CVEN9513

Advanced Foundation Engineering

Term 3, 2022

Course Overview

Staff Contact Details

Convenors

Name	Email	Availability	Location	Phone
Rohit Tiwari	r.tiwari@unsw.edu.au	Email to to make appointment	Civil Engineering Building (H20) Level 6, Room CE604	+61293480182

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

Project based learning for understanding the principles of:

- Analysis and design of shallow foundations and limitations of methods,
- Design of shallow foundations and retaining walls in unsaturated soils,
- 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,
- Basics of geotechnical earthquake engineering, seismic design of foundations, and earth retaining structures.

Course Aims

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 and numerical analysis and design techniques to foundation engineering problems

Course Learning Outcomes

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

Learning Outcome	EA Stage 1 Competencies
1. Explain the strength and serviceability design aspects for shallow foundations.	PE1.1, PE1.2, PE2.1, PE2.2, PE3.1, PE3.5
2. Evaluate static designs of various earth retention systems for strength and serviceability aspects.	PE1.3, PE2.1, PE3.2, PE3.3, PE3.6
3. Perform advanced analysis of single piles and pile groups.	PE1.2, PE2.2, PE2.3, PE3.2, PE3.6
4. Explain the critical geotechnical earthquake engineering concepts related to seismic site response analysis.	PE1.3, PE1.4, PE2.3, PE3.3, PE3.4
5. Evaluate the liquefaction potential of a given site by applying soil mechanics principles and geotechnical earthquake engineering.	PE1.1, PE2.1, PE2.2, PE3.2, PE3.3
6. Evaluate the seismic performance of retaining walls using simplified calculations and complex non-linear time-history analyses.	PE1.1, PE2.1, PE2.2, PE3.1, PE3.4

Teaching Strategies

Please refer to the information in Moodle

Assessment

Assessment task	Weight	Due Date	Course Learning Outcomes Assessed
1. Assignment 1	10%	05/10/2022 06:00 PM	1
2. Assignment 2	30%	28/10/2022 06:00 PM	2, 3
3. Assignment 3	20%	15/11/2022 06:00 PM	4, 5, 6
4. Inspera Final Exam	40%	Not Applicable	1, 2, 3, 4, 5, 6

Assessment 1: Assignment 1

Start date: 29/09/2022 12:00 AM
Assessment length: 2
Submission notes: Moodle Assignment Submission
Due date: 05/10/2022 06:00 PM
Deadline for absolute fail: 15/10/2022
Marks returned: 07/10/2022

Incorporating suction into a bearing capacity problem using Sigma/W.

Assessment criteria

See assignment question uploaded on Moodle

Assessment 2: Assignment 2

Start date: 05/10/2022 12:00 AM
Assessment length: 21
Submission notes: Moodle Assignment Submission
Due date: 28/10/2022 06:00 PM
Deadline for absolute fail: 05/11/2022
Marks returned: 8/11/2022

Analyses and Design of Earth Retention Systems.

Assessment criteria

See assignment question uploaded on Moodle

Assessment 3: Assignment 3

Start date: 05/10/2022 12:00 AM
Assessment length: 14
Submission notes: Moodle Assignment Submission
Due date: 15/11/2022 06:00 PM
Deadline for absolute fail: 02/12/2022
Marks returned: 20/11/2022

Seismic Assessment of Retaining Walls.

Assessment criteria

See assignment question uploaded on Moodle

Assessment 4: Inspera Final Exam

2 Hrs open book Inspera exam.

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

Students are strongly encouraged to attend all classes and review lecture recordings.

Course Schedule

View class timetable

Timetable

Date/Module	Type	Content
28/9/2022	Lecture	**Bearing capacity of shallow foundations:** conventional approaches, methods of analyses**.** **Problems in bearing capacity of shallow foundations:** strength & stiffness, irregular shapes, Ng, Nc, layered soils, settlements & consolidations. **Shallow foundations in unsaturated soils:** Soil suction and its incorporation into 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.
29/9/2022	Lecture	**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. **Case study – Nicoll Highway collapse** **Retaining walls in unsaturated soils:** Extension of earth pressure theory. Knowledge gaps. **Assignment 2 Introduction.**
30/9/2022	Lecture	**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. **Cast in-situ piles**: construction, ultimate bearing capacity and allowable bearing capacity based on tolerable settlement of bored cast in-situ piles**.**
04/10/2022	Lecture	**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. **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.
05/10/2022	Lecture	**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. Introduction to Inspera Examination Platform **Exam Tips and Consultation**

Resources

Recommended 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 (if interrested) students to refer to these works.

Das Braja M, Principles of Foundation Engineering 8e SI, Cengage Learning.

Steven L. Kramer, Geotechnical Earthquake Engineering, Pearson Education.

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

Mike Gal.

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	✓