

Time : 3 Hours

Max. Marks : 60

The candidates shall limit their answers precisely within the answer-book (40 pages) issued to them and no supplementary/continuation sheet will be issued.

**Note:** Attempt Four questions out of eight questions which is of 10 marks each. Q.No. 9 is compulsory, which is of 20 marks.

1. a) The moist unit weight of a soil is  $16.30\text{kN/m}^3$ . Given that the water content = 13% and specific gravity of soil solids = 2.68, find the dry unit weight, porosity, degree of saturation, the mass of water that must be added to reach full saturation. (2.5)
- b) Determine the field density of a natural soil by using core cutter method. (2.5)
- c) Classify the soils as per BIS and HRB method and also explain the suitability of soil type for highway construction. (5)

Or

2. a) Write a short note about diffuse double layer and base exchange capacity. (2.5)
- b) What is meant by consistency of soils? Define all the Atterberg limits. (2.5)
- c) Explain the mineral structure of Kaolinite and montmorillonite. (2.5)
- d) The undisturbed soil at a pit has a water content of 15%, void ratio 0.60 and specific gravity of 2.70. The soil from the pit is to be used to construct a rolled fill having a finished

volume of  $32000\text{m}^3$ . The soil is to be transported from the pit to the construction site by trucks having a net carrying capacity of 5.5 tons. After completion, the fill soil has a water content of 17% and dry density of  $1.72\text{ g/cm}^3$ . Calculate the total number of trips the truck will have to make to construct the rolled fill. (2.5)

3. a) Define Quick sand condition and derive the expression for critical hydraulic gradient. (2)
- b) A soil strata consists of 3 layers of thickness 1 m, 1.4 m and 2 m having the coefficients of permeability of  $2.6 \times 10^{-3}\text{ cm/s}$ ,  $1.9 \times 10^{-3}\text{ cm/s}$  and  $3.6 \times 10^{-4}\text{ cm/s}$  respectively. Estimate the average coefficient of permeability in the direction: i) parallel and ii) normal to the flow. (2)
- c) Explain the following terms:
  - (i) Seepage & superficial velocity
  - (ii) Coefficient of percolation
  - (iii) Flow nets (6)

Or

4. A three-legged tower forms an equilateral triangle of side 5m in plan. If the total weight of the tower is 450kN and is equally carried by all the legs, compute the vertical stress increase caused in the soil by the tower at a depth of 5m directly below one of the legs and also at the same depth below the centroid of the triangle. (10)
5. a) Explain the Terzaghi's theory of consolidation in detail. (2.5)
- b) Explain the difference between initial, primary and secondary consolidation. (2.5)

[P.T.O.]

- c) Define pre consolidation pressure. Describe a suitable procedure for determining the pre-consolidation pressure. (5)

Or

6. Two clay specimens A and B, of thickness of 2.5cm and 4cm, have equilibrium voids ratios 0.65 and 0.70 respectively under a pressure of 200 kN/m<sup>2</sup>. If the equilibrium void ratios of two soils reduced to 0.5 and 0.62 respectively when the pressure was increased to 400 kN/m<sup>2</sup>, find the ratio of the coefficient of permeability of the two specimens. The time required by the specimen A to reach 40 percent degree of consolidation is ¼ of that required by specimen B for reaching 40 percent degree of consolidation. (10)
7. a) The flowing test results are obtained from the direct shear test. Compute the shear strength parameters. Dimensions of the sample are 6 cm × 6 cm × 2 cm. (2.5)

Normal stress (kg/cm <sup>2</sup> )	0.25	0.4	0.5	0.6	0.7
Shear Load (kg.)	6.50	10.0	12.5	14.0	16.0

- b) Find an expression for the unconfined compressive strength  $q_u$  in terms of  $c'$ ,  $\theta'$  and  $A_f$  (pore pressure parameter at failure). Take parameter  $B=1$  and initial capillary tension =  $\mu_c$ . (5)
- c) Explain briefly about the Mohr's Coulomb failure theory. (2.5)

Or

8. a) Explain in detail about the various types of slope failures. Explain also the Swedish circle method in detail. (5)
- b) A vane, 12cm long and 6 cm in diameter, was pressed into soft clay at the bottom of a bore hole. Torque was applied and gradually increased to 50N-m when failure took place. Subsequently, the vane rotated rapidly so as to completely remould the soil. The remoulded soil was sheared at a

torque of 25N-m. Calculate the cohesion of the clay in the natural and remoulded state and also the value of the sensitivity. (5)

9. Write briefly: (10×2=20)

- What is isomorphous substitution?
- Explain the Darcy's law of flow through soils and its assumptions.
- Factors affecting creep/secondary compression in soils.
- Define Consistency Limits. Why they are required to be found in geotechnical Engineering?
- Discuss the spring analogy for primary consolidation.
- Draw the Mohr's circle for unconsolidated undrained test and explain about its failure envelop.
- Briefly explain e-p and e-log p curves.
- Explain with neat sketch, the concept of total, effective and neutral pressure in soils and also explain the effect of rise in the water table on effective stress.
- Differentiate between liquidity index and consistency index.
- What is stability number?