B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

June 2025 Semester End Main Examinations

Programme: B.E.   **Semester: IV**

Branch: Civil Engineering   **Duration: 3 hrs.**

Course Code: 23CV4PCGTE / 22CV4PCGTE   **Max Marks: 100**

Course: Geotechnical Engineering-I

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

			UNIT - I	CO	PO	Marks
1	a)		Define the terms: Degree of saturation, percentage air voids and unit weight of solids, with the help of three phase diagram.	CO1	PO1	**06**
	b)		Distinguish between i. Water content and air content ii. Void ratio and percentage air voids iii. Bulk density and bulk unit weight iv. Saturated unit weight and submerged unit weight v. Specific gravity of soil particles and specific gravity of soil mass vi. Air content and degree of saturation	CO1	PO1	**06**
	c)		If an earthen embankment under construction the bulk unit weight is $16.5 kN/m^3$ at water content of 11%. If the water content is to be raised to 15%, compute the quantity of water required to be added per cubic meter of soil? Assume no change in the void ratio.	CO1	PO2	**08**
			OR			
2	a)		Show the phase diagram for dry soil, saturated soil and partially saturated soil with their corresponding unit weights along with their degrees of saturation.	CO1	PO1	**06**
	b)		Define the following with the help of a phase diagram i. Void ratio ii. Air content iii. Porosity	CO1	PO1	**06**
	c)		A sample of clay with a weight of 6.7N was coated with paraffin wax. The combined weight of clay and wax was found to be 6.78N. The volume of the wax coated sample was found, by immersion in water,	CO1	PO2	**08**

to be 350 x 10^3 mm^3. The sample was then broken open and moisture content was found to be 17%. If the specific gravities of soil particles and wax are 2.67 and 0.89, determine the bulk unit weight, void ratio and degree of saturation of the soil sample.

UNIT - II

3	a)	Explain how soils are classified according to IS soil classification system with the help of Plasticity Chart.	*CO1*	*PO1*	**06**

	b)	The following results refer to a liquid limit test:	*CO1*	*PO2*	**06**

Number of blows	33	23	18	11
Water content (%)	45.5	49.5	51.5	55.6

The plastic limit is 23.5%. Determine the plasticity index and toughness index for the soil.

	c)	The mass and volume of a saturates clay specimen were 29.8g and 17.7cm^3 respectively. On oven drying the mass got reduced to 19g and volume to 8.9cm^3, Calculate the shrinkage limit, shrinkage ratio and volumetric shrinkage. Also compute G of the soil.	*CO1*	*PO2*	**08**

OR

4	a)	Discuss the corrections applied to hydrometer readings	*CO1*	*PO1*	**06**
	b)	An oven dried soil sample having mass of 195g was put inside a pycnometer which was then completely filled with distilled water. The mass of pycnometer with soil and water was found to be 1584g. the mass of pycnometer filled with water alone was 1465g. Calculate the specific gravity of soil solids.	*CO1*	*PO2*	**06**
	c)	50g of oven dried soil passing 75μ test sieve was taken in a hydrometer analysis. The corrected hydrometer reading in 1000ml soil suspension at 2 minutes elapsed time interval was 25. The effective depth corresponding to Rh=25 is He=12.1cm. Taking G=2.7 and η=0.01 x 10^{-4} kN-s/m^2, calculate the coordinates of the point on the grain size distribution curve.	*CO1*	*PO2*	**08**

UNIT - III

5	a)	Distinguish between dispersed and flocculent structure	*CO2*	*PO1*	**06**
	b)	Explain with neat sketches Kaolinite and Montmorillonite clay minerals	*CO2*	*PO1*	**06**
	c)	A sand stratum is 10m thick. The water table is 2m below ground level. The unit weights of sand layer above and below water table are 17kN/m^3 and 21kN/m^3 respectively. The capillary rise above water table is 1m. Draw the effective stress, pore pressure and total stress diagrams for the sand stratum.	*CO2*	*PO2*	**08**

			OR			
6	a)	Discuss the types of soil structure	CO2	PO1	**06**
	b)	Explain with sketches montmorillonite and Illite clay mineral	CO2	PO1	**06**

	c)	In a site reclamation project, 2.5m of graded fill (γ=22kN/m^3) were laid in compacted layers over an existing layer of silty clay (γ=18kN/m^3) which was 3m thick. This was underlain by a 2m thick layer of gravel (γ=20kN/m^3). Assuming that the water table remains at the surface of the silty clay, draw the effective stress profiles for cases
		
		   i. before the fill is placed
		   ii. after the fill has been placed
			CO2	PO2	**08**

			UNIT - IV			
7	a)	Discuss the effects of compaction on the properties of soil.	CO2	PO1	**06**
	b)	Differentiate between coefficient of permeability and coefficient of percolation	CO2	PO1	**04**
	c)	In a falling head permeability test the length and area of cross section of soil specimen are 0.17m and 21.8 x 10^{-4} m^2 respectively. Calculate the time required for the head to drop from 0.25m to 0.10m. The area of cross section of stand pipe is 2 x 10^{-4} m^2. The sample has three layers with permeabilities 3 x 10^{-5} m/s for the first 0.06m, 4 x 10^{-5} m/s for the second 0.06m and 6 x 10^{-5} m/s for the third 0.05m thickness. Assume the flow is taking place perpendicular to the bedding plane.	CO2	PO2	**10**
			OR			
8	a)	State Darcy's law and define coefficient of permeability. What are the limitations in the application of Darcy's law to flow through soil media?	CO2	PO1	**06**
	b)	Write short notes on Proctor test (Standard and Modified)	CO2	PO1	**04**
	c)	The following observations were made in a Standard Proctor Test	CO2	PO2	**10**

For question 8 c), the following table is given:

Trial No.	1	2	3	4	5	6
Mass of wet soil (kg)	1.70	1.89	2.03	1.99	1.96	1.92
Water content (%)	7.7	11.5	14.6	17.5	19.7	21.2

Volume of mould = 945cc and G=2.67

Determine the maximum dry density and optimum moisture content. Also plot zero air void line.

			UNIT - V			
9	a)	List the merits and demerits of direct shear test	CO2	PO1	**05**
	b)	Discuss the factors affecting shear strength in cohesionless soils	CO2	PO1	**05**

	c)	A consolidated undrained test was conducted on a clay sample and the following results were obtained.
		
		 <table><tr><td>All round pressure (kPa)</td><td>200</td><td>400</td><td>600</td></tr><tr><td>Deviator stress at failure (kPa)</td><td>118</td><td>240</td><td>352</td></tr><tr><td>Pore water pressure at failure (kPa)</td><td>110</td><td>220</td><td>320</td></tr></table>
		 Determine the shear strength parameters with respect to
		   i. Total stress
		   ii. Effective stress
			CO2	PO2	**10**

			OR			
10	a)	List the advantages of triaxial shear test over direct shear test	CO2	PO1	**05**
	b)	On which types of soils unconfined compression test is conducted? Explain with the help of Mohr circles how shear strength parameters are determined in this type of test.	CO2	PO1	**05**
	c)	A cylindrical specimen of a saturated soil fails at an axial stress of 167 kN/m^2 in an unconfined compression test. The failure plane makes an angle of 54 degrees with the horizontal. Calculate the shear strength parameters. Verify by graphical method.	CO2	PO2	**10**

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