Annexe A: New/Revised Course Content in OBTL+ Format

Course Overview

The sections shown on this interface are based on the templates UG OBTL+ or PG OBTL+
If you are revising/duplicating an existing course and do not see the pre-filled contents you expect in the subsequent sections e.g. Course Aims, Intended Learning Outcomes etc. please refer to Data Transformation Status for more information.

Expected Implementation in Academic Year	AY 2022/2023
Semester/Trimester/Others (specify approx. Start/End date)	Semester 2
Course Author * Faculty proposing/revising the course	Lee-Chua Lee Hong
Course Author Email	clhlee@ntu.edu.sg
Course Title	Ground Engineering
Course Code	CV4111
Academic Units	3
Contact Hours	39
Research Experience Components	Not Applicable

Course Requisites (if applicable)

Pre-requisites	CV2014 Geotechnical Engineering
Co-requisites	
Pre-requisite to	
Mutually exclusive to	
Replacement course to	
Remarks (if any)	

Course Aims

Ground engineering, including ground improvement and slope stability, is commonly encountered in civil engineering projects. This course aims to acquaint you with the principles of engineering ground improvement and the methods of slope stability analysis and slope stabilization.

Course's Intended Learning Outcomes (ILOs)

Upon the successful completion of this course, you (student) would be able to:

ILO 1	Explain the purpose and principles of ground improvement
ILO 2	Evaluate and select ground improvement methods
ILO 3	Understand the hydraulic properties and shear strength of saturated and unsaturated soil
ILO 4	Understand the principles of slope stability analyses incorporating unsaturated soil
ILO 5	Understand the mechanism and assessment of rainfall-induced slope failures
ILO 6	Understand monitoring and stabilization for slope protection against rainfall

Course Content

S/N	Topic	Lecture Hrs	Tutorial Hrs
1	Principles of ground improvement	1	1
2	Shallow surface compaction	2	1
3	Deep densification	2	1
4	Deep replacement	2	1
5	Preloading and vertical drains	2	1
6	Chemical stabilization	2	1
7	Soil reinforcement	2	1
8	Hydraulic properties and shear strength of saturated and unsaturated soil	3	1
9	Slope stability analyses using method of slices	2	1
10	Rainfall-induced slope failures: mechanism and assessment	2	1
11	Case studies of residual soil slopes	2	1
12	Slope monitoring and slope stabilization	2	1
13	Slope cover and drainage systems	2	1
	Total:	26	13

Reading and References (if applicable)

Texts

1. Jie Han.(2015). Principles and Practices of Ground Improvement, John Wiley.
2. CV4111 Course Notes.
3. Fredlund, D.G. and H. Rahardjo (1993) "Soil Mechanics for Unsaturated Soils". John Wiley & Sons, Inc., New York, 517 pages (ISBN 0-471-85008-X).

References

1. Kirsch, K. and Bell, A. (2013). Ground Improvement, 3rd Edition, CRC Press.
2. Bo, M.W., Chu, J., Low, B.K., and Choa, V. (2003). Soil Improvement: Prefabricated Vertical Drain Techniques, by Thomson Learning, Thomson Asia Pte Ltd.
3. Cornforth, D. (2005). Landslides in Practice: Investigation, Analysis, and Remedial/Preventive Options in Soils, John Wiley.
4. Fredlund, D.G., Rahardjo, H. and Fredlund, M.D. (2012). Unsaturated Soil Mechanics in Engineering Practice, John Wiley & Sons, Inc., New York. (ISBN 978-1-118-13359-0).
5. Rahardjo, H., Leong, E.C., Ortigao, J.A.R. and Rezaur, R.B. (2012) "Slopes", Chapter 7 in Handbook of Tropical Residual Soil Engineering, ed. B.B.K. Huat, D.G. Toll and A. Prasad, Taylor & Francis Group, Leiden, the Netherlands, pp. 213-282 (ISBN: 978-0-415-45731-6).

Planned Schedule

Week or Session	Topics or Themes	ILO	Readings	Delivery Mode	Activities
1	Overview and principles of ground improvement Shallow surface compaction	1,2	Reading texts and references	In-person	Tutorial 1
2	Shallow surface compaction Deep densification	1,2	Reading texts and references	In-person	Tutorial 2
3	Deep densification. Deep replacement	1,2	Reading texts and references	In-person	Tutorial 3
4	Deep replacement. Preloading and vertical drains	1,2	Reading texts and references	In-person	Tutorial 4
5	Preloading and vertical drains Chemical stabilization	1,2	Reading texts and references	In-person	Tutorial 5
6	Chemical stabilization Soil reinforcement	1,2	Reading texts and references	In-person	Tutorial 6
7	Soil reinforcement Hydraulic properties of saturated and unsaturated soil	1,2,3	Reading texts and references	In-person	Tutorial 7
8	Shear strength of saturated and unsaturated soils	3	Reading texts and references	In-person	Tutorial 8

