USN

Fifth Semester B.E. Degree Examination, Dec.2024/Jan.2025
Basic Geotechnical Engineering

Time: 3 hrs.

Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. Missing data may be assumed suitably.

Module-1

1 a. Starting from three phase diagram, with usual notations deduce.

$$\gamma_b = \frac{(G + S_r e)\gamma_w}{(1+e)}$$

and hence from this equation obtain the expressions for γ_d, γ_{sat} and γ_{sub}. **(10 Marks)**

b. A saturated specimen of undistorted inorganic clay has a volume of 19.20 cm³ and mass 32.50 gm. After overdrying at 105°C for 24 hrs, the mass reduces to 20.90 gm. For the soil in the natural state find the following:
   i) Water content
   ii) Dry unit weight (γ_d)
   iii) Specific gravity of soil solids
   iv) Voids ratio
   v) Saturated unit weight (γ_{sat}). **(10 Marks)**

OR

2 a. With a neat sketch, explain Atterberg limits. **(06 Marks)**
   b. Explain with a neat sketch the particle size distribution curve. **(04 Marks)**
   c. A soil sample consisting of particles of size ranging from 0.5 mm to 0.01 mm is put on the surface of still water tank of 5 m deep. Calculate the time of settlement of the coarsest and finest particles of the sample, to the bottom of the tank. Assume average specific gravity of soil particles as 2.66 and viscosity of water as 0.01 poise. **(10 Marks)**

Module-2

3 a. Explain with sketches the following clay minerals:
   i) Kaolinite   ii) Illite   iii) Montmorillonite **(09 Marks)**
   b. With sketches explain briefly primary and secondary bonds. **(05 Marks)**
   c. With a neat sketch, explain diffuse double layer in fine grained soils. **(06 Marks)**

OR

4 a. Discuss compaction of soils. Distinguish between standard procotor and modified proctor compaction tests. **(06 Marks)**
   b. With a neat sketch, explain zero air voids line. **(04 Marks)**
   c. The following results refer to a standard compaction test:

Water content (%)	10	12	14.3	16.1	18.2
Weight of soil with mould (N)	29.25	30.95	31.50	31.25	30.70

Determine the optimum moisture context and maximum dry unit weight by plotting the compaction curve. Take G = 2.70, volume of mould = 1000 cm³ and weight of mould = 10N. **(10 Marks)**

Module-3

5 a. Explain the following:
   i) Superficial velocity
   ii) Seepage velocity **(04 Marks)**
   b. Explain briefly factors affecting permeability. **(06 Marks)**
   c. In a falling head permeability test, the soil sample used is 20 cm long with a cross sectional area 24 cm². Calculate the time required for the head causing flow to drop from 250 mm to 120 mm. The cross sectional area of the stand pipe is 2 cm². The soil sample is made up of 3 layers.
   The thickness of first layer from the top is 8 cm and has a value of K as 2×10^{-4} cm/sec. The second layer has thickness of 7 cm and it has $K = 5 \times 10^{-4}$ cm/sec. The bottom most layer has a K value of 7×10^{-4} cm/sec. Flow is in a direction perpendicular to the layers. **(10 Marks)**

OR

6 a. What is a flow net? What are the uses and characteristics of flow nets? **(06 Marks)**
   b. Calculate the seepage loss in m³/day for a hydraulic structure, if the flow net contains 5 flow lines and 9 equipotential lines and the head causing flow is 20 m. K of soil is 2.6×10^{-6} cm/sec. **(04 Marks)**
   c. The water table in a deposit of sand 10 m thick, is at a depth of 4 m below the surface. Above the water table, the sand is saturated with capillary water. The bulk unit weight of sand is 19 kN/m³. Calculate the effective pressures at 2 m, 4 m and 10 m below the surface. Hence plot the variation of total pressure, neutral pressure and effective pressure over the depth of 10 m. **(10 Marks)**

Module-4

7 a. Explain Mohr-Coulomb's failure theory and draw the failure envelope for different soils. **(08 Marks)**
   b. In a triaxial test on two identical soil samples, the following data was obtained.

Test No	Cell pressure (kN/m²)	Maximum deviator stress (kN/m²)	Maximum principal stress (kN/m²)
1	50	120	-
2	100	-	332

Compute shear parameters. **(12 Marks)**

OR

8 a. Mention the advantages and disadvantages of direct shear test. **(05 Marks)**
   b. Classify shear tests based on drainage conditions. **(03 Marks)**
   c. A soil has unconfined compression strength of 120 kN/m². In triaxial compression test, specimen of same soil (under similar conditions) when subjected to cell pressure of 40 kN/m², failed at an additional stress of 160 kN/m². Determine:
   i) Shear strength parameters
   ii) Angle made by failure plane with axial stress direction in case of triaxial test. **(12 Marks)**

Module-5

9 a. Explain with neat sketches the mass spring analogy of consolidation of soils. **(08 Marks)**
   b. Explain normally consolidated soil and over consolidated soil. **(06 Marks)**
   c. The thickness of a normally consolidated clay layer is 3.0 m. The initial voids ratio of the sample is 1.0 and its liquid limit is 60%. The effective over burden pressure at the middle of the clay layer was 154 kN/m². Due to construction of a building the increase in effective stress is 92.4 kN/m². Determine the consolidation settlement of the clay layer. **(06 Marks)**

OR

10 a. What are the assumptions mode in Terzaghi's theory of one-dimensional consolidation?
  (04 Marks)

  b. Explain the significance of pre-consolidation pressure. Describe the Casagrande's method of determining it. **(08 Marks)**

  c. In a consolidation test voids ratio decreased from 0.70 to 0.60, when the pressure changes from 50 kN/m^2 to 100 kN/m^2. Determine:
  i) Compression Index
  ii) Coefficient of compressibility
  iii) Coefficient of volume change. **(08 Marks)**

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