2023

GEOTECHNICAL ENGINEERING

Full Marks : 100

Time : Three hours

The figures in the margin indicate full marks for the questions.

Answer any five questions.

1. (a) Draw the 3-phase diagram of a partially saturated soil and define the following?   (5+5)

      (i)   Water content

      (ii)   Specific gravity

      (iii)   Dry unit weight of soil

      (iv)   Degree of saturation

      (v)   Percentage air voids

1. (b) A soil sample is partially saturated and its natural moisture content is 23% and bulk   (5)
density is 3 g/cm^3. If the specific gravity of soil solids is 2.65, determine the degree
of saturation and void ratio.

1. (c) What are the corrections that are applied in a hydrometer analysis of a fine grained   (5)
soil? write the equation for a corrected hydrometer reading.

2. (a) A partially saturated soil sample obtained from an earth fill has a natural moisture   (10)
content of 22% and unit weight of 18.67 kN/m^3. Assuming specific gravity of soil
solids as 2.6 and density of water as 1 g/cm^3. Compute (a) The degree of saturation
(b) Void ratio (c) If subsequently the soil gets saturated, determine its unit weight.

2. (b) Define:

      (5x2)

      (i)   Coefficient of uniformity

      (ii)   Coefficient of curvature

      (iii)   Consistency of soil

      (iv)   Relative density or density index

      (v)   Permeability of soil

3. (a) What is consolidation? Explain primary and secondary consolidation?   (10)

3. (b) With respect to the consolidation of soil, define: (10)

      (i)   Coefficient of compressibility (a_v)

      (ii)   Coefficient of volume change (m_v)

4. (a) Differentiate between compaction and consolidation? (6)

4. (b) Define Normally consolidated soil and over consolidated soil. (4)

4. (c) A soil profile is shown in Fig.1. Calculate the settlement due to primary consolidation for the 6 m clay layer due to a surcharge of 100 kN/m². Ground water table is flush with the top of the clay layer. (10)
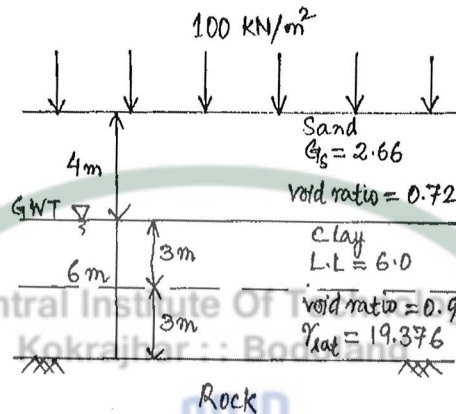

Fig. 1

5. (a) What is compaction? What are the factors affecting compaction of soil? (2+8)

5. (b) A laboratory compaction test on soil having specific gravity equal to 2.65 gave a maximum dry density of 1.68 g/cm³ and a water content of 16%. Determine the degree of saturation, air content and percentage air voids at the maximum dry density. What would be the theoretical maximum dry density corresponding to zero air voids at the optimum water content. (10)

6. (a) In a falling head permeability test, the initial head is 45 cm. The head drops by 6 cm in 10 minutes. Calculate the time required to run the test for the final head to be at 20 cm. If the sample is 6 cm in height and 50 cm² in cross-sectional area, calculate the coefficient of permeability, taking cross-sectional area of stand pipe as 0.5 cm². (10)

6. (b) Define principal stress and principal planes? What are the laboratory tests used to determine shear strength of soil. (5)

6. (c) What are Atterberg's limits? Explain them? (5)

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