them followed by a discussion of different site investigation techniques. Methods of analysing slopes including the use of stability analysis programs will be learnt. Finally different methods for stabilising slopes will be covered.

An important part of this course will be the two days of (separate) field trips where you will visit major engineering works including quarries, roads and dams together with unstable and stabilised slopes. What you are shown and the activities you carry out will give a practical insight into the subjects covered in the course.

The field trip has been split into two days. The first day (Monday Week 5) will be to the Illawarra area and the second day (Thursday Week 5) to the Southern Highlands (Mittagong, Marulan etc). Activities will include looking at quarries, slope stability problems in roads and railways, and Nepean Dam. It will run 8:00am-6:00pm each day leaving from and returning to UNSW on both days.

A coach will be organised by the School and will depart at 8am sharp from just inside Gate 14, Barker St. It is a safety requirement that you need to have your own steel capped safety boots/shoes for the fieldtrip. These can be purchased at many department stores or specialty shops like http://www.totallyworkwear.com.au/ (good for small sizes/womens etc.). The School will provide hard hats, safety vests and safety glasses where required.

HANDBOOK DESCRIPTION

See: **https://www.handbook.unsw.edu.au/undergraduate/courses/2020/CVEN4201**

OBJECTIVES

- To teach you the basic principles related to the theory and design of rock engineering including methods for describing, recording and presenting features of rock masses.
- To enable you to be able to perform basic designs in rock including foundations, slope stability and tunnel designs.
- To study the basic principles related to the theory and design of rock and soil slopes including an examination of the different types of slope instability and different site investigation methods, methods of analysing slopes and different methods for stabilising slopes.
- To give you some experience in using computer software to assess the stability of a slope and various remediation measures.
- To give you a practical understanding of rock and slope engineering using the field trip and assignments.

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 brings together previous courses in geology and soil mechanics with new information on rock mechanics to solve geotechnical problems
Capacity for analytical and critical thinking and for creative problem solving	Most of the assignments require you to consider a quantity of information and supplement it with your own research to solve open ended questions.
Ability to engage independent and reflective learning	You are expected to do pre and post lecture reading and study. Much of the notes provide references for further independent study to increase the depth of your knowledge.
The skills to locate, evaluate and use relevant information (Information literacy)	In practice, you are expected to use recent publications (journals/conferences) to keep abreast of recent advances. This course will often use these types of references rather than lecture notes to improve your information literacy.
Skills for collaborative and multi-disciplinary work	The parts in Assignment 1 will be performed in groups. From previous experience, groups that receive high marks generally have good collaboration between members.
Skills for effective communication	Assignments are expected to be presented in a professional ‘report style’ manner (unless stated otherwise).

TEACHING STRATEGIES

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

Lectures: Formal lectures will be presented to discuss the basic principles of rock and slope engineering. Lectures will vary from standard PowerPoint and overhead projector lectures to more hands on demonstrations of various engineering techniques. 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 myself. Further communication will be via your student email and Moodle. It is very important that you frequently check your messages.

Demonstrations/workshops: The demonstrations/workshops in this subject are used to teach you ‘hands on’ rock description and classification; plotting of defect data and use of computer programs. They will also contain opportunities for you to work on example problems and the assignments. You will be expected to be present and participate at all demonstrations/workshops, as they will contain material not covered in lectures.

Fieldtrip: The field trip is compulsory (unless you are attending the Groundwater fieldtrip) as it gives you a practical understanding of the content of the course. You will be taken to a number of sites where you will be shown various

geological environments, slope, mines and dams. At some of the stops you will be expected to carry out various tasks to enhance your learning. The knowledge you gain will be useful in answering some parts of the final exam.

Assignment: Your first assignment will be a group assignment. The assignment has been developed so that it covers all the aspects of rock engineering and therefore provides you with a good facility for learning the course content. The second assignment will teach you how to analyse a slope using a computer program similar to those used in industry. You may approach me for guidance when doing your assignments. This includes showing drafts of your work to me for comment prior to submission.

Private study: Your private study should include review and reflection of lecture material; workshop and assignment problems; accessing provided links and supplementary material on Moodle and generally taking notice of the characteristics of the geological environments that you travel through each day. 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 tunnels*	PE1.1, PE1.2, PE1.3, PE1.5, PE2.1, PE2.2, PE2.3
4.	*Use software to assess the stability of a slope.*	PE1.2, PE1.5

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

SCHOOL PRIZES

Results in this course may contribute to the Geotechnical Engineering Discipline Prize presented at the fourth year dinner. In 2019 the prize was worth $1000 and was sponsored by the geotechnical consultancy Pells Sullivan Meynink (PSM).

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 55% of the Final Mark if class work is included and 100% if class work is not included. The class work is worth 45% 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 semester. Note: The lecturer reserves the right to adjust the final scores by scaling if agreed by the Head of School.

There will be tasks to complete as part of the field trip, but there will be no positive marks awarded for it (just as you do not get marks for attending lectures). Failure to attend without WELL documented medical support or completing the required tasks on the field trip satisfactorily will result in a reduction in your overall assessment in the subject by up to 10 marks. A substantial assignment will also be set for those who do not attend and it must be completed satisfactorily.

Supplementary Examinations for Term 1 2020 will be held on Monday 25th May – Friday 29th May (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

1. Assignment: Rock Engineering out: Week 1 due: in stages as per course program value: 30%

This assignment will be carried out in groups of three or four and will cover the entire rock engineering component of the course including: core logging, hemispherical projections and a simple rock slope design, a foundation design and a tunnel design. It is important that you all contribute to each part of the assignment so that you can practice applying everything you are presented with in class.

