

**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; August - 2023****Geotechnical Engineering - I**

Time: 3 hrs

Max. Marks: 100

Course Outcomes*The Students will be able to:**CO1: Apply the knowledge of chemistry & Geology to distinguish structural arrangements of soils.**CO2: Examine and evaluate index properties of soils**CO3: Implement compaction and consolidation characteristics of ground modification for sustainable developments**CO4: Examine and evaluate the 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
	I : PART - A	10			
1 a.	With the help of phase diagram, define the following terms:				
	i) Void ratio	2	L1	CO1	PO1
	ii) Degree of Saturation				
b.	With the help of volume versus water content diagram, define the following terms:				
	i) Consistency index	2	L1	CO2	PO2
	ii) Liquidity index				
c.	Calculate the compactive energy for the following compaction test				
	i) Standard proctor's test	2	L1	CO3	PO7
	ii) Modified proctor's test				
d.	Define the following terms with help of neat sketch:				
	i) Capillary phenomena	2	L1	CO3	PO7
	ii) Quick sand phenomena				
e.	Define the following terms:				
	i) Sensitivity of clay	2	L1	CO4	PO2
	ii) Thixotropy of clay				
	II : PART - B	90			
	UNIT - I	18			
2 a.	With the help of phase diagram, derive relation between γ_d , ω , n_a and G.				
		9	L2	CO1	PO2

$$\gamma_d = \frac{(1 - n_a)G\gamma\omega}{1 + \omega G}$$

- b. A soil in the borrow pit is at a bulk unit weight of 18.70 kN/m^3 with a moisture content of 10%. The soil is excavated from this pit and compacted in an embankment to bulk unit weight of 20.70 kN/m^3 with a moisture content of 15 %. Computer the quantity of soil to be excavated from the barrow pit and the amount of water to be added for 100 m^3 of compacted soil in the embankment.
- c. Critically distinguish between the following:
- i) Soil fabric and Soil structure
 - ii) Residual soil and Transported soil
 - iii) Single grained and Honey combed structures
 - iv) Flocculent and Dispersed structures

9 L2 CO1 PO3

9 L2 CO1 PO1

UNIT - II

18

- 3.a i) Explain test on field identification of soil.
- ii) Draw a neat sketch of IS plasticity chart and explains its uses.
- b. 500 g of dry soil was subjected to a fine sieve analysis. The mass of soil retained on each sieve is as follows:

9 L2 CO2 PO2

Sieve size (mm)	4.75	2	1	0.425	0.212	0.15	0.075
Mass of soil (g)	10	165	100	85	60	30	30

9 L2 CO2 PO2

- i) Plot the Grain size distribution curve.
 - ii) Percentage of gravel, sand and silt-clay fraction in the soil as per IS.
 - iii) Gradation of the soil sample as per IS.
- c. The following refer to a liquid limit test of a soil sample, whose plastic limit is 20%:

Number of blows (N)	12	18	22	34
Water content (ω)%	56	52	50	45

9 L2 CO2 PO2

- i) Plot flow curve and obtain liquid limit, plasticity index, flow index and toughness index
- ii) Classify the soil sample as per IS

UNIT - III

18

- 4 a. List and enumerate the factor affecting permeability.
- b. A permeameter of diameter 82.5 mm contains columns of withstand of 460mm long. Where water flows under constant head at the rate of $191 \times 10^3 \text{ mm}^3$ in 1 minutes. The loss of head between two points 250 mm apart is 380 mm. Calculate the coefficient of permeability. If a falling head test is made on the same soil sample using stand pipe of diameter 8 mm in what time when the water level in the stand pipe fall from 1560 mm to 1060 mm above the outflow level?

9 L3 CO3 PO7

9 L3 CO3 PO7

- c. An earthen embankment is to be constructed with soil having the void ratio of 0.85 near the dam three borrow pits are available which are designated as A, B and C. The void ration of the soil in each pit and cost of conveying to the dam per cubic meter in the following section:

Pit	A	B	C
Void ratio	0.95	1.90	1.65
Cost Rs./m ³	23	16	21

9 L3 CO3 PO7

The total volume of soil is required is $5 \times 10^5 \text{ m}^3$. Estimate which pit is economical.

UNIT - IV

18

- 5 a. Enumerate the following with neat sketch, step by step procedure to determine coefficient of consolidation:

9 L3 CO3 PO7

- i) Square root of time fitting method.
- ii) Logarithm time fitting method

- b. The water table in a certain area is at a depth of 4 m below ground surface to a depth of 12 m. The soil consists of very fine sand having an average void ratio of 0.70. Above the water table, the sand has a degree of saturation of 50 % Calculate the total stress, pore water stress and effective stress on a horizontal plane at a depth of 10 m below the ground surface. Take $G = 2.65$. Draw the variation of stresses with respect to depth.

9 L3 CO3 PO7

- c. A consolidation test was performed on a 25 mm thick undisturbed clay sample. 50 % consolidation occurred in 5 minutes. The sample was drained both at the top and at the bottom. In the field, the clay layer is 2 m thick and is underlain by an impervious rock. Drainage is possible only at the top surface. Determine the coefficient of Consolidation and calculate the time in days for 50% and 90% consolidation to takes place in the field deposit.

9 L3 CO3 PO7

UNIT - V

18

- 6 a. Enumerate briefly different drainage conditions in tri axial test in laboratory and how these simulate field problems.

9 L3 CO4 PO2

- b. A direct shear test was carried out on a cohesive soil sample and the following results were obtained:

Normal stress (kN/m ²)	150	250
Shear stress at failure (kN/m ²)	110	120

9 L3 CO4 PO2

What would be the deviator stress at failure if a tri-axial test is carried out on the same soil with cell pressure of 150 kN/m²?

- c. An unconfined compression test was done on a saturated clay specimen of diameter 40mm and height 80 mm. The failure load was 400 N and the axial deformation then was 7 mm. compute the unconfined strength of soil. When an identical specimen of the same soil was tested in a tri-axial compression at a chamber pressure of 100 kN/m^2 , the sample failed at a deviator stress of 390 kN/m^2 . Determine the shear strength parameters.

9 L3 CO4 PO2

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