School of Civil and Environmental Engineering

Term 1, 2020

CVEN9525

FUNDAMENTALS OF GEOMECHANICS (Short Course)

COURSE DETAILS

Units of Credit	6		
Contact hours	35 hours per week		
Class	Day 1, Wednesday 19th Feb	9:00 – 17:00	Civil Engineering 109 (K-H20-109)
(Lectures and Workshops)	Day 2, Thursday 20th Feb	9:00 – 17:00	Civil Engineering 109 (K-H20-109)
	Day 3, Friday 21st Feb	9:00 – 17:00	Civil Engineering 109 (K-H20-109)
	Day 4, Monday 24th Feb	9:00 – 17:00	Civil Engineering 109 (K-H20-109)
	Day 5, Tuesday 25th Feb	9:00 – 17:00	Civil Engineering 109 (K-H20-109)
Course Coordinator and Lecturer	Dr. Arman Khoshghalb email: **Arman.khoshghalb@unsw.edu.au** office: CE 503, Civil Engineering Building Consultation times: Mondays from 15:30 to 17:00 Fridays from 15:30 to 17:00		

INFORMATION ABOUT THE COURSE

This is an introductory course to fundamentals of soil mechanics, designed for geologist. It covers the most important topics in soil mechanics; the basic classification of soil, phase relationships, the principle of effective stress and its importance in soil mechanics and geotechnical engineering, how water flows through soil and the equations governing the one-dimensional and two-dimensional flow of water in soil. It also covers the behaviour of soil under imposed loads, in particular the time-dependent behaviour of clay, the shearing strength of soil, failure criteria, and Mohr-Coulomb failure criterion.

There is no pre- or co-requisite to this course; students are expected to have a good understanding of the fundamentals of geology.

HANDBOOK DESCRIPTION

This is a Professional Development Course. Fundamentals of Geomechanics for geologists and other professionals who wish to work in geotechnical engineering, engineering geology, and environmental engineering. Classification of soil, phase relationships, flow of water in soil, the principle of effective stress, consolidation theory, stress distribution and settlement, Mohr Circle, failure criteria, stress paths and strength of soils and lateral earth pressures.

OBJECTIVES

To introduce students to the state of the fundamentals of soil mechanics and the important concepts of soil behaviour.

By the end of the course successful students should:

- understand the fundamentals of the behaviour of soil as an engineering material,
- relate to those aspects of soil behaviour which have a significant environmental impact,
- be able to solve a range of soil related problems especially those involving water flow, soil settlement and soil strength,
- have a sound basis for further formal study and self-study in the geotechnical area,
- be developing a rational approach to problem solving which will lead to the development of design skills.

OBJECTIVES AND EXPECTED LEARNING OUTCOMES

The objective of the course is to understand the basic principles of soil mechanics and to study the behaviour of soil as an engineering material.

By the end of the course successful students should:

Learning Outcome	EA Stage 1 Competencies
understand the fundamentals of the behaviour of soil as an engineering material,	PE1.1, PE1.2, PE1.3, PE1.5, PE2.3
relate to those aspects of soil behaviour which have a significant environmental impact,	PE1.3, PE1.6, PE3.1
be able to solve a range of soil related problems especially those involving water flow, soil settlement and soil strength,	PE1.1, PE1.2, PE2.1, PE2.2, PE3.3, PE3.5
have a sound basis for further formal study and self-study in the geotechnical engineering area,	PE1.1, PE1.4,
be developing a rational approach to problem solving which will lead to the development of design skills.	PE2.1, PE2.3, PE2.4, PE3.4

TEACHING STRATEGIES

The contents of this subject will be presented in a series of lectures followed by workshop questions. The lectures explain the theory of soil behaviour and greatly assist in understanding the different concepts in classical soil mechanics. Understanding and application of each concept will be enhanced in workshops. The class meets in two sessions every day, each session include a lecture followed by problem solving workshop session.

In order to understand different soil mechanics topics well, it is essential for students to attend the workshops and solve the workshop problems by themselves. A series of assignments will be given so that students can examine their understanding of the theories. Students are advised to tackle some of the assignments during the two days break between the lectures and reflect on their learning. It is expected that students will put in at least 1.5 hours of private study for each hour of contact. During private studies students should review and reflect on lecture material and class problems, solve workshop and assignment problems, and generally study the concepts taught in a soil mechanics book.

An example of the approaches to learning is:

Lectures	• Find out what you must learn • Follow worked examples • Observe solution methods
Workshops	• Practice solving set problems • Ask questions
Private Study	• Review lecture material and textbook • Do set problems and assignments • Reflect on class problems and assignments
Assessments (examinations and assignments)	• Demonstrate your knowledge and skills • Demonstrate higher understanding and problem solving

ASSESSMENT

Assessment will be based on a quiz, an assignment and a final exam, as follows:

Item	*Marks*	*Date*	*Assessment Criteria*
Quiz	10%	**Wednesday 11st March at 6:00 pm**	The quiz will be assessed on the basis of technical accuracy of calculations and evidence of understanding the main concepts taught in the course. The quiz will be in **online** format (in Moodle) and **open** book.
Assignment	30%	**Due on Friday 1st May 2020, 11:59 pm**	The assignments will be assessed on the basis of technical accuracy of calculations and evidence of understanding the learning outcomes of the course. Late submission will be penalised at the rate of 10% per day after the due date.
Final Exam	60%	Exam period	The final exam will cover the entire course. It will be assessed against the learning outcomes of the course. The final exam is **open** book and you may bring any textbooks or course materials to the exam.

