

Mapping of course outcomes with Knowledge and Attitude Profile (WK)

	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
CO1	*	*	*	*				*	
CO2	*	*	*	*				*	
CO3	*	*	*	*	*			*	
CO4	*	*	*	*	*			*	

Wks Mapped with the course

WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
*	*	*	*	*			*	

Mark Distribution:

Total Marks	CIE Marks	ESE Marks	ESE Duration
100	40	60	2.5 hrs

Continuous Internal Evaluation Pattern:

Attendance : 5 marks
Continuous Assessment Test : 20 marks
Continuous Assessment Assignment/ Industrial Visit/Field study :15 marks

SYLLABUS**Module 1 (12 hrs)**

Introduction to geotechnical engineering : Types of soil– Major soil deposits of India - Clay minerals - Soil structure -Three phase soil system – Basic soil properties and their relations - Numerical problems. Laboratory determination of moisture content by oven drying, Specific gravity using pycnometer & specific gravity bottle - Determination of Field density by sand replacement method and Core Cutter method - Numerical problems.

Module 2 (14 hrs)

Index properties - Particle size analysis, Hydrometer analysis, limitations, Relative density – Numerical problems. Atterberg limits and their determination, Various indices - Flow-Index, Plasticity Index, Toughness Index, Liquidity Index, Activity Ratio- Numerical problems - IS classification of soil. Compaction : IS Light & Heavy compaction, OMC and MDD, Zero Air voids line - Numerical problems - Factors affecting compaction - Effects of compaction on soil properties- Field compaction equipment and compaction quality control – Proctor needle.

Module 3 (15 hrs)

Permeability of soils - Darcy's law – Factors affecting permeability - Laboratory tests :Falling head and constant head - Average permeability of layered deposits - Numerical problems. Principle of effective stress : Total, neutral and effective stress – Stress diagrams under various loading conditions – Numerical problems - Quick sand condition.

Stress distribution in soils : Vertical stress due to point and line loads using Boussinesq's equations (assumptions and limitations). Vertical stress beneath strip, circular, and rectangular loaded area- Newmark's influence chart- Approximate methods: equivalent point load and 2:1 distribution methods - Pressure isobars- pressure bulbs.

Module 4 (15 hrs)

Consolidation of soils: Compressibility parameters, e -log p curve, consolidation characteristics, Terzaghi's one-dimensional consolidation theory (assumptions), degree and rate of consolidation, laboratory consolidation test, and numerical problems. Shear strength of soils: Mohr-Coulomb failure criterion, stress relationships using Mohr's circle, laboratory shear tests, total and effective stress parameters.

Field study/Industrial Visit

Students shall visit a construction site to observe and document various field test for soil/collecting samples and testing of soil properties in the laboratory. A detailed technical report is mandatory for internal assessment.

Text Books:

1. Arora, K. R. (2020). Soil mechanics and foundation engineering (7th ed.). Standard Publishers and Distributors.
2. Punmia, B. C., Kumar, A., & Jain, A. K. (2015). Soil mechanics and foundations (18th ed.). Laxmi Publications.
3. Das, B. M. (2010). Principles of geotechnical engineering. Cengage India Pvt. Ltd.
4. Venkatramaiah, C. (2000). Geotechnical engineering. Universities Press.

Reference Books:

1. Purushothamaraj, P. (2013). Soil mechanics and foundation engineering. Dorling Kindersley (India) Pvt. Ltd.
2. Rao, A. V. N., & Venkatramaiah, C. (2000). Numerical problems, examples and objective questions in geotechnical engineering. Universities Press (India) Ltd.
3. Terzaghi, K., & Peck, R. B. (1967). Soil mechanics in engineering practice. John Wiley & Sons.

END SEMESTER EXAMINATION – MODEL QUESTION PAPER

Course Code	25UCET401
Course Name	GEOTECHNICAL ENGINEERING I
Max. Marks: 60	Duration: 2.5 Hours

Part A

(Answer all questions. Each question carries 3 marks)

