School of Civil and Environmental Engineering

Term 3, 2021

CVEN9513 ADVANCED FOUNDATION ENGINEERING

COURSE DETAILS

Units of Credit	**6**
Contact hours	One 3-hour session per week for 9 weeks plus three 2-hour sessions across the term
Class	Lectures - Wednesday: 15:00-18:00 Online (Wks 1-5, 7-10) Workshops - Friday: 10:00-12:00 (Wks 4,7,9)
Course Coordinator and Lecturer	Dr. Rohit Tiwari email: r.tiwari@unsw.edu.au office: CE604

INFORMATION ABOUT THE COURSE

Students enrolling in this course are assumed to have knowledge of soil mechanics and foundation engineering to Bachelor of Civil Engineering standard. Students without a civil engineering degree (or equivalent) should have completed (or be currently enrolled in) CVEN9525 Fundamentals of Geomechanics.

Students wishing to refresh their knowledge may consider reading Chapters 5,6,7,8,9,11 from 'Craig's Soil Mechanics, Eighth Edition'. An electronic copy of that book is accessible through UNSW's library.

HANDBOOK DESCRIPTION

The course covers analysis and design of shallow foundations and limitations of methods, advanced analysis methods of single piles and pile groups, analysis and construction methods of sheet pile walls, anchored and strutted walls, cast in-situ piles, diaphragm walls, soil anchors and nails. It will also cover the basics of geotechnical earthquake engineering, seismic design of foundations, and earth retaining structures. Also, issues relevant to the design of shallow foundations and retaining walls when interacting with unsaturated soils will be addressed. The course will also require students to carry out analysis and design through project-based learning.

OBJECTIVES

To introduce students to the state of the art of analysis and design in foundation engineering. By the end of the course successful students will be able to apply theoretical, empirical, analytical and design techniques to foundation engineering problems.

TEACHING STRATEGIES

Suggested approaches to learning in the course are tabulated below.

Private Study	• Review lecture material • Do set problems and assignments • Join Moodle discussions of problems • Reflect on class problems and assignments • Download materials from Moodle • Keep up with notices and find out marks via Moodle
Lectures	• Find out what you must learn • Follow worked examples • Hear announcements on course changes
Workshops	• Be guided by the lecturers • Practice solving set problems • Ask questions
Assessments	• Demonstrate your knowledge and skills • Demonstrate higher understanding and problem solving

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.	*Understand and be able to apply the techniques of analysis.*	*PE1.1-1.4, PE2.1-2.2,*
2.	*Understand and be able to apply the techniques of design.*	*PE1.1-1.5, PE2.1-2.5, PE3.2-3.5*

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

COURSE PROGRAM

A table of lectures and workshops or practical class topics for each week, indicating the name of lecturer involved (where multiple lecturers teaching in course), online activities, such as discussion forums, and relevant readings from textbook and other reference material identified for the course.

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Day	**Topic**
Week 1 Wednesday 15:00-18:00	**Bearing capacity of shallow foundations:** conventional approaches, methods of analyses**.** **Problems in bearing capacity of shallow foundations:** strength & stiffness, irregular shapes, N_γ, N_c, layered soils, settlements & consolidations.
Week 2 Wednesday 15:00-18:00	**Problems in bearing capacity of shallow foundations:** continued. **Shallow foundations in unsaturated soils:** Soil suction and its incorporation in to the effective stress and soil strength. Extension of bearing capacity theory. Knowledge gaps.

