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B.Tech. IV Sem Main/Back (New Scheme) 2025-26

Civil Engineering

(4CE4-01) - Geotechnical Engineering-I

Time : 3 Hours

Maximum Marks: 70

Min. Passing Marks:

Instructions to Candidates:

Part-A: Short answer questions (up to 25 words) 10x2 marks = 20 marks. All ten questions are compulsory.

Part- B: Analytical/Problem Solving questions 5x4 marks = 20 marks. Candidates have to answer 5 questions out of 7.

Part – C: Descriptive/Analytical/Problem Solving questions 3x10 marks = 30 marks. Candidates have to answer 3 questions out of 5.

Schematic diagrams must be shown wherever necessary. Any data you feel missing may suitably be assumed and stated clearly. Units of quantities used/calculated must be stated clearly.

Use of following supporting materials is permitted during examination. (Mentioned in form No. 205)

1 _____ NIL _____

2 _____ NIL _____

Part-A

- Q.1. Differentiate between percentage air voids and air content.
- Q.2. What are Atterberg limits?
- Q.3. What are the main systems of soil classification?
- Q.4. What causes flow of water through soils?
- Q.5. What is seepage velocity?
- Q.6. How does capillary action affect pore water pressure and effective stress?
- Q.7. What is dilation in soil?
- Q.8. What is meant by dry and wet of optimum in soil compaction?
- Q.9. Under what conditions is soil stabilized bitumen?
- Q.10. What are index properties of soil?

PART-B

- Q.1. A compacted cylindrical specimen 50 mm dia and 100 mm length, is to be prepared by oven dry soil. If the specimen is required to have a water content of 15% and the percentage air voids of 20%. Calculate the mass of the soil and water required for the preparation of the sample. Take $G = 2.69$
- Q.2. What is Darcy's law? What are its limitations?
- Q.3. Explain the uses of a flow net?
- Q.4. A soil profile consists of a surface of sand 3.5 m thick ($\rho_{\text{sand}} = 1.65 \text{ g/cm}^3$), an intermediate layer of clay 3 m thick ($\rho_{\text{clay}} = 1.95 \text{ g/cm}^3$) and the bottom layer of gravel 3.5 m thick ($\rho_{\text{gravel}} = 1.925 \text{ g/cm}^3$). The water table is at upper surface of the clay layer. Determine the effective stress at various levels immediately after placement of

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surcharge load of 56.86 kN/m^2 to the ground surface.

- Q.5. What are the differences between peak, critical, and residual effective friction angles?
- Q.6. The maximum dry density of a soil sample by the light compaction test is 1.78 gm/cm^3 at an optimum water content of 15%. Find the air voids and the degree of saturation. $G = 2.67$
- Q.7. What is mechanical stabilization? What are the factors that affect the mechanical stability of a mixed soil?

PART- C

- Q.1. An oven dried sample of soil has a volume of 265 cm^3 and a mass of 456 g. Taking $G = 2.71$, determine the void ratio and shrinkage limit. What will be the, water content which will fully saturate the soil sample and also cause an increase in volume equal to 10% of the original dry volume?
- Q.2. Explain in detail, the factors affecting the permeability of soil.
- Q.3. A 1.25 m layer of soil ($n = 0.35$; $G = 2.65$) is subjected to an upward seepage head of 1.85 m. What depth of coarse sand would be required above the existing soil to provide a factor of safety 2 against piping? Assume that the coarse sand has the same porosity and specific gravity as the soil and that there is negligible head loss in sand. Take $\gamma_w = 9.81 \text{ kN/m}^3$.
- Q.4. An unconfined compression test was carried out on a saturated clay sample. The maximum load the clay sustained was 127 N and vertical displacement was 0.8mm. The size of the sample was 38 mm diameter X 76 mm long. Determine the undrained shear strength. Draw Mohr's circle of stress for the test and locate undrained shear strength (C_u).
- Q.5. Explain in detail, the effects of compaction on the engineering properties of the soil?
