

**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>												
<b><u>Module-1</u></b>															
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><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															
<b><u>Module-2</u></b>															
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><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)												
<b><u>Module-3</u></b>															
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  $2 \times 10^{-2}$  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 ( $\sigma$ )=100 kN/ m<sup>2</sup>; Shear stress ( $\tau$ )=40 kN/m<sup>2</sup>. 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/ m <sup>2</sup> )	200	400	600
Deviator stress at failure (kN/ m <sup>2</sup> )	118	240	352
Pore water pressure at failure (kN/ m <sup>2</sup> )	110	220	320

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

#### 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/ m<sup>2</sup>. Determine the coefficient of consolidation, if the coefficient of permeability is  $8 \times 10^{-7}$  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 layer overlies an impervious rock. The coefficient of consolidation of soil is  $5 \times 10^{-2}$  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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