Qn No.	Question	Marks	CO	BL
1	Represent a relation connecting void ratio and porosity.	3	1	L2
2	Describe Sensitivity and Thixotropy.	3	1	L2
3	Differentiate between well graded, gap graded and uniformly graded soil.	3	2	L2
4	Water flows through a cylindrical soil specimen of diameter 5 cm. The coefficient of permeability of soil is 5×10^{-3} m/s and the hydraulic gradient is 0.5. Calculate the quantity of water flowing through the specimen in one hour.	3	2	L3
5	Explain effective stress principle.	3	3	L2
6	Explain any three methods of field compaction.	3	3	L2
7	Outline any three limitations of unconfined compressive strength test.	3	4	L2
8	Explain CU and CD tests	3	4	L2
Part B (Answer any one full question from each Module. Each carry 9 marks)				
Module I				
Qn No.	Question	Marks	CO	BL
9.a	1m ³ of wet soil weighs 20kN. Its dry weight is 18kN and G=2.67. Calculate the water content, porosity, void ratio and degree of saturation.	6	1	L3
9.b	The specific gravity of a soil is 2.75, void ratio is 0.7, degree of saturation is 90%. Calculate the porosity, bulk unit weight, saturated unit weight and dry unit weight of the soil.	3	1	L3
OR				
10.a	The mass of an empty gas jar was 0.498kg. When compacted and filled with water its mass was 1.528kg. An oven dried sample of soil mass 0.198kg was placed in the jar and water was added to fill the jar and mass was found to be 1.653kg respectively. Compute the specific gravity.	6	1	L3
10.b	A soil has a dry density of 1.816g/mL in the natural condition. When 410g of soil was poured in a vessel in a very loose state, its volume was 290mL. The same soil when vibrated and compacted was found to have a volume of 215mL. Calculate the relative density of soil.	3	1	L3
Module II				
Qn No.	Question	Marks	CO	BL
11.a	Explain IS plasticity chart along with its practical applications.	5	2	L2
11.b	A test for determination of liquid limit was carried out and the following results were obtained. Liquid limit 72% and	4	2	L3

	flow index 22. Compute the consistency index and water plasticity ratio of the soil if the plastic limit and natural moisture content are 28% and 32% respectively.																	
OR																		
12.a	Explain the procedure to find the liquid limit of soil using Casagrande apparatus.	5	2	L2														
12.b	In a falling head permeameter, the sample was 18cm long with cross sectional area of 22cm ² . Calculate the time required for the drop of head from 25 to 10cm if the cross-sectional area of the stand pipe was 2cm ² . The sample of soil was heterogeneous, with a coefficient of permeability of 3x10 ⁻⁴ cm/s for the first 6cm thickness, 4x10 ⁻⁴ cm/s for the second 6cm and 6x10 ⁻⁴ cm/s for the last 6cm thickness. Assume the flow taking place perpendicular to the bedding plane.	4	2	L3														
Module III																		
Qn No.	Question	Marks	CO	BL														
13. a	Explain quick sand condition and critical hydraulic gradient.	5	3	L2														
13. b	Illustrate the variation of total stress, pore water pressure and neutral stress upto a depth of 6m below ground level. The water table is 2m below ground level. The dry density of soil is 17.66kN/m ³ , water content is 12% and G = 2.65.	4	3	L3														
OR																		
14. a	A long strip footing of width 2m carries a load of 400kN/m. Calculate the maximum stress at a depth of 5m below the centre line of footing.	5	3	L2														
14. b	The following are results of a standard proctor compaction test performed on a sample of soil.<table><tr><td>Water content, w (%)</td><td>6</td><td>8</td><td>10</td><td>12</td><td>14</td><td>16</td></tr><tr><td>Bulk density (kN/m³)</td><td>17.7</td><td>19.8</td><td>21</td><td>21.3</td><td>20.9</td><td>20.2</td></tr></table>Plot the water content- dry density curve and obtain MDD and OMC. Take G=2.65.	Water content, w (%)	6	8	10	12	14	16	Bulk density (kN/m ³)	17.7	19.8	21	21.3	20.9	20.2	4	3	L3
Water content, w (%)	6	8	10	12	14	16												
Bulk density (kN/m ³)	17.7	19.8	21	21.3	20.9	20.2												
Module IV																		
Qn No.	Question	Marks	CO	BL														
15. a	Explain the procedure to determine the consolidation of soil in laboratory.	6	4	L2														
15. b	A 8m thick clay layer with double drainage settles by 120mm in 2 years. C _v = 1.5 x 10 ⁻³ cm ² /s. Calculate the likely ultimate settlement and find out how long will it take	3	4	L3														

	to undergo 90% of this settlement.			
OR				
16. a	Explain Mohr's circle and major and minor principal stresses.	6	4	L2
16. b	In a triaxial test the confining pressure was 100 kN/m ² and deviator stress was 50 kN/m ² at failure. Assume that the test is a CD test and the failure envelope passes through the origin. Calculate the shear parameters and the inclination of failure plane graphically.	3	4	L3
