

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, February 2025

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>
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Module-1

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| 1. | a. | With the help of a 3-phase diagram for soil and indicating the volumes and weights, define (i) Void ratio (ii) Porosity (iii) Degree of saturation (iv) Water content. | 10 | (2 :1: 1.2.1) |
| | b. | A sample of 1000 gm of soil from a site was performed sieve analysis. The weights of soil collected on each sieve are presented in the tabular entry. (i) Find the effective diameter D ₁₀ , D ₃₀ and D ₆₀ (ii) find the coefficients of uniformity and curvature. | 10 | (3 :1: 2.1.3) |

Sieve size (mm)	4.75	2.36	1.18	0.60	0.425	0.30	0.212	0.15	0.075	pan
Weight of soil on each sieve(gm)	60	110	150	170	110	120	90	60	80	50

(OR)

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| 2. | a. | With usual notations, derive the relationship with a phase diagram, $\gamma_d = (1 - n_a) G \gamma_w / (1 + wG)$ | 10 | (2 :1: 1.2.1) |
| | b. | One cum of wet soil weighs 20 kN, its dry weight is 18 kN, and the specific gravity of solids is 2.67. Determine the Water content, porosity, void ratio and degree of saturation. Also, draw the phase diagram. | 10 | (3 :1: 2.1.3) |

Module-2

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| 3. | a. | Name the three clay minerals. Explain the structure of each of them. | 10 | (2 :2: 1.2.1) |
| | b. | Explain different types of soil structures. | 10 | (2 :2: 1.2.1) |

(OR)

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| 4. | a. | Discuss the factors affecting and effecting compaction of soil in detail. Also, differentiate between standard and modified compaction test. | 10 | (2 :2: 1.2.1) |
| | b. | A Proctor compaction test was conducted on a soil sample and the following observations were made: | 10 | (3 :2: 2.1.3) |

Water Content	0.008	0.115	0.145	0.175	0.195	0.215
Mass of wet soil (g)	1700	1900	2000	1980	1950	1920

If the volume of the mould is 950 cm³, and specific gravity of soil was 2.65, draw the

- (i) Dry density v/s moisture content curve and get the MDD and OMC
(ii) 100% saturation line
(iii) Also calculate the minimum void ratio and saturation at OMC

Module-3

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| 5. | a. | Derive the equations for average coefficient of permeability's in parallel and perpendicular directions of flow. | 10 | (2 :3: 1.2.1) |
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- b. Calculate the coefficient of permeability of a soil sample, 6 cm in height and 50 cm² in cross-sectional area, if a quantity of water equal to 430 ml passed down in 10 minutes, under an effective constant head of 40 cm. On oven drying the test specimen has a mass of 498 grams. Taking the specific gravity of soil solids as 2.65, calculate the seepage velocity of water during the test. **10 (3 :3: 2.1.3)**

(OR)

6. a. Explain Casagrande's method of establishing the phreatic line of an earth dam with horizontal drainage filter on the downstream side. **10 (2 :3: 1.2.1)**
- b. (i) Explain the quick sand condition in detail with neat sketch. **10 (3 :3: 2.1.3)**
 (ii) A stratum of fine sand is 2 m thick. Under what head of water, flowing in an upward direction will the quick condition develop? Take $G = 2.68$ and $e = 0.6$.

Module-4

7. a. Enumerate the various laboratory and field tests employed for determining the shear strength of soil. Explain the triaxial compression test of three cases. **10 (2 :4: 1.2.1)**
- b. In a direct shear test, the normal stress for a sand sample was 200 kN/m² and shear stress was 120 kN/m². Draw the Mohr circle and strength envelope. Determine (i) The angle of shearing resistance (ii) The magnitude of major and minor principal stresses (iii) Orientation of principal stresses. **10 (3 :4: 2.1.3)**

(OR)

8. a. Explain the Mohr-Coulomb failure theory of soils **10 (2 :4: 1.2.1)**
- b. A consolidated undrained test was conducted on a clay sample and the following results were obtained: Determine the shear strength parameters for (i) Total & (ii) Effective stresses **10 (3 :4: 2.1.3)**

Cell Pressure (kN/m ²)	200	400	600
Deviator stress at failure (kN/m ²)	118	240	352
Pore water pressure at failure (kN/m ²)	110	220	320

Module-5

9. a. What is preconsolidation pressure? Explain by Casagrandes graphical method. **10 (2 :5: 1.2.1)**
- b. In a consolidation test, a soil sample 20 mm in thickness took 28 min to reach 90 % consolidation under two-way drainage conditions. For the same soil in the field, what would be the time taken in days for 50 % and 90 % consolidation. If the thickness of soil layer is 4 m and if there: (i) one way drainage (ii) Two way drainage **10 (3 :5: 2.1.3)**

(OR)

10. a. Explain the determination of coefficient of consolidation by (i) Square root of time fitting method (ii) Logarithmic of time fitting method. **10 (2 :5: 1.2.1)**
- b. A saturated soil layer 5 m thick lies above an impervious stratum. Below a pervious stratum it has $C_c = 0.25$, $k = 3.2 \times 10^{-10}$ m/s. Its void ratio of 147 kN/m² is 1.9. Calculate (i) Change in void ratio due to increase in stress to 196 kN/m² (ii) M_v (iii) C_v (iv) time taken for 50% consolidation **10 (3 :5: 2.1.3)**

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