Week or Session	Topics or Themes	ILO	Readings	Delivery Mode	Activities
9	Slope stability analyses using method of slices	3.4	Reading texts and references	In-person	Tutorial 9
10	Rainfall-induced slope failures: mechanism and assessment	3,4,5	Reading texts and references	In-person	Tutorial 10
11	Case studies of residual soil slopes	4,5	Reading texts and references	In-person	Tutorial 11
12	Slope monitoring and slope stabilization	4,5,6	Reading texts and references	In-person	Tutorial 12
13	Slope cover and drainage systems	4,5,6	Reading texts and references	In-person	Tutorial 13

Learning and Teaching Approach

Approach	How does this approach support you in achieving the learning outcomes?
Lecture	Provide materials to you and guidance in scope for reading of texts and references
Tutorials	Reinforce materials covered in lectures and further explain concepts, process and design philosophy in ground engineering.
CA1 & CA2	Provide feedback to you on your understanding of the course

Assessment Structure

Assessment Components (includes both continuous and summative assessment)

No.	Component	ILO	Related PLO or Accreditation	Weightage	Team/Individual	Rubrics	Level of Understanding
1	Summative Assessment (EXAM): Final exam(Final Examination)		(a), (b)	60	Individual	Holistic	Relational
2	Continuous Assessment (CA): Test/Quiz(CA1: Quiz 1)	1, 2	(a), (b)	20	Individual	Analytic	Multistructural
3	Continuous Assessment (CA): Test/Quiz(CA2: Quiz 2)	3,4,5,6	(a), (b)	20	Individual	Analytic	Multistructural

Description of Assessment Components (if applicable)

EAB Graduate Attributes

"Engineering Knowledge

Apply the knowledge of mathematics, natural science, engineering fundamentals, and an engineering specialisation to the solution of complex engineering problems."

"Problem Analysis

Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences."

"Design / Development of Solutions

Design solutions for complex engineering problems and design systems, components or processes that meet the specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations."

"Investigation

Conduct investigations of complex problems using research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions."

"Modern Tool Usage

Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations."

"The Engineer and Society

Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice."

"Environment and Sustainability

Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for the sustainable development."

"Ethics

Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice."

"Individual and Team Work

Function effectively as an individual, and as a member or leader in diverse teams and in multidisciplinary

settings."

"Communication

Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions."

"Project Management and Finance

Demonstrate knowledge and understanding of the engineering management principles and economic decision-making, and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments."

"Life-long Learning

Recognise the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change."

Formative Feedback

Feedback will be through the dissemination of the student's performance in quizzes as well as review of the quiz questions in class.

We encourage you to initiate an individual consultation session, on your learning needs.

NTU Graduate Attributes/Competency Mapping

This course intends to develop the following graduate attributes and competencies (maximum 5 most relevant)

Attributes/Competency	Level
Creative Thinking	Intermediate
Decision Making	Intermediate
Problem Solving	Intermediate
Critical Thinking	Intermediate
Design Thinking	Intermediate

Course Policy

Policy (Academic Integrity)

Good academic work depends on honesty and ethical behaviour. The quality of your work as a student relies on adhering to the principles of academic integrity and to the NTU Honour Code, a set of values shared by the whole university community. Truth, Trust and Justice are at the core of NTU's shared values. As a student, it is important that you recognize your responsibilities in understanding and applying the principles of academic integrity in all the work you do at NTU. Not knowing what is involved in maintaining academic integrity does not excuse academic dishonesty. You need to actively equip yourself with strategies to avoid all forms of academic dishonesty, including plagiarism, academic fraud, collusion and cheating. If you are uncertain of the definitions of any of these terms, you should go to the academic integrity website for more information. On the use of technological tools (such as Generative AI tools), different courses / assignments have different intended learning outcomes. Students should refer to the specific assignment instructions on their use and requirements and/or consult your instructors on how you can use these tools to help your learning. Consult your instructor(s) if you need any clarification about the requirements of academic integrity in the course.

Policy (General)

Students are expected to complete all assigned pre-class readings and activities, attend all lessons punctually and take all scheduled assignments and tests by due dates. Students are expected to take responsibility to follow up with course notes, assignments, and course-related announcements that they have missed. Students are expected to participate in all discussions and activities.

Policy (Absenteeism)

The quizzes make up a significant portion of your course grade. Absence from quizzes without a valid reason will affect your overall course grade. Valid reasons include falling sick supported by a medical certificate and participation in NTU's approved activities supported by an excuse letter from the relevant bodies. There will be no make-up opportunities for quizzes.

If you miss a quiz, you must inform your course lecturer via email. Students who miss quizzes with valid reasons will have to apply for short term leave of absent through CEE Undergraduate Office supported with medical certificates or excuse letter from the relevant bodies.

Policy (Others, if applicable)

Last Updated Date: 25-11-2024 03:16:32

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