

BALLARI INSTITUTE OF TECHNOLOGY & MANAGEMENT

(Autonomous Institute under Visvesvaraya Technological University, Belagavi)

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Course Code

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Fifth Semester B.E. Degree Examinations, September / October 2024

GEOTECHNICAL ENGINEERING

Duration: 3 hrs

Max. Marks: 100

Note: 1. Answer any FIVE full questions choosing ONE full Question from each Module.
2. Missing data, if any, may be suitably assumed.

<u>Q. No</u>	<u>Question</u>	<u>Marks</u>	<u>(RBTL:CO:PI)</u>												
<u>Module-1</u>															
1.	a. With the help of 3-phase diagram, explain (i) Void ratio (ii) Porosity (iii) Water content (iv) Degree of saturation	10	(2 : 1 : 1.2.1)												
	b. A fully saturated soil sample has a water content of 35 % and specific gravity of 2.65 Determine its porosity saturated unit weight and dry unit weight. If the water content is 15 %, what will be the amount of water to be added for saturation?	10	(2 : 1 : 1.2.1)												
(OR)															
2.	a. With a neat sketch, explain the importance of plasticity chart.	10	(2 : 1 : 1.2.1)												
	b. A liquid limit test on a clayey sample gave the following results. The plastic limit of the soil is 20 %.	10	(2 : 1 : 1.2.1)												
<table border="1" style="width: 100%; text-align: center;"> <tr> <td>Number of Blows</td> <td>12</td> <td>18</td> <td>22</td> <td>34</td> </tr> <tr> <td>Water content (%)</td> <td>56</td> <td>52</td> <td>50</td> <td>45</td> </tr> </table>				Number of Blows	12	18	22	34	Water content (%)	56	52	50	45		
Number of Blows	12	18	22	34											
Water content (%)	56	52	50	45											
Plot the flow curve and obtain (i) liquid limit (ii) flow index (iii) plasticity index (iv) toughness index															
<u>Module-2</u>															
3.	a. Briefly explain how water content, compactive effort and type of soil affect compaction.	06	(2 : 2 : 1.2.1)												
	b. Distinguish between standard proctor and modified proctor compaction tests.	04	(2 : 2 : 1.2.1)												
	c. The following data was obtained from standard proctor compaction test	10	(2 : 2 : 1.2.1)												
<table border="1" style="width: 100%; text-align: center;"> <tr> <td>Water content</td> <td>5.90</td> <td>7.50</td> <td>9.70</td> <td>11.65</td> <td>13.85</td> </tr> <tr> <td>Weight of wet sample (N)</td> <td>18.20</td> <td>19:50</td> <td>20.10</td> <td>20.00</td> <td>19.70</td> </tr> </table>				Water content	5.90	7.50	9.70	11.65	13.85	Weight of wet sample (N)	18.20	19:50	20.10	20.00	19.70
Water content	5.90	7.50	9.70	11.65	13.85										
Weight of wet sample (N)	18.20	19:50	20.10	20.00	19.70										
G=2.70, Volume of mould $9.5 \times 10^{-4} \text{ m}^3$. Plot the compaction curve and zero air voids line Determine OMC and maximum dry density.															
(OR)															
4.	a. With sketch explain the three principal clay minerals.	08	(2 : 2 : 1.2.1)												
	b. Explain electrical diffuse double layer and adsorbed water..	06	(2 : 2 : 1.2.1)												
	c. Explain with sketches the various soil structures	06	(2 : 2 : 1.2.1)												
<u>Module-3</u>															
5.	a. Define Darcy's law. List the assumptions made in Darcy's law.	06	(2 : 3 : 1.2.1)												
	b. If during a variable head permeability test on a soil sample, equal time intervals are noted for drops of head from h_1 to h_2 and again from h_2 to h_3 . Find the relationship between h_1 , h_2 and h_3 .	06	(2 : 3 : 1.2.1)												

Note: (RBTL - Revised Bloom's Taxonomy Level: CO - Course Outcome: PI- Performance Indicator)

- c. Derive the equations for average coefficient of permeabilities in vertical and horizontal directions (i.e. in stratified soil layers). **08** (2 :3 : 1.2.1)

(OR)

6. a. Explain with a neat sketch, the method of locating the phreatic line in homogeneous earth dam with horizontal toe filter. **08** (2 :3 : 1.2.1)
- b. Explain the characteristics of flow nets with neat sketch. **06** (2 :3 : 1.2.1)
- c. Compute the quantity of water seeping under a weir per day for which the flow net has been satisfactorily constructed. The coefficient of permeability is 2×10^{-2} mm/s. $n_f = 5$ and $n_d = 18$. The difference in water level between upstream and downstream is 3.0 m. The length of the weir is 60 m. **06** (2 :3 : 1.2.1)

Module-4

7. a. Explain Mohr's Coulombs failure theory. **06** (2 :4 : 1.2.1)
- b. Explain sensitivity and thixotropy of clay. **06** (2 :4 : 1.2.1)
- c. The stresses on a failure plane in a drained test on a cohesion less soil are: Normal stress (σ)=100 kN/ m²; Shear stress (τ)=40 kN/m². Determine the angle of shearing resistance and the angle which the failure plane makes with the major principal plane. Also find the major and minor principal stresses **08** (2 :4 : 1.2.1)

(OR)

8. a. Explain the types of shear test based on the drainage conditions. **06** (2 :4 : 1.2.1)
- b. Explain the vane shear test with a neat sketch. **06** (2 :4 : 1.2.1)
- c. A consolidated undrained test was conducted on a clay sample and the following results were obtained- **08** (2 :4 : 1.2.1)

Cell pressure (kN/ m²)	200	400	600
Deviator stress at failure (kN/ m²)	118	240	352
Pore water pressure at failure (kN/ m²)	110	220	320

Determine the shear strength parameters with respect to (i) Total stress (c & ϕ) (ii) Effective stress (c' & ϕ').

Module-5

9. a. Briefly explain consolidation using spring analogy. **08** (2 :5 : 1.2.1)
- b. What is pre-consolidation pressure? How is it determined by Casagrande's graphical method? **06** (2 :5 : 1.2.1)
- c. In a consolidation test, the void ratio of soil sample decreases from 1.20 to 1.10 when the pressure increases from 160 to 320 kN/ m². Determine the coefficient of consolidation, if the coefficient of permeability is 8×10^{-7} mm/sec. **06** (2 :5 : 1.2.1)

(OR)

- 10 a. Explain pre consolidated, normally consolidated and under consolidated soil. **06** (2 :5 : 1.2.1)
- b. Explain square root of time fitting method. **06** (2 :5 : 1.2.1)
- c. A 20 m thick isotropic clay laver overlies an impervious rock. The coefficient of consolidation of soil is 5×10^{-2} mm/sec Find the time required for 50 % and 90 % consolidation Time factors are 0.2 and 0.85 for 50 % and 90 % consolidations respectively. **08** (2 :5 : 1.2.1)

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