



**P.E.S. College of Engineering, Mandya - 571 401**

*(An Autonomous Institution affiliated to VTU, Belagavi)*

**Sixth Semester, B.E. - Civil Engineering  
Semester End Examination; July / Aug. - 2022  
Geotechnical Engineering - I**

Time: 3 hrs

Max. Marks: 100

**Course Outcomes**

The Students will be able to:

- CO1: History of soil mechanics, origin and formation of soil.
- CO2: Clay mineralogy and soil structure, soil as three phase system and inter relationship.
- CO3: Index properties and their determination, classification of soil.
- CO4: Flow of water through soils, effective stress concept, compaction of soil.
- CO5: Consolidation of soil and shear strength of soil.

**Note: I) PART - A** is compulsory. **Two** marks for each question.

**II) PART - B:** Answer any **Two** sub questions (from a, b, c) for a Maximum of **18 marks** from each unit.

Q. No.	Questions	Marks	BLs	COs	POs										
<b>I : PART - A</b>		<b>10</b>													
I a.	Define void ratio, porosity, and degree of saturation with the help of 3 phase diagram.	2	L1	CO1	PO1										
b.	Define liquid limit and plastic limit.	2	L1	CO2	PO2										
c.	Define seepage and superficial velocity.	2	L1	CO2	PO2										
d.	Define normally and under consolidated soil.	2	L1	CO3	PO7										
e.	Define sensitivity of clay.	2	L1	CO4	PO2										
<b>II : PART - B</b>		<b>90</b>													
<b>UNIT - I</b>		<b>18</b>													
1 a.	With sketch, explain the common clay minerals.	9	L2	CO1	PO1										
b.	With usual notations prove that, $r_d = \frac{G r_w}{1+e}$ .	9	L3	CO1	PO1										
c.	A soil sample has a porosity of 40%. The specific gravity of solids is 2.70. Calculate; i) Void ratio														
	ii) Dry density	9	L2	CO1	PO1										
	iii) Unit weight if the soil is 50% saturated														
	iv) Unit weight if the soil is completely saturated														
<b>UNIT - II</b>		<b>18</b>													
2 a.	Explain determination of in-situ density of soil by core cutter method.	9	L2	CO2	PO2										
b.	A liquid limit test on clay sample gave following results. The plastic limit of soil is 20% and natural waste content is 60%. Plot flow curve and obtain liquid limit, plasticity index and toughness index.	9	L2	CO2	PO2										
<table border="1" style="margin: auto; border-collapse: collapse;"> <tr> <td style="padding: 5px;">Number of blows</td> <td style="padding: 5px;">12</td> <td style="padding: 5px;">18</td> <td style="padding: 5px;">22</td> <td style="padding: 5px;">34</td> </tr> <tr> <td style="padding: 5px;">Water content (%)</td> <td style="padding: 5px;">56</td> <td style="padding: 5px;">52</td> <td style="padding: 5px;">50</td> <td style="padding: 5px;">45</td> </tr> </table>		Number of blows	12	18	22	34	Water content (%)	56	52	50	45				
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c.	Explain the plasticity chart and its importance	9	L2	CO2	PO2										

**UNIT - III**

**18**

- 3 a. Write the assumptions and limitations of Darcy’s law for the flow through soil. 9 L2 CO2 PO2
- b. Calculate the horizontal and vertical permeability of a soil deposit consisting of 3 layers 150 cm, 180 cm and 200 cm thickness with permeability of  $10^{-5}$ ,  $10^{-7}$  and  $10^{-9}$  m/s. 9 L2 CO2 PO2
- c. Explain the factors affecting compaction. 9 L3 CO2 PO2

**UNIT - IV**

**18**

- 4 a. Write the assumptions and limitations of Terzaghi’s one dimensional consolidation theory. 9 L2 CO3 PO7
- b. In a consolidation test of soil sample 20 mm in thickness took 28 min to reach 90% consolidation under two way drainage condition, for the same soil in the field, what would be the time taken in days for 50% and 90% consolidation? If the thickness of the soil layer is 4 m and if there is: i) One drainage, and ii) Two drainage. 9 L3 CO3 PO7
- c. Explain how pre-consolidation pressure is determined by Casagrande’s method? 9 L2 CO3 PO7

**UNIT - V**

**18**

- 5 a. Explain Mohr-Coulomb failure theory of soil. 9 L2 CO4 PO2
- b. In direct shear test was carried out on a cohesive soil sample and the following results were obtained. What would be the deviator stress at failure of a tri-axial test is carried out on the same soil with cell pressure of  $150 \text{ kN/m}^2$ ? 9 L3 CO4 PO2

Normal stress ( $\text{kN/m}^2$ )	150	250
Shear stress ( $\text{kN/m}^2$ )	110	120

- c. Explain the tri-axial shear test under different drainage conditions. 9 L2 CO4 PO2

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