

### Undergraduate Civil Engineering Programme

|   |  |                |      |
|---|--|----------------|------|
| Coordinating Unit:  | Department of Civil and Environmental Engineering,<br>Faculty of Science and Technology  |                |      |
| Supporting Unit(s):                                       | Nil  |                |      |
| Course Code:  | CEEB322 / CIVL455  | Year of Study: | 3, 4 |
| Course Title:   | Foundation Engineering   |                |      |
| Compulsory/Elective:                                      | Compulsory (CEEB322) / Elective (CIVL455)  |                |      |
| Course Prerequisites:                                     | CEEB313 / CIVL 352   |                |      |
| Prerequisite Knowledge:                                   | Basic knowledge of soil mechanics; good understanding of soil properties and behavior;   |                |      |
| Duration:   | One semester   | Credit Units:  | 3    |
| Class/Laboratory Schedule:                                | (Three hours of lecture per week.)<br>Session 1 (CIVL 455): Tue. 14:30-15:50, Fri. 10:00-11:20, J219<br>Session 2 (CEEB 322): Wed. 11:30-12:50, J312, Fri. 16:00-17:20, U103   |                |      |
| Laboratory/Software Usage:                                | None   |                |      |
| Course Description:                                       | The course introduces civil engineering students the fundamental concepts of foundation analysis and design. This course covers the following topics: Review of Soil Mechanics; Subsurface Exploration; Shallow Foundations; Pile Foundations, and selected topics of foundation engineering.  |                |      |
| Course Objectives:  | <ol style="list-style-type: none"> <li>1. To introduce to students the fundamental concepts of foundation analysis and design.</li> <li>2. To develop students the ability to interpret field and laboratory data to get design parameters for foundation analysis.</li> <li>3. To prepare students for the effective use of the commonly used formulas, tables, and figures in the design and analysis of shallow and deep foundations.</li> <li>4. To introduce some selected topics in foundation engineering.</li> </ol>                                     |                |      |
| Learning Outcomes (LO):                                   | <p>Upon completion of this course, students should be able to:</p> <ol style="list-style-type: none"> <li>1. recognize the design philosophy of foundation engineering. [POs: a,c];</li> <li>2. identify the typical failure modes of common foundations. [POs: a,e];</li> <li>3. interpret field and laboratory data to get design parameters for foundation analysis. [POs:e,c];</li> <li>4. perform basic analyses to solve foundation problems with the given procedures and the soil properties, and understand their limitations. [POs: a,c,e];</li> </ol> |                |      |
| Texts & References:<br><i>(* recommended textbook(s))</i> | Braja M. Das. (2010) Principles of Foundation Engineering, 7th Edition.  |                |      |
| Student Assessment:                                       | <ul style="list-style-type: none"> <li>• Quizzes : 30%;</li> <li>• Midterm Exam : 30%</li> <li>• Final Exam: 40%</li> </ul>  |                |      |
| Learning Outcome Assessment:                              | <ul style="list-style-type: none"> <li>• Quizzes</li> <li>• Midterm and final examination.</li> <li>• Course evaluation</li> </ul>   |                |      |

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|----------------------|---|--|
| Pedagogical Methods: | <input checked="" type="checkbox"/> Lecture<br><input type="checkbox"/> Guest speakers<br><input type="checkbox"/> Case study<br><input type="checkbox"/> Role playing<br><input type="checkbox"/> Student presentation<br><input type="checkbox"/> Project<br><input type="checkbox"/> Simulation game<br><input checked="" type="checkbox"/> Exercises and problems | <input type="checkbox"/> Service learning<br><input type="checkbox"/> Internship<br><input type="checkbox"/> Field study<br><input type="checkbox"/> Company visits<br><input type="checkbox"/> e-learning<br><input checked="" type="checkbox"/> Independent study<br><input type="checkbox"/> Others: __ |
|----------------------|---|--|

| Major Assessment Methods:                      | Case Study | Role Playing | Student Presentation | Individual project/paper | Group project/paper | Simulation Game | Exercises & problems | Service learning | Internship | Field Study | Company visits | Written examination | Oral examination | Others (please specify) |
|--|------------|--------------|----------------------|--------------------------|---------------------|-----------------|----------------------|------------------|------------|-------------|----------------|---------------------|------------------|-------------------------|
| Class Participation/ Discussion (0%)           |            |              |                      |                          |                     |                 |                      |                  |            |             |                |                     |                  |                         |
| Quizzes (30%)                                  |            |              |                      |                          |                     |                 |                      |                  |            |             |                | ✓                   |                  |                         |
| Midterm exam (30%)                             |            |              |                      |                          |                     |                 |                      |                  |            |             |                | ✓                   |                  |                         |
| Final exam (40%)                               |            |              |                      |                          |                     |                 |                      |                  |            |             |                | ✓                   |                  |                         |
| Others (please specify) Reports, presentations |            |              |                      |                          |                     |                 |                      |                  |            |             |                |                     |                  |                         |
| Course Web: (if any)                           |            |              |                      |                          |                     |                 |                      |                  |            |             |                |                     |                  |                         |

