CVEN4201 Rock and Slope Engineering

Semester 1, 2016

Never Stand Still | Faculty of Engineering | School of Civil and Environmental Engineering

COURSE DETAILS

Units of Credit	6UOC	
Contact hours	4 hours per week	
Class	Friday, 9:00 – 1:00	Civeng 101
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 11 four 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.

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 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 (4th April) will be to the Illawarra area and the second day (5th April) 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: **www.handbook.unsw.edu.au/undergraduate/courses/2016/CVEN4201.html**

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.

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. 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 various sites where you will be shown various geological environments, slope, mines and dams. At a number of 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.

GRADUATE ATTRIBUTES

It is an aim of this course to help develop the following graduate attributes:

To give students a solid grasp of the theory and practice of geotechnical engineering, and to be familiar with the bases of research to further develop its technology. In addition, graduates should be able to apply theory to practice in familiar and unfamiliar situations;

To stimulate the intellectual curiosity of students so that they will be motivated to undertake independent reflective learning as a lifelong skill;

To teach students how to define, analyse and solve problems clearly and logically and in doing so be able to find, evaluate, interpret and collate information;

To develop independent critical thought within students so that when necessary they will be able to challenge current knowledge and thinking;

To encourage proactive behaviour in students and to give them the associated entrepreneurial skills necessary;

To promote a respect within students for individual human rights and dignity, particularly when it relates to members of the public or other people who will be affected by the projects that they design and execute;

To foster effective self-management skills;

To nurture the skills required for effective leadership including an ability to manage and deliver projects, an understanding of the social dynamics of group performance, a repertoire of processes for the effective management of groups, and the ability to value diverse backgrounds and opinions and function effectively in multidisciplinary teams; and

To impart sound IT working skills.

SCHOOL PRIZES

Results in this course may contribute to the Geotechnical Engineering Discipline Prize presented at the fourth year dinner. In 2015 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 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 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.

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 4 due: in stages value: 35%

This assignment will be carried out in groups of three or four and will cover the entire rock engineering component of the course including: hemispherical projections and a simple rock slope design, rock core logging, 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.

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.

2. Assignment: Slope Stability out: Week 6 due: Week 10 value: 15%

This assignment will cover the slope stability component of the course. It will test your ability to analyse a slope using the program Slope/W and to 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.

3. Final exam held: Formal exam period value: 50%

The final exam will test your understanding of the whole course with particular emphasis on your ability to 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.

COURSE PROGRAM

SEMESTER 1, 2016 (Indicative only, subject to change)

Week	Topic	Assessments Due
1	Description of rock mass and discontinuities.	
2	Rock strength and failure criteria. Core logging.	
3	Field data collection, mapping and fracture surveys. Data presentation.	
4	Hemispherical projections, introductory rock slope stability.	Assignment 1 due in sections throughout course
Break	*Mid-Session Break*	
5	*Year 4 Fieldtrip Week*	
6	Site investigations for landslides.	
7	Slope stability analysis.	
8	Slope stabilisation techniques.	
9	Foundations on rock.	
10	In-situ stress. Stresses about underground openings.	Assignment 2 due
11	Classification systems and tunnel support requirements.	
12	Classification systems and tunnel support requirements.	

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 from: https://www.rocscience.com/learning/hoek-s-corner

Brady, B.H.G. and Brown, E.T. (2004) Rock Mechanics for Underground Mining, 3rd Edition.

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.]

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. (1997) Engineering Rock Mechanics. Permagon.

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:	http://www.australiangeomechanics.org
Australian Geomechanics Society, Sydney:	http://australiangeomechanics.org/chapters/sydney/
Int. Soc. for Soil Mechanics & Geotechnical Engineering:	http://www.issmge.org
International Society for Rock Mechanics:	http://www.isrm.net
International Association of Engineering Geology:	http://www.iaeg.info
The Australasian Institute of Mining and Metallurgy:	http://www.ausimm.com.au
The U.S. Geological Survey:	http://www.usgs.gov
Science Direct Journal Search:	http://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. The ones for the iPhone are still pretty basic and look like they are still in development. Some that I have looked at include:

- GeoID (preferred) or Lambert – 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. ‘Strike & Dip’ is another option however, it is not as easy to use and does not plot data.
- Geotimescale – gives a summary of the geological time scale
- Microscope – shows examples of rock samples under a microscope – only a limited number of examples at the moment
- Jurassic – an application that explores the geological history of the Dorset and East Devon coast. The location is not really relevant but the example of how geology develops over deep time is. In the menu check out: ‘Pangaea’ – this includes an animation of the movement of continents from when Pangaea existed to the present; ‘A walk through time’ – this discusses the development of the local geology and includes an animation showing how geological sections develop over time (in this case a sedimentary sequence developing over the last 250 million years).
- Rocks – gives examples of various rock types – still a limited number and (probably) more will be added with time.
- Mohs (free) – Gives Mohs Hardness Scale with example minerals and mineral descriptions including photos.
- USGSSeismic – Gives a list of the latest earthquakes around the world.

I have not looked at many you have to pay for. ‘Theodolite’ seems to be a useful application. The best geology glossary would be the one by AGI however, at $36.99 best to use the UNSW library.Recommended Internet sites.

DATES TO NOTE

Refer to MyUNSW for Important Dates available at:

https://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:

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

ACADEMIC ADVICE

For information about:

- Notes on assessments and plagiarism,
- School policy on Supplementary exams,
- Special Considerations,
- 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:

http://www.engineering.unsw.edu.au/civil-engineering/resources/academic-advice

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Assignment Cover Sheet 2016

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: ☐☐ ☐☐ ☐☐

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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