	Assignment 1 Introduction and Software Analysis: Incorporating suction into a bearing capacity problem using Sigma/W.
Week 3 Wednesday 15:00-18:00	**Sheet pile walls**: construction, cantilever walls designed by UK method, USA method, and King (1995) and Day (1999) method; anchored walls. **Case study – Cutter soil mix (CSM) walls in sand:** fundamental concepts and innovations through fibre reinforcement. **Anchored and strutted walls, diaphragm walls, soil anchors and nails**: construction, earth pressure envelop, design and analysis of walls and soil anchors.
Week 4 Wednesday 15:00-18:00	**Anchored and strutted walls, diaphragm walls, soil anchors and nails**: continued. **Case study – Nicoll Highway collapse** **Retaining walls in unsaturated soils:** Extension of earth pressure theory. Knowledge gaps. **Assignment 2 Introduction.**
Week 5 Wednesday 15:00-18:00	**Advanced analysis of single pile**: load-settlement analysis of single pile by load transfer method, analytical method of Randolph and Wroth, elastic method. Introduction to numerical discretization of load transfer method. Influence factor method for pile group.
Week 6	**No class – non-teaching week**
Week 7 Wednesday 15:00-18:00	**Cast in-situ piles**: construction, ultimate bearing capacity and allowable bearing capacity based on tolerable settlement of bored cast in-situ piles**.**
Week 8 Wednesday 15:00-18:00	**Geotechnical earthquake engineering – Basics** Introduction, theory of continental drift and plate tectonics, fault mechanisms, quantification of earthquake size, waves in a semi-infinite body, concept of damping, modal analysis, constitutive behaviour of cyclic loaded soils, liquefaction.
Week 9 Wednesday 15:00-18:00	**Seismic design of footings and piles** Seismic bearing capacity of shallow foundation, settlement of foundation in liquefied ground, total and differential settlement of shallow foundation, seismic performance of pile foundation, failure mechanism of pile supported structures, seismic performance of piles in liquefiable soils, seismic design of piles and design checks.
Week 10 Wednesday 15:00-18:00	**Seismic design of retaining walls** Dynamic soil pressure, earthquake induced displacement of retaining walls, seismic design considerations for gravity and cantilever retaining walls, finite element analyses of seismic actions on earth retaining structures. **Exam Tips and Consultation**

ASSESSMENT

- Assignment 1 is due in week 3 (5pm, Friday 1st October) value 10%
- Assignment 2 is due in week 7 (5pm, Friday 29th October) value 30%
- Assignment 3 is due at 5pm, (Friday 19th November) value 20%

- Two-hour final exam in Inspera (Term 3, 2021 Examination Period) value 40%

The Assignments (1, 2 and 3) are to be submitted electronically though Moodle.

Term 3, 2021 Examination Period: 26th November – 9th December 2021

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 to make any personal or travel arrangements during this period.

PENALTIES

Late work will be penalised at the rate of 10% per day after the due time and date have expired.

HURDLE REQUIREMENTS

(i) The student must achieve a mark of at least 50% of total assessment (Assignment 1, 2, 3 & final exam).

(ii) The final grade for this course will normally be based on the sum of the scores from each of the assessment tasks. Therefore, to ensure that you have met the learning outcomes you must achieve a mark of at least 40% in the final Inspera exam in order for the assignment marks will be included.

ASSESSMENT OVERVIEW

Item	**Length**	**Weighting**	**Learning outcomes assessed**	**Assessment Criteria** *(this needs to explicitly describe what students are expected to demonstrate in the task)*	**Due date and submission requirements**	**Deadline for absolute fail**	**Marks returned**
1. Assignment 1	*~2 days*	*10%*	*PE1.1-1.5, PE2.1-2.5, PE3.2-3.5*	*See assignment question uploaded on Moodle*	*1st October*	*9th October*	*9th October*
2. Assignment 2	*~3 weeks*	30%	*PE1.1-1.5, PE2.1-2.5, PE3.2-3.5*	*See assignment question uploaded on Moodle*	29th October	5th November	8th November
3. Assignment 3	*~2 weeks*	20%	*PE1.1-1.5, PE2.1-2.5, PE3.2-3.5*	*See assignment question uploaded on Moodle*	19th November	2nd December	25th November
4. Exam	2 hours	40%	*PE1.1-1.5, PE2.1-2.5, PE3.2-3.5*		Final exam period		Official release of results

RELEVANT RESOURCES

It is not necessary to buy a text book as the notes provided are extensive and sufficient. These will include references to several books and numerous articles in the technical literature. Completion of the assignments may require students to refer to these works.

If you do want to buy a book then a few copies of the following are in the bookshop.
Das Braja M, Principles of Foundation Engineering 8e SI, Cengage Learning.

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: 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://intranet.civeng.unsw.edu.au/key-staff-to-contact-during-your-studies-at-unsw

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