| Course Content:<br>(topic outline) | Week no. | Topics   | LO no. |
|------------------------------------|----------|--|--------|
|                                    | 1        | <b>Review of Soil Mechanics</b> <ul style="list-style-type: none"> <li>• Index properties;</li> <li>• Hydraulic Conductivity and Seepage of Soil;</li> <li>• Consolidation;</li> <li>• Shear Strength</li> </ul>   | 3      |
|                                    | 2,3      | <b>Subsurface Exploration</b> <ul style="list-style-type: none"> <li>• Subsurface Exploration Program;</li> <li>• Exploratory Borings in the Field;</li> <li>• Procedure for Sampling Soil, Undisturbed and disturbed samples;</li> <li>• Rock sampling; Rock Quality Designation;</li> <li>• Observation of Water Tables;</li> <li>• SPT, CPT, Vane Shear Test</li> <li>• Preparation of Boring Logs and Exploration Report</li> </ul>  | 1,3    |
|                                    | 4, 5     | <b>Shallow Foundation</b> <ul style="list-style-type: none"> <li>• General Concept; Terzaghi's Bearing Capacity Theory;</li> <li>• Factor of Safety;</li> <li>• Modification of Bearing Capacity Equations for Water Table; Eccentrically Loaded Foundations</li> <li>• The General Bearing Capacity Equation;</li> </ul>  | 2~4    |
|                                    | 6, 7     | <b>Settlement of Shallow Foundations</b> <ul style="list-style-type: none"> <li>• Types of Foundation Settlement;</li> <li>• Elastic Settlement;</li> <li>• Primary Consolidation Settlement;</li> <li>• Allowable Bearing Pressure in Sand Based on Settlement Consideration;</li> <li>• Tolerable Settlement of Buildings</li> </ul>   | 2~4    |
|                                    | 8        | <b>(Midterm Exam)</b>  |        |
|                                    | 9, 10    | <b>Deep Foundation</b> <ul style="list-style-type: none"> <li>• Types of Pile in Use;</li> <li>• Estimating Pile Length; Installation of Piles;</li> <li>• Load Transfer Mechanism;</li> <li>• Equations for Estimating Pile Capacity;</li> <li>• Method for Estimating <math>Q_p</math>;</li> <li>• Correlations for Calculating <math>Q_p</math> with SPT and CPT;</li> <li>• Frictional Resistance (<math>Q_s</math>) in Sand and Clay;</li> <li>• General Comments and Allowable Pile Capacity;</li> <li>• Point Bearing Capacity of Piles Resting on Rock;</li> <li>• Elastic Settlement of Piles;</li> </ul> | 2~4    |
|                                    | 11, 12   | <b>Other Issue for Deep Foundation</b> <ul style="list-style-type: none"> <li>• Laterally Loaded Piles;</li> <li>• Pile-Driving Formulas;</li> <li>• Group Piles – Efficiency;</li> <li>• Pile Load Test;</li> <li>• Negative Skin Friction;</li> <li>• Bore pile/Drilled shaft techniques.</li> </ul>   | 2~4    |
|                                    | 13, 14   | <b>Selected topics in foundation engineering</b> <ul style="list-style-type: none"> <li>• Soil Compaction;</li> <li>• Preloading and Vertical Drains;</li> </ul>   | 1,5    |

|                                    |         |               |                     |                                  |                       |                  |       |
|------------------------------------|---------|---------------|---------------------|----------------------------------|-----------------------|------------------|-------|
| Percentage Content of:             | Math    | Basic Science | Engineering Science | Engineering Design and Synthesis | Complementary Studies | Computer Studies | Total |
|                                    | 20      | 0             | 60                  | 20                               | 0                     | 0                | 100   |
|                                    |         |               |                     |                                  |                       |                  |       |
| Timetabled work in hours per week: | Lecture | Tutorial      | Laboratory          | Other                            |                       |                  | Total |
|                                    | 3       | ----          | ---                 |                                  |                       |                  | 3     |
|                                    |         |               |                     |                                  |                       |                  |       |

