



- (b) A three-legged tower forms an equilateral triangle of side 4 m in plan. If the total weight of the tower is 450 kN and is equally carried by all the legs, compute the vertical stress increase caused in the soil by the tower at a depth of 4 m directly below one of the legs and also at the same depth below, the centroid of the triangle. 7.5

### Section C

5. (a) Explain Taylor's method to determine the coefficient of consolidation. 7.5
- (b) A consolidation test was performed on a 20 mm thick undisturbed clay sample. 50% consolidation occurred in 5 minutes. The sample was drained both at the top and at the bottom.

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**B. Tech. EXAMINATION, 2021**

Semester IV (CBCS)

**GEOTECHNICAL ENGINEERING-I**

CE-402

Time : 2 Hours

Maximum Marks : 60

*The candidates shall limit their answers precisely within 20 pages only (A4 size sheets/assignment sheets), no extra sheet allowed. The candidates should write only on one side of the page and the back side of the page should remain blank. Only blue ball pen is admissible.*

**Note :** Attempt *Four* questions in all, selecting *one* question from any of the Sections A, B, C and D. Q. No. 9 is compulsory.

### Section A

1. (a) A soil sample has a porosity of 30% the specific gravity of solids is 2.60. Calculate (i) void ratio, (ii) dry density (iii) unit weight if the soil is 50% saturated and (iv) unit weight if the soil is completely saturated. 4

- (b) Determine the field density of a natural soil by using sand replacement method. 4
- (c) Explain the classification of soils by IS classification system. 7
2. (a) The following results were recorded in a shrinkage limit test using mercury :
- Mass of container = 17.0 g
- Mass of wet soil and container = 72.30 g
- Mass of dish = 132.40 g
- Mass of dish and displaced mercury = 486.10 g
- Mass of dry soil and container = 58.20 g
- Volume of wet soil = 32.4 cm<sup>3</sup>
- Determine the shrinkage limit, the linear shrinkage and the shrinkage ratio. The density of mercury is 13.6g/cm<sup>3</sup>. 4
- (b) What are the two basic structural units of clay minerals ? Explain them. 4
- (c) In a hydrometer test, the initial reading is 1.08. After one hour, the corrected hydrometer reading is 1.03 and the corresponding effective depth is : 12 cm. Find the initial weight of soil placed in 1000cc suspension, the particle size corresponding to the 15 min reading, and the percentage of articles finer than this size. Take  $G = 2.65$ , and  $\mu = 0.1$  poise. 7

## Section B

3. (a) Determine the average horizontal and vertical permeability coefficients of a soil deposit made up of three horizontal strata, each 1 m thick, if the coefficients of permeability are  $1 \times 10^{-1}$  mm/s,  $3 \times 10^{-2}$  mm/s and  $8 \times 10^{-3}$  mm/s respectively for the three layers. 7.5
- (b) A soil profile Consists of a surface layer of sand 3m thick ( $\gamma = 16\text{kN/m}^3$ ), an intermediate clay layer 2 m thick ( $\psi_{\text{sat}}=19.25 \text{ kN/m}^3$ ), and a bottom layer of gravel 4 m thick ( $\psi_{\text{sat}} = 19 \text{ kN/m}^3$ ). The water table is at the top of the clay layer. Determine the effective stress at various interfaces. There is a surcharge of  $50 \text{ kN/m}^2$ , on the ground surface. 7.5
4. (a) A flow net for flow around a single row of sheet piles in a permeable soil layer is shown in Figure. Given that  $k_x = k_z = k = 5 \times 10^{-3} \text{ cm/s}$
- (i) How high (above the ground surface) will the water rise, if piezometers are placed at points  $a$  and  $d$  ?
- (ii) What is the rate of seepage through flow channel II per unit length (perpendicular to the section shown) 7.5

- (g) Write the formula to determine height of capillary rise in a soil and mention, what each term of the formula stands for ?
- (h) Explain about Poiseuille's law ?
- (i) Explain quick sand condition. Explain, how determination of seepage pressure is done ?
- (j) Write the relationship between the time factor and degree of consolidation, when the degree of consolidation is greater than 60% ?

In the field, the clay layer is 2.4 m thick and is underlain by an impervious rock. Drainage is possible only at the top surface. (i) Determine the coefficient of consolidation and (ii) calculate the time in days for 50% and 90% consolidation to take place in the field deposit. **7.5**

- 6. (a) Describe Casagrande's method of geometrical construction to find the pre consolidation pressure. **7.5**
- (b) The settlement analysis of a proposed structure indicated that 5cm of settlement will occur in three years, and the total, settlement will be 150 mm. The analysis was based on the assumption that the compressible layer is drained only at the top surface. However further investigations showed that there will be drainage both at the bottom and the top of the layer. For the case of double drainage, calculate (i) ultimate total settlement, (ii) time required for 50 mm of settlement. **7.5**

#### **Section D**

- 7. (a) Write a note on the laboratory box shear test. **7.5**

- (b) The following results were obtained from a triaxial test on two soil specimens. **7.5**

Sample No.	Confining Pressure (kPa)	Deviator Stress at failure kPa	Pore water pressure (kPa)
1	200	244	55
2	300	314	107

8. (a) The following results were obtained from a direct shear test on a sandy clay sample.

Normal load (N)	Shear load proving ring reading (divisions)
360	13
720	19
1080	26
1440	26

If the shear box is 60 mm square and the proving ring constant is 20 N per division, estimate the shear strength parameters of the soil. Would failure occur on a plane within this soil at a point where the normal stress is 320 kN/m<sup>2</sup> and the corresponding shear stress is 138 kN/m<sup>2</sup> ? **7.5**

- (b) In a direct shear test on a specimen of clean dry sand, a normal stress of 180 kPa was applied and failure occurred at a shear stress of 100 kPa. Determine analytically the angle of shearing resistance, the principal stresses during failure, and directions of the principal planes with respect to the direction of the plane of shearing. **7.5**

### Compulsory Question

9. Write briefly : **10×1.5=15**
- Distinguish between angle of repose and angle of internal friction.
  - What is an A-line, equipotential line and a flow-line?
  - Write the relationship-between coefficient of permeability, coefficient of consolidation and unit weight of water.
  - Define over consolidated under consolidated and normally consolidated clays.
  - List any *two* types of field compaction equipment. Also list any *two* types of soil structures.
  - What are the corrections to be applied to hydrometer test readings ?