University of Macau
Undergraduate Civil Engineering Programme

Coordinating Unit:	Department of Civil and Environmental Engineering, Faculty of Science and Technology		
Supporting Unit(s):	Nil		
Course Code:	CIVL351	Year of Study:	3
Course Title:	Soil Mechanics I		
Compulsory/Elective:	Compulsory		
Course Prerequisites:	None		
Prerequisite Knowledge:	A good understanding of mechanics; basic knowledge of stress, strain and strength for materials.		
Duration:	One semester	Credit Units:	4
Class/Laboratory Schedule:	Three hours of lecture, one hour of tutorial and one hour of laboratory per week.		
Laboratory/Software Usage:	Students will conduct totally four labs in groups: Field Identification of Soil and Sieve Analysis; Atterberg Limits; Relative Density and Compaction; Permeability of Soils;		
Course Description:	Soil Mechanics I introduces the Fundamental engineering properties of soil and their applications in geotechnical engineering. This course covers the following topics: origin of soil and grain size, phase relationships, plasticity and structure of soil, engineering classification of soil, soil compaction, permeability, seepage, effective stress, stresses in a soil mass. Several laboratory exercises will be performed in conjunction with the theories.		
Course Objectives:	1. To introduce to students the fundamental principles of soil mechanics. 2. To develop the students with an understanding of soil as a natural engineering material for civil and environmental engineering projects. 3. To assist student to perform several laboratory exercises in conjunction with the theories.		
Learning Outcomes (LO):	Upon completion of this course, students should: 1. understand the origin, formation, parameters and basic fundamental behavior of soils [POs: a,e,g]; 2. have the knowledge of soil classification and be able to classify the soil using Unified Soil Classification System [POs: a,b,e]; 3. understand the principles of soil compaction and the factors affecting soil compaction [POs: a,b,e]; 4. understand soil permeability and seepage theory and be able to analyze a seepage problem by flow net [POs: a,b,e]; 5. understand the effective stress concept and be able to calculate effective stress in non-seepage and seepage problems [POs: a,e]; 6. be able to calculate the vertical stress in soils caused by various types of loading [POs: a,e]; 7. be able to carry out laboratory tests to determine the engineering properties of soils [POs: b,d,g,k];		
Texts & References: *(* recommended textbook(s))*	1. Das, Braja M. (2010)*, Principles of Geotechnical Engineering, 7th edition, SI Edition, Cengage Learning. 2. Craig R.F. (2004) Craig's Soil Mechanics, 7th edition, Spon Press, London.		

Student Assessment:	• Mid-term examination and Quizzes: 20% • Assignments: 20% • Laboratory: 20% • Final examination: 40%
Learning Outcome Assessment:	• Tests and final examination • Assignments • Laboratory • Course evaluation
Pedagogical Methods:	☑ Lecture ☐ Guest speakers ☐ Case study ☐ Role playing ☐ Student presentation ☐ Project ☐ Simulation game ☑ Exercises and problems ☐ Service learning ☐ Internship ☐ Field study ☐ Company visits ☐ e-learning ☑ Independent study ☑ Others: Laboratory tests.

Major Assessment Methods: For each Major Assessment Method below, please indicate the specific pedagogical methods involved (by putting a ✓ in the relevant box(es) on the right-hand side).	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%)														
Assignment(s) (20%)							✓							
Test(s) (20%)												✓		
Examination (40%)												✓		
Others *(please specify)* Lab report (20 %)					✓									
Course Web: (if any)	Course materials are available in UMMoodle (http://webcourse.umac.mo/).													

Course Content: (topic outline)

Week no.	Topics	Assignment no.	Lab report no.	LO no.
1,2	**Origin of Soil and Grain Size** The nature of soils; Specific gravity (Gs); Soil-particle size; Mechanical analysis of soil; Effective size, uniformity coefficient, and coefficient of gradation	--		1
3,4	**Phase Relationships, Plasticity, and Structure of Soil** Phase Relationships; Relative Density; Atterberg Limits; Plasticity Chart; Soil Structure	1		1
4,5	**Lab 1: Field Identification of Soil and Sieve Analysis**	--	1	7
5,6	**Engineering Classification of Soil** Unified Soil Classification System; British Standard for Soil Classification	2		2
6,7	**Lab 2: Atterberg Limits**	--	2	7
6,7	**Soil Compaction** Compaction – General Principles; Standard Proctor Test; Factors Affecting Compaction; Modified Proctor Test; Effect of Compaction on Cohesive Soil Properties; Field Compaction; Specifications for Field Compaction; Determination of Field Unit Weight of Compaction; Special Compaction Techniques	3		3
8,9	**Permeability** Hydraulic Gradient; Darcy's Law; Coefficient of Permeability; Laboratory Permeability Test; Directional Variation of Permeability; Equivalent Permeability in Stratified Soil; Field Permeability Test	--		4
9,10	**Lab 3: Relative Density and Compaction**	--	3	7
9,10	**Seepage** Laplace's Equation of Continuity; Equation of Continuity for 1-D Problem; Seepage Theory and Flow Nets; Flow Nets Construction and Seepage Calculation; Uplift Pressure Under Hydraulic Structures; Flow nets in Anisotropic Soil	4		4
11,12	**Lab 4: Permeability of Soils**	--	4	7
11,12	**Effective Stress** Stresses in Saturated Soil without Seepage; Stresses in Saturated Soil with Upward Seepage; Stresses in Saturated Soil with Downward Seepage; Seepage Force; Heaving in Soil Due to Flow Around Sheet Piles; Effective Stress in Partially Saturated Soil; Capillary Rise in Soils	--		5
13,14	**Stresses in a Soil Mass** Normal and Shear Stresses on a Plane; The Pole Method of Finding Stresses Along a Plane; Stresses Caused by a Point Load; Vertical Stress Caused by a Line Load; Vertical Stress Caused by a Strip Load; Vertical Stress Below a Uniformly Loaded Circular Area; Vertical Stress Caused by a Rectangularly Loaded Area	5		6

Percentage Content of:

Math	Basic Science	Engineering Science	Engineering Design and Synthesis	Complementary Studies	Computer Studies	Total
20	---	80	---	---	---	100

Timetabled work in hours per week:

Lecture	Tutorial	Laboratory	Other		Total
3	1	1	---		5

Contribution to Program Outcomes:

Program Outcomes	Contribution to POs[#] 5 ----------> 1 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): Dr. W.H. Zhou