| Contribution to Program Outcomes:   | <table border="1"> <thead> <tr> <th rowspan="2">Program Outcomes</th> <th colspan="5">Contribution to POs<sup>#</sup></th> </tr> <tr> <th colspan="5">5 -----&gt; 1<br/>Significant      Least</th> </tr> <tr> <th></th> <th>5</th> <th>4</th> <th>3</th> <th>2</th> <th>1</th> </tr> </thead> <tbody> <tr> <td>(a) apply knowledge of mathematics, science, and engineering</td> <td>✓</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>(b) design and conduct experiments, and analyze data</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>(c) design components, systems or processes in presence of constraints</td> <td></td> <td></td> <td>✓</td> <td></td> <td></td> </tr> <tr> <td>(d) Function in a multi-disciplinary team</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>(e) Engineering problem solving</td> <td>✓</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>(f) Understand professional and ethical responsibility</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>(g) Communicate effectively</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>(h) Understand the impact of engineering solutions to the society</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>(i) Recognize the need and have the ability for lifelong learning</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>(j) Have knowledge of contemporary issues</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>(k) Apply the skills, techniques, modern engineering tools</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>(l) Use the computer/IT tools relevant to the discipline</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table> | Program Outcomes                     | Contribution to POs <sup>#</sup> |   |   |   |  | 5 -----> 1<br>Significant      Least |  |  |  |  |  | 5 | 4 | 3 | 2 | 1 | (a) apply knowledge of mathematics, science, and engineering | ✓ |  |  |  |  | (b) design and conduct experiments, and analyze data |  |  |  |  |  | (c) design components, systems or processes in presence of constraints |  |  | ✓ |  |  | (d) Function in a multi-disciplinary team |  |  |  |  |  | (e) Engineering problem solving | ✓ |  |  |  |  | (f) Understand professional and ethical responsibility |  |  |  |  |  | (g) Communicate effectively |  |  |  |  |  | (h) Understand the impact of engineering solutions to the society |  |  |  |  |  | (i) Recognize the need and have the ability for lifelong learning |  |  |  |  |  | (j) Have knowledge of contemporary issues |  |  |  |  |  | (k) Apply the skills, techniques, modern engineering tools |  |  |  |  |  | (l) Use the computer/IT tools relevant to the discipline |  |  |  |  |  |
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|   | Program Outcomes  |                                      | Contribution to POs <sup>#</sup> |   |   |   |  |                                      |  |  |  |  |  |   |   |   |   |   |  |   |  |  |  |  |  |  |  |  |  |  |  |  |  |   |  |  |   |  |  |  |  |  |                                 |   |  |  |  |  |  |  |  |  |  |  |                             |  |  |  |  |  |   |  |  |  |  |  |   |  |  |  |  |  |   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|   |   | 5 -----> 1<br>Significant      Least |                                  |   |   |   |  |                                      |  |  |  |  |  |   |   |   |   |   |  |   |  |  |  |  |  |  |  |  |  |  |  |  |  |   |  |  |   |  |  |  |  |  |                                 |   |  |  |  |  |  |  |  |  |  |  |                             |  |  |  |  |  |   |  |  |  |  |  |   |  |  |  |  |  |   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|   |   | 5                                    | 4                                | 3 | 2 | 1 |  |                                      |  |  |  |  |  |   |   |   |   |   |  |   |  |  |  |  |  |  |  |  |  |  |  |  |  |   |  |  |   |  |  |  |  |  |                                 |   |  |  |  |  |  |  |  |  |  |  |                             |  |  |  |  |  |   |  |  |  |  |  |   |  |  |  |  |  |   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|   | (a) apply knowledge of mathematics, science, and engineering  | ✓                                    |                                  |   |   |   |  |                                      |  |  |  |  |  |   |   |   |   |   |  |   |  |  |  |  |  |  |  |  |  |  |  |  |  |   |  |  |   |  |  |  |  |  |                                 |   |  |  |  |  |  |  |  |  |  |  |                             |  |  |  |  |  |   |  |  |  |  |  |   |  |  |  |  |  |   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|   | (b) design and conduct experiments, and analyze data  |                                      |                                  |   |   |   |  |                                      |  |  |  |  |  |   |   |   |   |   |  |   |  |  |  |  |  |  |  |  |  |  |  |  |  |   |  |  |   |  |  |  |  |  |                                 |   |  |  |  |  |  |  |  |  |  |  |                             |  |  |  |  |  |   |  |  |  |  |  |   |  |  |  |  |  |   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|   | (c) design components, systems or processes in presence of constraints  |                                      |                                  | ✓ |   |   |  |                                      |  |  |  |  |  |   |   |   |   |   |  |   |  |  |  |  |  |  |  |  |  |  |  |  |  |   |  |  |   |  |  |  |  |  |                                 |   |  |  |  |  |  |  |  |  |  |  |                             |  |  |  |  |  |   |  |  |  |  |  |   |  |  |  |  |  |   