Roll No. .....

Total Pages : 05

002404

May 2025

B.Tech. (CIVIL ENGINEERING)

(Fourth Semester)

Soil Mechanics (PCC-CED207)

Time : 3 Hours] [*Maximum Marks : 75*

Note : It is compulsory to answer all the questions (1.5 marks each) of Part A in short. Answer any *four* questions from Part B in detail. Different sub-parts of a question are to be attempted adjacent to each other. Assume any missing data accordingly.

Part A

1. (a) A sample of sand has a volume of 1000 ml in its natural state. Its minimum volume when Compacted is 840 ml. When gently poured into a measuring cylinder, its possible maximum volume is 1320 ml. What is the relative density ? **1.5**

(b) A soil has a porosity of 40%, the specific gravity of solids of 2.65 and a water content

of 12%. Determine the mass of water required to be added to 100 m^3 of this soil for full saturation. **1.5**

(c) Explain the significance of effective stress in soil mechanics. **1.5**

(d) State Darcy's Law and its application in soil permeability. **1.5**

(e) A flow net has 4 flow channels and 20 equipotential drops, calculate the shape factor. **1.5**

(f) Differentiate between primary and secondary consolidation. **1.5**

(g) A soil sample has a cohesion of 30 kPa and an angle of internal friction of 25°. Determine its shear strength under a normal stress of 100 kPa. **1.5**

(h) State Mohr-Coulomb failure criterion and its importance. **1.5**

(i) Describe the negative skin friction in piles. **1.5**

(j) Discuss the limitation of plate load test. **1.5**

Part B

2. (a) Discuss the Unified and Indian Standard Soil Classification Systems. A soil sample has a liquid limit of 20% and plastic limit of 12%. The following data are also available from sieve analysis : 8

Sieve size	% Passing
2.032 mm	100
0.422 mm	85
0.075 mm	38

Classify the soil according to Unified Classification or IS Classification.

(b) How does soil compaction affect engineering properties ? Discuss the various field compaction equipment. 7

3. (a) Determine the seepage discharge through the foundation of an earth dam if the flow net has 10 equipotential drops and 3.5 flow channels. The length of the dam is 300 m and the coefficient of permeability of the soil is 2.5×10^{-4} cm/sec. The level of water above the base of the dam is 12 m on upstream and 4 m on downstream. 8

(b) Explain the concept of total, effective and neutral stresses in soils. 7

4. A clay layer 4m thick is subjected to a pressure of 55 kN/m^2. If the layer has the double drainage and undergoes 50% consolidation in one year, determine the coefficient of consolidation. Take $T_v = 0.196$.

If the coefficient of permeability is 0.020 m/yr, determine the settlement in one year and rate of flow of water per unit area in one year.

Explain Terzaghi's one-dimensional theory of consolidation and its assumptions. 15

5. (a) A direct shear test was performed on a 6 cm × 6 cm sample of dry sand. The normal load was 360 N. The failure occurred at a shear load of 180 N. Plot the Mohr strength envelope, and determine ϕ, assume C = 0. Also determine the principal stresses at failure. 8

(b) Explain the use of Newmark's influence chart in stress determination. 7

6. (a) Explain the Rankine earth pressure theories. A retaining wall is 7m high, with it back face smooth and vertical. It retains sand with its surface horizontal. Using Rankine's Theory, determine the active earth pressure at the base when the backfill is : 8

(i) Dry

(ii) Saturated

(iii) Submerged with water table at the surface. $\gamma = 18$ kN/m^3 and $\phi = 30°$, γ sat = 21 kN/m^3.

(b) Derive Boussinesq's equation for stress distribution due to a point load. 7

7. (a) What are the various types of pile foundations ? Explain their applications. 8

(b) Discuss the Standard Penetration Test (SPT) and its significance in foundation design. 7

❖❖❖❖❖❖❖