Total No. of printed pages = 3

CE 181505

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Roll No. of candidate ☐☐☐☐☐☐☐☐☐☐

2022

B.Tech. 5th Semester End-Term Examination

Civil Engineering

GEOTECHNICAL ENGINEERING – I

(New Regulation & New Syllabus)

Full Marks – 70   Time – Three hours

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

Answer question No. 1 and any *four* from the rest.

1. Answer the following :   (10 × 1 = 10)

    (i)   The range of sand size as per Indian standard soil classification system is.

          (a) 00.1 – 0.075 mm   (b)   0.002 – 0.100 mm

          (c) 0.002 – 0.075 mm   (d)   0.075 – 4.75 mm

    (ii) The water content of a soil has a range from 0% to 100%.

          (a) true   (b)   false

    (iii) Dry unit weight and unit weight of solids are one and same.

          (a) true   (b)   false

    (iv) At shrinkage limit, the soil remains fully saturated.

          (a) true   (b)   false

    (v)   The equation $\sigma' = \sigma - u$ is true only for a completely saturated soil.

          (a) true   (b)   false

    (vi) During compaction, soil always remains unsaturated.

          (a) true   (b)   false

    (vii) A falling head permeability test is better suited for measuring the permeability of fine sand and silts.

          (a) true   (b)   false

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(viii) Newmark chart can be used to determine the vertical stress at a point even if the point lies outside the loaded area.

    (a)   true   (b)   false

(ix) A plot of void ratio versus log of effective stress is a straight line for normally consolidated clay.

    (a)   true   (b)   false

(x) Thixotropy of a soil refers to the loss of strength of a soil with passage of time after remoulding.

    (a)   true   (b)   false

2.   (a) A saturated undisturbed sample of clay has a volume of 19.2 cm³ and mass of 32.5 gm. After oven-drying at 105°C for 24 hours, the mass reduces to 20.9 gin. For the soil in its natural state, find

      (i)   water content (w),

      (ii) specific gravity (G)

      (iii) void ratio (e),

      (iv) saturated unit weight (γ_{sat}) and

      (v) dry unit weight (γ_{dry}). (5×2)

  (b) Sketch the plasticity chart used for classifying fine grained soil in the Indian standard soil classification system and classify the soil having its liquid limit, $w_L = 60\%$ and plastic limit, $w_P = 32\%$.   (5)

3.   (a) State Darcy's law. Define coefficient of permeability of a soil from this law.
                                                             $(2 + 2)$

  (b) How can you estimate the coefficient of permeability of a soil from the particle size distribution curve?   (2)

  (c) Is falling head permeability test suitable for determination of the coefficient of permeability of sand? Give reasons in support of your answer.   (2)

  (d) How many litres of water will flow through a cylindrical soil sample of 8cm diameter and 12cm height in a day under a constant head of 65 cm, if the coefficient of permeability of the soil is 0.01 mm/s?   (7)

4. (a) Draw an ideal 'compaction curve' and discuss the effect of moisture on the dry unit weight of soil. (5)

(b) A soil having a specific gravity of solids $G = 2.75$, is subjected to Proctor compaction test in a mould of volume, $V = 945$ cm^3. The observations recorded are as follows :

Observation number	1	2	3	4	5
Mass of wet sample (gm)	1389	1767	1824	1784	1701
Water content (%)	7.5	12.1	17.5	21.0	25.1

What are the values of maximum dry unit weight and the optimum moisture content? Draw 100% saturation line. (10)

5. (a) A footing settles instantaneously if constructed on a sand stratum but takes a long time to settle if constructed on clay. Explain the reasons. (4)

(b) Draw a typical e vs log p' curve. Hence define the 'compression index of a soil. (5)

(c) A soil sample has a compression index of 0.3. If the void ratio (e) at a stress of 1.4 kg/m^2 is 0.5, compute the void ratio if the stress is increased to 2 kg/m^2, and the settlement of a soil stratum of 4 m thick. (6)

6. (a) What constitutes a flow-net? Write the practical applications of a flow-net. (5)

(b) Explain a graphical method of determining uplift pressures on the base of a concrete dam founded on permeable foundation. (10)

7. (a) A cylindrical soil sample, having cohesion (c) of S 1d4/m^2 and angle of shearing resistance (φ) of 20°, is subjected to a cell pressure (σ_3) of 10 kN/m^2. Calculate the maximum deviator stress at which the sample will fail. (5)

(b) A sample of cohesionless soil in a direct shear test fails under a shear stress (τf) of 160 kN/m^2 when the normal stress (σ_3) is 140 kN/m^2. Find the shear parameters of the soil. (5)

(c) A uniformly distributed pressure of 200 kN/m^2 is transferred by a square footing 2 m × 2 m at the ground surface. Find the vertical stress depth of 2 m below the footing. (5)

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