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|   | (d) Function in a multi-disciplinary team   |                                      |                                  |   |   |   |  |                                      |  |  |  |  |  |   |   |   |   |   |  |   |  |  |  |  |  |  |  |  |  |  |  |  |  |   |  |  |   |  |  |  |  |  |                                 |   |  |  |  |  |  |  |  |  |  |  |                             |  |  |  |  |  |   |  |  |  |  |  |   |  |  |  |  |  |   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|   | (e) Engineering problem solving   | ✓                                    |                                  |   |   |   |  |                                      |  |  |  |  |  |   |   |   |   |   |  |   |  |  |  |  |  |  |  |  |  |  |  |  |  |   |  |  |   |  |  |  |  |  |                                 |   |  |  |  |  |  |  |  |  |  |  |                             |  |  |  |  |  |   |  |  |  |  |  |   |  |  |  |  |  |   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|   | (f) Understand professional and ethical responsibility  |                                      |                                  |   |   |   |  |                                      |  |  |  |  |  |   |   |   |   |   |  |   |  |  |  |  |  |  |  |  |  |  |  |  |  |   |  |  |   |  |  |  |  |  |                                 |   |  |  |  |  |  |  |  |  |  |  |                             |  |  |  |  |  |   |  |  |  |  |  |   |  |  |  |  |  |   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|   | (g) Communicate effectively   |                                      |                                  |   |   |   |  |                                      |  |  |  |  |  |   |   |   |   |   |  |   |  |  |  |  |  |  |  |  |  |  |  |  |  |   |  |  |   |  |  |  |  |  |                                 |   |  |  |  |  |  |  |  |  |  |  |                             |  |  |  |  |  |   |  |  |  |  |  |   |  |  |  |  |  |   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|   | (h) Understand the impact of engineering solutions to the society   |                                      |                                  |   |   |   |  |                                      |  |  |  |  |  |   |   |   |   |   |  |   |  |  |  |  |  |  |  |  |  |  |  |  |  |   |  |  |   |  |  |  |  |  |                                 |   |  |  |  |  |  |  |  |  |  |  |                             |  |  |  |  |  |   |  |  |  |  |  |   |  |  |  |  |  |   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|   | (i) Recognize the need and have the ability for lifelong learning   |                                      |                                  |   |   |   |  |                                      |  |  |  |  |  |   |   |   |   |   |  |   |  |  |  |  |  |  |  |  |  |  |  |  |  |   |  |  |   |  |  |  |  |  |                                 |   |  |  |  |  |  |  |  |  |  |  |                             |  |  |  |  |  |   |  |  |  |  |  |   |  |  |  |  |  |   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| (j) Have knowledge of contemporary issues   |   |                                      |                                  |   |   |   |  |                                      |  |  |  |  |  |   |   |   |   |   |  |   |  |  |  |  |  |  |  |  |  |  |  |  |  |   |  |  |   |  |  |  |  |  |                                 |   |  |  |  |  |  |  |  |  |  |  |                             |  |  |  |  |  |   |  |  |  |  |  |   |  |  |  |  |  |   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| (k) Apply the skills, techniques, modern engineering tools  |   |                                      |                                  |   |   |   |  |                                      |  |  |  |  |  |   |   |   |   |   |  |   |  |  |  |  |  |  |  |  |  |  |  |  |  |   |  |  |   |  |  |  |  |  |                                 |   |  |  |  |  |  |  |  |  |  |  |                             |  |  |  |  |  |   |  |  |  |  |  |   |  |  |  |  |  |   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| (l) Use the computer/IT tools relevant to the discipline  |   |                                      |                                  |   |   |   |  |                                      |  |  |  |  |  |   |   |   |   |   |  |   |  |  |  |  |  |  |  |  |  |  |  |  |  |   |  |  |   |  |  |  |  |  |                                 |   |  |  |  |  |  |  |  |  |  |  |                             |  |  |  |  |  |   |  |  |  |  |  |   |  |  |  |  |  |   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| # Note 5: Significant contribution; 4: Supporting contribution; 3: Moderate contribution; 2: Marginal support; 1: Least support |   |                                      |                                  |   |   |   |  |                                      |  |  |  |  |  |   |   |   |   |   |  |   |  |  |  |  |  |  |  |  |  |  |  |  |  |   |  |  |   |  |  |  |  |  |                                 |   |  |  |  |  |  |  |  |  |  |  |                             |  |  |  |  |  |   |  |  |  |  |  |   |  |  |  |  |  |   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Course Instructor(s):   | <b>Dr. Man Hoi Lok</b>  |                                      |                                  |   |   |   |  |                                      |  |  |  |  |  |   |   |   |   |   |  |   |  |  |  |  |  |  |  |  |  |  |  |  |  |   |  |  |   |  |  |  |  |  |                                 |   |  |  |  |  |  |  |  |  |  |  |                             |  |  |  |  |  |   |  |  |  |  |  |   |  |  |  |  |  |   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |