Subject Code	CSE20352
Subject Title	Soil and Rock Engineering
Credit Value	3
Level	2
Pre-requisite / Co-requisite/ Exclusion	Pre-requisite: CSE10256 Soil Mechanics
Objectives	(1) To enable students to acquire basic knowledge of soil and rock engineering; (2) To train students with basic laboratory techniques; (3) To enable students to make engineering judgment on geotechnical design.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. apply the fundamentals of science and mathematics to understand soil and rock related engineering issues; b. apply the knowledge covered in Soil Mechanics and Geology and mathematical tools to establish models or formulations for solving soil and rock related engineering problems; c. recognize various site conditions for design, construction, and operation of substructures, such as shallow and deep foundations, retaining walls, and slopes; d. appreciate the development and application of modern geotechnologies for site investigations, ground improvements, slope stabilisations, and foundation constructions, *etc*; e. carry out triaxial tests, point load tests, unconfined compression test, and analysis of test data. f. to recognize the need for, and to engage in life-long learning
Subject Synopsis/ Indicative Syllabus	1. Geotechnical Problems in Hong Kong and Subsoil Exploration (1.5 weeks) Geotechnical problems: landslides, reclamations, soft marine soil, tunneling, fills, excessive settlements, problems associated with excavations. Subsoil exploration: subsurface exploration program, exploratory boring in the field, procedures for sampling soil, observation of water tables, vane shear test, cone penetration test, coring of rocks, preparation of boring logs, and subsoil exploration report. 2. Shallow Foundations (2.5 weeks) Ultimate bearing capacity by theoretical soil mechanics methods, bearing capacity under eccentric or inclined loadings, effect of groundwater table on bearing capacity, allowable bearing pressures by empirical methods. Causes of settlements; estimation of total settlement, differential settlement of structures; design procedures. 3. Lateral Earth Pressure and Retaining Wall Design (2 weeks) Geostatic stress and earth pressure at-rest; Rankine's theory and Coulomb's theory of active and passive earth pressures, surcharge and ground-water pressure. Different failure modes of retaining wall, design of retaining walls, and drainage requirements.

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4. Deep Foundations (2 weeks)
Ultimate pile carrying capacity by theoretical soil mechanics and empirical methods (according to HK practice). Negative skin friction on piles. Pile driving formulae. Piles subjected to horizontal or inclined loads. Capacity and efficiency of pile groups. Stress distribution under pile groups by empirical rules. Estimation of settlement under a group of piles.

5. Slope Stability (2 weeks)
Slope stability analysis for sand and clay soils. Fellenius' and Swedish method of slices, Bishop and Janbu methods. Slope Stability in Hong Kong.

6. Soil Improvement and Ground Modification (1 week)
Deep compaction by vibro compaction and compaction piles, deep compaction by blasting, consolidation by wick/sand drains. Injection and grouting. Admixture stabilization. Soil reinforcement.

7. Rock Mechanics and Rock Engineering (2 weeks)
Index properties of rocks, strength and failure criteria of intact rocks, common laboratory strength test, weak planes in rock, joint test methods, rock mass classification.
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<tr><td>Teaching/Learning Methodology</td><td>Fundamental knowledge will be covered in lectures. Tutorials will provide opportunities for discussion of lecture materials and will also be conducted in the form of example class and problem-solving session to supplement understanding from lectures. Laboratory work will help students appreciate the basic principles and familiarize themselves with basic instruments. Seminars will widen students' exposure and provide opportunities for learning state-of-the-art theories and technologies in soil and rock engineering.</td></tr>
<tr><td>Assessment Methods in Alignment with Intended Learning Outcomes</td><td>
<table>
<tr><td rowspan="2">Specific assessment methods/tasks</td><td rowspan="2">% weighting</td><td></td><td colspan="5">Intended subject learning outcomes to be assessed</td></tr>
<tr><td>a</td><td>b</td><td>c</td><td>d</td><td>e</td><td>f</td></tr>
<tr><td>(1) Assignments</td><td>10</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td></td><td></td></tr>
<tr><td>(2) Lab reports</td><td>10</td><td></td><td></td><td></td><td></td><td>✓</td><td></td></tr>
<tr><td>(3) Seminar report</td><td>5</td><td>✓</td><td></td><td></td><td>✓</td><td></td><td>✓</td></tr>
<tr><td>(4) Mid-term test(s)</td><td>10</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td></td><td></td></tr>
<tr><td>(5) Final examination</td><td>65</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td></td><td></td></tr>
<tr><td>Total</td><td>100</td><td></td><td colspan="5"></td></tr>
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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.

Explanation of the appropriateness of the assessment methods in
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<tr><td></td><td colspan="2">assessing the intended learning outcomes:

The students will be assessed with five components, i.e., assignments, laboratory tests, a seminar report, a written test in the middle of the semester and a final examination. The five components together with the report writing are best to achieve intended learning outcomes in a), b), c), d), and e).

The students will be required to do and submit assignments, attend laboratory sessions and submit group laboratory reports. These laboratory sessions will enable students to acquire basic laboratory techniques and report writing. The works in the laboratory sessions are closely related to soil engineering requirements. Student will have to attend at least one seminar and submit a written report. Students will have to exert engineering judgments to complete assignments and laboratory sessions. The examination will consolidate students' learning in lectures and tutorials. It is most appropriate to achieve the intended learning outcomes a), b), c) and d).</td></tr>
<tr><td rowspan="7">Student Study Effort Expected</td><td></td><td>Average hours per week</td></tr>
<tr><td>Class contact:</td><td></td></tr>
<tr><td>▪ Lectures/ Tutorials/ Laboratory Sessions</td><td>3 Hrs.</td></tr>
<tr><td>Other student study effort:</td><td></td></tr>
<tr><td>▪ Reading and studying</td><td>3 Hrs.</td></tr>
<tr><td>▪ Completion of Assignments/Lab Reports/Attending seminar(s) and writing a report</td><td>3 Hrs.</td></tr>
<tr><td>Total student study effort</td><td>9 Hrs.</td></tr>
<tr><td>Reading List and References</td><td colspan="2">B.M. Das (2007). Principles of Foundation Engineering, 7th edition, Thomson.

R.E. Goodman (1989). Introduction to Rock Mechanics, 2nd edition, Wiley.

Cernica, J.N. (1998). Geotechnical Engineering: Foundation Design, McGraw-Hill.

Bowles, J. (1996). Foundation Analysis and Design, 5th edition, McGraw-Hill.

Knappett, J. A. & Craig, R.F. (2012). Soil Mechanics, 8th edition.

Tomlinson, M.J. (2001). Foundation Design and Construction, 7th edition, Longman Scientific & Technical.</td></tr>
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