The assignment will assess: how well you develop your geotechnical model (if required); your ability to record, plot and synthesise information; your ability to perform appropriate calculations with appreciation of assumptions; and how well you assess your answer/s. Quality of presentation is also important.

Students in surveys in previous years have expressed the desire for ongoing feedback. To facilitate this, the assignment will be split into components with due dates distributed throughout the session. This will allow you to complete each part as it is taught in class (similar to a workshop) so as not to overload yourselves at the end of the session and to enable me to give you some marks/feedback prior to the end of the year. It is aimed to give feedback within two weeks of submission.

2. Assignment: Slope Stability out: Week 4 due: Week 7 value: 15%

This assignment will cover the slope stability component of the course. It will assess your ability to analyse a slope using the program Slope/W and to consider and design possible remediation measures. Geotechnical engineers often use computers to design and analyse slopes so it is important that you learn how to use them properly and also very importantly learn their limitations. Quality of presentation (as a report) is also important. It is aimed to give feedback within two weeks of submission.

3. Final exam held: Formal exam period value: 55%

The final OPEN BOOK exam will assess your understanding of the whole course with particular emphasis on your ability to synthesise data and investigate and design structures in rock masses and slopes. Approved calculators will be permitted in the exam. To find out how to get your calculator approved please see **https://student.unsw.edu.au/exam-approved-calculators-and-computers**

Note: Late assignments will be penalised at the rate of 10% per day after the due time and date have expired. Assignments will receive zero if submitted one week after the submission due date.

COURSE PROGRAM

TERM 1, 2020 (Indicative only, subject to change)

Week	Topic	Assessments
1 (19/2)	Description of rock mass and discontinuities. Data collection and presentation. Core logging.	*Ass 1a out 19/2*
2 (26/2)	Rock strength and failure criteria.	
3 (4/3)	Hemispherical projections, introductory rock slope stability.	**Ass 1a due 5/3** *Ass 1b out 4/3*
4 (11/3)	Site investigations for landslides. Slope stability analysis.	*Ass 2 out 11/3*
5 (18/3)	Slope stabilisation techniques.	**Ass 1b due 19/3**
6	*Fieldtrips: Mon 23/3 and Tues 24/3*	
7 (1/4)	Foundations on rock.	**Ass 2 due 2/4** *Acc 1c out 1/4*
8 (8/4)	In-situ stress. Stresses about underground openings.	*Ass 1d out 8/4*
9 (15/4)	Classification systems and tunnel support requirements.	**Ass 1c due 16/4**
10 (22/4)	Review	**Ass 1d due 24/4**

RELEVANT RESOURCES

No texts are required and notes will be provided in class. The following are recommended reading.

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

Brady, B.H.G. and Brown, E.T. (2006) Rock Mechanics for Underground Mining, 3rd Edition. [E-book Available Online through library]

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]

Bell, F.G. (2007) Engineering Geology. Burlington : Elsevier. [E-book Available Online through library]

Further reading will be given out as class notes.

Websites of interest include:

Australian Geomechanics Society: **https://australiangeomechanics.org/**

Australian Geomechanics Society, Sydney: **https://australiangeomechanics.org/chapter/sydney-nsw/**

Int. Soc. for Soil Mechanics & Geotechnical Engineering: **https://www.issmge.org/**

International Society for Rock Mechanics: **https://www.isrm.net/**

International Association of Engineering Geology: **https://www.iaeg.info/**

The Australasian Institute of Mining and Metallurgy: **https://ausimm.com/**

The U.S. Geological Survey: **https://www.usgs.gov/**

Science Direct Journal Search: **https://www.sciencedirect.com/**

More will be provided on Moodle as required.

iPhone (and other almost as smart phones)

There are numerous apps being developed for various smart phones. At the moment, there are only a handful developed for geology/geotechnical work that are free. One that may be useful for this course is:

- GeoID– works as a geological compass that can be used for basic rock mapping. It also allows for real-time plotting on a Schmidt Net or similar (useful to check your assignment).

Computer Software

The School computer laboratories provide you access to *Rocscience* programs, *Dips* (plotting defect data) and *Examine* and *RS2* (underground stress analysis); and the *GeoStudio* program *GeoSlope* (soil slope stability analysis)

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,
- 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

CVEN4201 Rock & Slope Engineering

Assignment Cover Sheet 2020

Assignment: ……

Name: …… **SID:** ……..

Name: …… **SID:** ……..

Name: …… **SID:** ……..

Name: …… **SID:** ……..

Name: …… **SID:** ……..

Date: ……

I/We declare that this assessment item is my/our own work, except where acknowledged, and has not been submitted for academic credit elsewhere, and acknowledge that the assessor of this item may, for the purpose of assessing this item:

Reproduce this assessment item and provide a copy to another member of the University; and/or,

Communicate a copy of this assessment item to a plagiarism checking service (which may then retain a copy of the assessment item on its database for the purpose of future plagiarism checking).

I certify that I have read and understood the University Rules in respect of Student Academic Misconduct.

Signed: .....date: ☐☐ ☐☐ ☐☐

Signed: .....date: ☐☐ ☐☐ ☐☐

Signed: .....date: ☐☐ ☐☐ ☐☐

Signed: .....date: ☐☐ ☐☐ ☐☐

Signed: .....date: ☐☐ ☐☐ ☐☐

Where a physical assignment is requested, please place this assignment in the submission box for Dr Kurt Douglas located at the eastern end, Level 5, School of Civil & Environmental Engineering.

PLEASE ENSURE THAT YOU KEEP A COPY OF YOUR ASSIGNMENT