

Rubric Title of course Instructor	CIVL3740 (Spring 22-23) Geotechnical Analysis and Design Professor Pui San SO (Email: cepssso@ust.hk)
Course catalog description, prerequisites, and credit	This course is about the applications of fundamental principles of soil and rock mechanics to geotechnical analyses and designs. It covers lateral earth theories, design of earth retaining structures, braced cuts or multi-propped excavations, shallow and deep foundations, slope stability and reinforced earth structures, and introduction of basic rock mechanics. (Prerequisite: CIVL3730; Credit: 3)
Textbook(s) and/or other required material	<ul style="list-style-type: none"> <li>• Craig, R.F. (2012) Soil Mechanics. 8th edition, E &amp; FN SPON.</li> <li>• Budhu, M. (2011). Soil Mechanics and Foundations John Wiley, 3rd edition.</li> <li>• Das, B. M. (2011). Principles of Foundation Engineering. 7th edition, 2011.</li> <li>• Das, B. M. (2012). Fundamentals of Geotechnical Engineering. 4th edition.</li> <li>• Ng, C.W.W., Simons, N. &amp; Menzies, B. (2008). Soil-structure Engineering of Deep Foundations, Excavations and Tunnels. Publisher: Thomas Telford, UK. 3rd Reprint. 416p.</li> <li>• Powrie, W. (2004). Soil Mechanics - Concept and Applications, 2nd edition, E &amp; FN SPON.</li> </ul>
Course objectives	<p>This course will enable students to:</p> <ul style="list-style-type: none"> <li>• Understand the basic principles of soil mechanics</li> <li>• Comprehend and apply the basic soil mechanics theories in the design of earth retaining structures, braced cuts or multi-propped excavations, shallow and deep foundations, slope stability and reinforced earth structures</li> <li>• Improve the ability of solving geotechnical problems independently and scientifically</li> </ul>
Topics/chapters	<p><b>1. Lateral earth pressure</b>  1.1 Lateral earth pressure at rest (<math>K_0</math>)  1.2 Rankine's theory  1.3 Coulomb's theory  1.4 Assignment and worked examples</p> <p><b>2. Design of retaining walls</b>  2.1 General design philosophy  2.2 Gravity &amp; cantilever concrete walls  2.3 Cantilever sheet pile walls  2.4 Anchored sheet pile walls  2.5 Soil arching  2.6 Pore pressure distributions behind retaining wall  2.7 Assignment and worked examples</p> <p><b>3. Braced cuts or multi-propped excavations</b>  3.1 General design philosophy  3.2 Short-term lateral wall stability &amp; strut loads  3.3 Base heave in clays  3.4 Piping in sands  3.5 Ground settlement &amp; swelling</p>

	<p>3.6 Assignment and worked examples</p> <p><b>4. Shallow Foundations</b></p> <p>4.1 General behaviour and design principles</p> <p>4.2 Terzaghi's general ultimate bearing capacity theory</p> <p>4.3 Other bearing capacity theories</p> <p>4.4 Vertical stress distributions below shallow foundations</p> <p>4.5 Settlements of shallow foundations</p> <p>4.6 Assignment and worked examples</p> <p><b>5. Deep Foundations</b></p> <p>5.1 Types and uses of pile foundations</p> <p>5.2 Design principles of vertically loaded single piles</p> <p>5.3 Design of rock socketed piles</p> <p>5.4 Negative skin friction</p> <p>5.5 Pile load tests</p> <p>5.6 Assignment and worked examples</p> <p><b>6. Slope Stability</b></p> <p>6.1 Slope characterisation</p> <p>6.2 Methods of slope stability analysis</p> <p>6.3 Practical consideration of methods of analysis</p> <p>6.4 Choice between total and effective stress analysis</p> <p>6.5 Assignment and worked examples</p> <p><b>7. Reinforced Earth Structures</b></p> <p>7.1 Types and considerations of soil reinforcement</p> <p>7.2 Failure mechanisms</p> <p>7.3 Assignment and worked examples</p> <p><b>8. Introduction of Rock Mechanics</b></p> <p>8.1 Composition and characteristics of the rock</p> <p>8.2 Rock mechanical properties and influencing factors</p> <p>8.3 Rock strength and failure criterion</p>
Computer usage	Required for showing ppt
Laboratory projects	Not required
Class schedule	Lecture: 3 hours/week; Tutorial: 100 mins/week
Contribution to the professional component	100% engineering topics
Relationship to program objectives	<p>This course contributes to the following objectives:</p> <ul style="list-style-type: none"> <li>• Provide students with professional skills in the design, construction and management of the civil infrastructure. This course provides a detailed instruction of the fundamentals of behaviour and design of geotechnical problems.</li> <li>• Challenge students with research-type and open-ended design problems to stimulate self-learning and innovative problem-solving skills. This course requires students to analyse geotechnical problems and apply problem-solving skills to develop an appropriate design solution.</li> <li>• Expose students to real world engineering projects as well as cutting edge research to improve their understanding of the profession and technological</li> </ul>

	<p>advancements that can improve current practice. This course covers the state-of-the-art design of geotechnical infrastructure in detail, and illustrate comprehensively how these designs are related to the technological advancements.</p>
Relationship to program outcomes	<p>This course contributes to the following program outcomes:</p> <ul style="list-style-type: none"> <li>• Understand fundamental principles of engineering science relevant to civil engineering disciplines. This course provides the fundamentals of basic soil mechanics and their applications in geotechnical problems.</li> <li>• Develop an ability to identify and formulate civil engineering problems, and propose feasible solutions with an appreciation of their underlying assumptions, uncertainties, constraints, and technical limitations. This course provides the basic skills to tackle geotechnical problems and their pros and cons.</li> <li>• Develop technical competency to design civil engineering components and systems, with an understanding of the principles behind the design methodologies. This course equips the students with state-of-the-art knowledge in the design of retaining wall, excavation, foundation, etc.</li> <li>• Obtain in-depth knowledge in at least one major area of specialization within civil engineering. This course provides the advanced knowledge in geotechnical design.</li> <li>• Develop an ability to stay abreast of contemporary issues, both nationally and internationally, and the awareness of the impact of engineering in these areas. This course can provide the basic solutions to the geotechnical disasters at home and abroad.</li> </ul>
Assessment of outcomes	<ul style="list-style-type: none"> <li>• Tutorial Assignments = 10%, there are 5 assignments</li> <li>• Mid-term examination= 30%</li> <li>• Final examination= 60%</li> </ul>
Prepared by	Pui San SO
Date	16 January 2023