Quiz: The quiz will cover the materials of **day 1 only** (from the beginning to the end of USCS). The quiz will be in online format (in Moodle) and open book. You can take the quiz remotely (from home, workplace, etc.).

Assignment: Detailed solutions to the assignment questions should be included in your submission. Both handwritten and typed solutions are accepted. The submission must be well organised and clear to follow. Your solutions must be neat and clearly legible.

Final Exam: The written final exam is held in the formal exam period and normally consists of 5 to 7 questions of different topics. The formal exam scripts will not be returned. The Coordinator or Lecturer reserves the right to adjust the final scores by scaling if agreed to by the Head of School.

In order to pass the subject, students must receive **40% or more** in the final examination **and** receive an overall total of 50% marks or more for the subject.

Notes:

- *"All Distance/Short course mode students are expected to sit their final examination on Kensington campus (Sydney). If you reside further than 40 Km from the Kensington campus, and you wish to sit your exam externally (by distance), you must register for an external exam by the UNIVERSITY CENSUS DATE (Term 1: 15th March; Term 2: 28th June, Term 3: 11th October) more information found here:* https://www.engineering.unsw.edu.au/civil-engineering/student-resources/policies-procedures-and-forms/exam*"*
- A mark of at least 40% in the final examination is required before the class work is included in the final mark.
- Assignments should be submitted online through Moodle by the deadline.
- Late work may not be accepted or assessed. If you have a good reason for being unable to submit your work on time, it is important that you let your course coordinator know promptly. There are two kinds of provisions made for students who have good reasons for late submission, as detailed in the next two points.

  - Students who are late with assignments may apply to the subject coordinator for an extension. You must apply for an extension before the due date. Extensions may be refused if you do not present documented medical or other evidence of illness or misadventure. An extension is only for a short period, usually no more than a week.

  - Where a longer period is needed, you should apply for Special Consideration. You must make a formal application as soon as practicable after the problem occurs and within three working days of the assessment to which it refers. All Special Consideration requests to be made formally through myUNSW. **https://student.unsw.edu.au/special-consideration**

- 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 to make any personal or travel arrangements during this period.

COURSE PROGRAM

Table below shows the course program.

Day	Morning (9:00 am-12:30 pm)	Afternoon (1:30 pm-5:00 pm)
Day 1 Wednesday	Introduction to Soil Mechanics, Phase relationships	Compaction, Classification of soils, USCS Classification system
Day 2 Thursday	Stress and Mohr circle, Stress in soils, Effective stress concept, Stress distribution	One-dimensional seepage, Darcy's law, Soil permeability
Day 3 Friday	Two-dimensional seepage, Flow nets, Pore water pressure, Uplift forces	One-dimensional settlement of soil deposits, Normally consolidated and overconsolidated soils
Saturday		
Sunday		
Day 4 Monday	Consolidation theory, Rate of settlement	Shear strength of soils, Mohr Coulomb failure criterion, Direct shear test
Day 5 Tuesday	Shear strength of soils (cont.), Triaxial test, drained and undrained tests	Slope stability, infinite slopes, Graphical Methods

RELEVANT RESOURCES

Learning will be greatly enhanced by reading a text book on the topic. Also, people working in industry where geomechanics is used are recommended to buy a text book to add to their own library. There are many books published on the topic, and the main UNSW library has dozens.

One of the best text books, on which most of the course PowerPoint slides are based and contains thorough explanations and dozens of worked examples, is sold in the UNSW bookshop:

Holtz, R.D., Kovacs, W.D. and Sheahan, T.C. (2011), “An Introduction to Geotechnical Engineering”, Second Edition. International Edition. Pearson.

The following reference books may also be useful for additional reading, many of them can be found in the UNSW library:

- Craig, R. F. "Soil Mechanics", CRC press, 2004
- Das, B. M., “Principles of Geotechnical Engineering”, PWS publishing, 1998-2006
- Lambe and Whitman, "Soil Mechanics", Wiley, 1975
- Scott, C., "An Introduction to Soil Mechanics and Foundation Engineering", AS Publisher, 1980
- Budhu, M., “Soil Mechanics and Foundations”, Wiley & Sons, 2007
- Smith, I, “Smith’s Element of Soil Mechanics”, Blackwell, 2006

Also, students may find the following Soil Mechanics Book in PDF (5.5MB) in a table under the “software” section” from <http://geo.verruijt.net/> website, as SoilMechBook.pdf

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

(Formerly known as Common School Information)

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:

https://www.engineering.unsw.edu.au/civil-engineering/student-resources/policies-procedures-and-forms/academic-advice

Appendix A: Engineers Australia (EA) Competencies

	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