

Fifth Semester B.E. Degree Examination, Jan./Feb. 2021

Basic Geotechnical Engineering

Time: 3 hrs.

Max. Marks: 100

*Note: Answer any FIVE full questions, choosing ONE full question from each module.*Module-1

- 1 a. With the help of 3-phase diagram, explain (i) Void ratio (ii) Porosity (iii) Water content (iv) Degree of saturation. (06 Marks)
- b. With usual notations, derive the relationship,

$$\gamma_d = \frac{(1 - n_a)G\gamma_w}{1 + \omega G}$$
 (06 Marks)
- c. 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 w.c. is 15%, what will be the amount of water to be added for saturation? (08 Marks)

OR

- 2 a. Explain the Indian standard soil classification system. (06 Marks)
- b. Define stoke's law. What are its assumptions and limitations? (06 Marks)
- c. A liquid limit test on a clayey sample gave the following results. The plastic limit of the soil is 20%.

Number of blows	12	18	22	34
Water content, %	56	52	50	45

Plot flow curve and obtain:

- (i) Liquid limit (ii) Flow Index (iii) Plasticity Index (iv) Toughness Index. (08 Marks)

Module-2

- 3 a. Briefly explain how water content, compactive effort and type of soil affect compaction. (06 Marks)
- b. Distinguish between standard Proctor and Modified Proctor compaction tests. (04 Marks)
- c. The following data was obtained from standard Proctor compaction test.

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. (10 Marks)

OR

- 4 a. Explain with sketches the various soil structures. (06 Marks)
- b. With sketch explain the three principal clay minerals. (08 Marks)
- c. Explain electrical diffuse double layer and adsorbed water. (06 Marks)

Module-3

- 5 a. Derive the equations for average coefficient of permeabilities in vertical and horizontal directions. (08 Marks)
- b. Explain with a neat sketch the method of locating the phreatic line in a homogeneous earth dam with horizontal filter. (06 Marks)
- c. 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 Marks)

OR

- 6 a. State the characteristics and uses of flownets. (06 Marks)
 b. Explain the terms superficial velocity and seepage velocity. Derive the relationship between them. (08 Marks)
 c. Compute the quantity of water seeping under a weir per day for which the flownet 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 Marks)

Module-4

- 7 a. What are the advantages and disadvantages of direct shear test over triaxial test? (06 Marks)
 b. Explain sensitivity and thixotropy of clay. (06 Marks)
 c. The stresses on a failure plane in a drained test on a cohesionless soil are as under:
 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 Marks)

OR

- 8 a. Explain Mohr-Coulomb failure theory of soils. (06 Marks)
 b. Explain Vane shear test with a neat sketch. (06 Marks)
 c. A consolidated undrained test was conducted on a clay sample and the following results were obtained:-

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

Determine the shear strength parameters with respect to,

- (i) Total stresses.
 (ii) Effective stresses.

(08 Marks)

Module-5

- 9 a. Explain spring analogy theory of consolidation of soil. (08 Marks)
 b. What is pre consolidation pressure? How is it determined by Casagrande's graphical method? (06 Marks)
 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 Marks)

OR

- 10 a. Explain square root of time fitting method. (06 Marks)
 b. A 20 m thick isotropic clay layer overlies an impervious rock. The coefficient of consolidation of soil is 5×10^{-2} mm²/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 Marks)
 c. Explain pre consolidated, normally consolidated and under consolidated soil. (06 Marks)
