The Hong Kong Polytechnic University

Subject Description Form

Subject Code	CSE584
Subject Title	Advanced Soil Mechanics
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Students should have a knowledge and understanding of engineering geology, soil mechanics, and foundation engineering consistent with undergraduate level study in civil engineering.
Objectives	1. To provide students with the knowledge about advanced soil lab tests and stress-strain behavior of soils; 2. To equip students with the knowledge about constitutive models for soils; 3. To equip students with Elastic Visco-Plastic (EVP) model for time-dependent stress-strain behavior of soils and analysis methods for consolidation settlements of soils exhibiting creep; 4. To introduce students with commonly used finite element software in geotechnical engineering; 5. To introduce students with state-of-the-art settlement control and ground improvement methods.
Intended Learning Outcomes	Upon completion of the subject, students will be able: a. to describe the test methods and stress-strain behavior of soils b. to understand commonly used constitutive models of soils; c. to master analysis and calculation of consolidation settlements of soils exhibiting creep; d. to be able to conduct numerical simulation using PLAXIS software; e. to understand the mechanisms performance of state-of-the-art ground improvement methods.
Subject Synopsis/ Indicative Syllabus	1. <u>Laboratory tests and stress-strain behavior of soils (3 weeks)</u> Basic properties, oedometer test, direct shear test, triaxial test, true triaxial test; volume compression behavior, elasto-plasticity, non-linearity; shear strength, shear behavior, shear dilatancy, critical state; visit to soil laboratory. 2. <u>Commonly used constitutive models (3 weeks)</u> Stress space and invariants; linear isotropic elasticity; linear anisotropic elasticity; hypo-elastic models; Mohr-Coulomb elastic-plastic model; critical state models.

3. Elastic Visco-Plastic Model of Soils (3 weeks)
Time-dependent behaviours of soils; Maxwell rheological model; 1D EVP; 3D EVP model; 1D non-linear creep of soils; verification and applications.

4. Calculation methods of soil deformation and applications (4 weeks)
Terzaghi' consolidation theory, 2D/3D consolidation, Hypotheses A and B, simple methods for consolidation settlement calculation of soils exhibiting creep; settlement control and ground improvement methods.

Teaching/Learning Methodology

1. Lectures to deliver teaching materials.
2. Technical seminars delivered by practicing engineers.
3. Tour to Soil Mechanics Laboratory in PolyU.
4. An individual report on detailed study of finite element (FE) analysis using PLAXIS software.
5. Assignments related to the subject contents.
6. Examination.

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)				
		a	b	c	d	e
1. Continuous Assessment	40%	✓	✓	✓	✓	✓
2. Written Examination	60%	✓	✓	✓		✓
Total	100 %					

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

Assignment to problems relevant lecture contents will help the students to understand and apply the concepts and methods for real applications. The individual report is good for each student to have critical thinking and apply their knowledge to solve a geotechnical engineering problem. The final examination will check the intended learning outcomes of the whole subject.

Students must attain at least grade D in both coursework and final examination (whenever applicable) in order to attain a passing grade in the overall result.

	Class contact:	

<table>
<tr><td rowspan="5">Student Study Effort Expected</td><td>▪ Lecture / Talk</td><td>26 Hrs.</td></tr>
<tr><td>▪ Tutorial / Lab Visit</td><td>13 Hrs.</td></tr>
<tr><td>Other student study effort:</td><td></td></tr>
<tr><td>▪ Self-study and homework</td><td>78 Hrs.</td></tr>
<tr><td>Total student study effort</td><td>117 Hrs.</td></tr>
<tr><td>Reading List and References</td><td colspan="2">Books:
1. Muir Wood, David, Soil Behaviour and Critical State Soil Mechanics, Cambridge University Press, (1990).
2. Craig, R. F. Soil mechanics, CRC Press, (2004)
3. Mitchell, James K., “Fundamentals of Soil Behaviour”, Second Edition, John Wiley & Sons, Inc. (1993).
4. Potts, D.M. and Zdravkovic, L., Finite Element Analysis in Geotechnical Engineering – Theory, Thomas Telford Publishing Ltd, U.K. (ISBN: 0 7277 2753 2), (1999).
5. Potts, D.M. and Zdravkovic, L., Finite Element Analysis in Geotechnical Engineering - Application, (2001).
6. Yin, JH and Zhu, GF (2020). Consolidation Analyses of Soils. Consolidation Analyses of Soils. CRC Press of Taylor & Francis Group (ISBN 9780367555320). For more information see https://www.routledge.com/9780367555320.

Manuals:
1. Buildings Department (2017). Code of Practice for Foundations 2017. Buildings Department, HKSARG.
2. Guide to Retaining Wall Construction (2020) by GEO (Geotechnical Engineering Office), HKSARG.
3. Guide to Site Investigation (2017). GEO, HKSARG.
4. Geospec 3 Model Specification for Soil Testing (2017). GEO, HKSARG.
5. Review of Design Methods for Excavations (1990). GEO, HKSARG.
6. Foundation Design and Construction (2006). GEO, HKSARG.
7. These manuals from GEO can be found at: https://www.cedd.gov.hk/eng/publications/geo/index.html
8. published by the Geotechnical Control Office (GEO), Civil Engineering Services Department (CEDD), HKSARG of China.
9. PLAXIS software manuals.

Papers:
1. Feng, W.Q. and JH Yin (2017). A new simplified Hypothesis B method for calculating consolidation settlements of double soil</td></tr>
</table>

	layers exhibiting creep. International Journal for Numerical and Analytical Methods in Geomechanics, 41, 899–917. 2. Yin, JH and Feng, WQ (2017). A new simplified method and its verification for calculation of consolidation settlement of a clayey soil with creep. Canadian Geotechnical Journal. Can. Geotech. J. 54(3), 333–347. 3. Yin, JH, Chen, ZJ, and Feng. WQ (2022). A general simple method for calculating consolidation settlements of layered clayey soils with vertical drains under staged loadings. Canadian Geotechnical Journal. Acta Geotechnica, Jan 2022, https://doi.org/10.1007/s11440-021-01318-2.