

**R22**

**Code No: 185CM**

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**

**B. Tech III Year I Semester Examinations, January - 2025**

**GEOTECHNICAL ENGINEERING**

**(Civil Engineering)**

**Time: 3 Hours**

**Max. Marks: 60**

**Note:** This question paper contains two parts A and B.

i) Part- A for 10 marks, ii) Part - B for 50 marks.

- Part-A is a compulsory question which consists of ten sub-questions from all units carrying equal marks.
- Part-B consists of ten questions (numbered from 2 to 11) carrying 10 marks each. From each unit, there are two questions and the student should answer one of them. Hence, the student should answer five questions from Part-B.

**PART- A**

**(10 Marks)**

- 1.a) What do you understand by the Plasticity Index? [1]
- b) What is sensitivity? [1]
- c) What are the uses of flow net? [1]
- d) Define quick sand condition. [1]
- e) Why is it essential to know the stress distribution of load? [1]
- f) What do you understand by relative density? [1]
- g) What is consolidation? [1]
- h) What do you understand by the pre consolidation pressure? [1]
- i) What do you understand by the Mohr's circle? [1]
- j) Draw the failure envelope for the UU test for partially saturated soil. [1]

**PART - B**

**(50 Marks)**

- 2.a) Derive an expression of bulk unit weight of soil using specific gravity, void ratio, degree of saturation and unit weight of water. Use phase diagram.
- b) A soil has a liquid limit of 50% and a plasticity index of 20. When the soil at its liquid limit was dried, the percentage decrease in volume was 40% of its dry volume. When it was dried from its plastic limit, the percentage decrease in volume was 20% of its dry volume. Determine the shrinkage limit of the soil. [5+5]

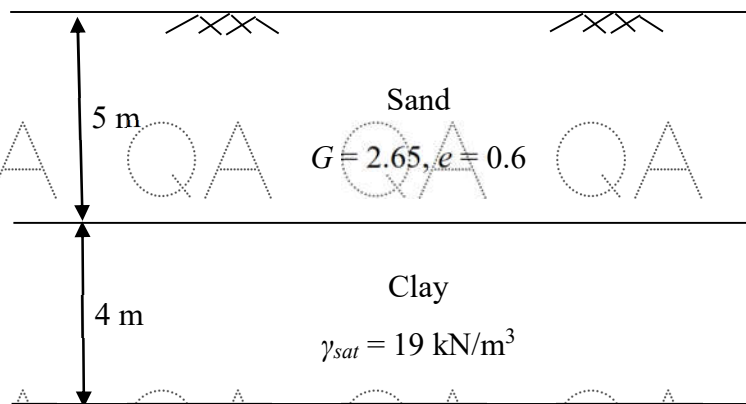
**OR**

- 3.a) Categorize different types of grading of soil based on the grain size distribution and discuss the significance of grading of soil.
- b) The moisture content of an undisturbed sample of clay belonging to a volcanic region is 235% at full saturation. The specific gravity of the solids is 2.57. The dry weight of the sample is 330 g. Determine, the saturated unit weight and void ratio of the soil sample. If the sample is at 50% saturation, determine the total unit weight of the soil sample. Use phase diagram. [5+5]

- 4.a) What solutions would you suggest to find out the permeability of stratified soil medium if the permeability and height of all the soil layers are known?
- b) In a falling head permeameter, the sample used is 20 cm long having a cross-sectional area of  $24 \text{ cm}^2$ . Calculate the time required for a drop of head from 25 cm to 12 cm if the cross-sectional area of the stand pipe is  $2 \text{ cm}^2$ . The sample of soil is made of three layers. The thickness of the first layer from the top is 8 cm and has permeability of  $3 \times 10^{-4} \text{ cm/sec}$ , the second layer of thickness 8 cm has permeability of  $5 \times 10^{-4} \text{ cm/sec}$  and the bottom layer of thickness 4 cm has permeability of  $6 \times 10^{-4} \text{ cm/sec}$ . Assume that the flow is taking place perpendicular to the layers. [6+4]

OR

- 5.a) Explain the procedure to find out the permeability of soil by constant head test.
- b) For the subsoil condition shown in the following figure, illustrate total, effective and pore water pressure distribution when (i) the water table is at 2 m below the ground level [S = 50% above the water table] (ii) the water table is 2 m above the ground level. [4+6]



- 6.a) What are the different methods to find out the stress distribution in the soil at different depths under vertically applied load. Discuss the advantages and limitations of these methods.
- b) The natural water content of a sample taken from a soil deposit was found to be 11.5%. It has been calculated that the maximum density for the soil will be obtained when the water content reaches 21.5%. Compute how much water must be added to 10,500 kg of soil (in its natural state) in order to increase the water content to 21.5%. Assume that the degree of saturation in its natural state was 40% and  $G = 2.7$ . [5+5]

OR

- 7.a) What are the different types of roller used for compaction of soil. Explain in details.
- b) A concentrated load of 50 kN acts on the surface of the soil. Determine the vertical stresses at points directly beneath the load up to a depth of 10 m at every 2.5 m interval. [6+4]

- 8.a) What are the factor affects the compressibility of the soil. Explain the effect of these factors on the compressibility of soil.
- b) A certain clay layer 9 m thick is expected to have an ultimate settlement of 40 cm. If the settlement was 10 cm after four years, how much longer will it take to obtain a settlement of 15 cm? [6+4]

OR

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9.a) Explain the procedures to perform the oedometer test. What parameters of soil can be found out from this test?

b) Two clay samples A and B, of thickness 2 cm and 3 cm, have voids ratios of 0.68 and 0.72 respectively under a pressure of  $200 \text{ kN/m}^2$ . If the void ratios of the two soils reduced to 0.5 and 0.62 respectively, when the pressure was increased to  $400 \text{ kN/m}^2$ , find the ratio of coefficients of permeability of the two samples. The time required by the sample A to reach 40% consolidation is 25% of that required by sample B for reaching 40% consolidation. [5+5]

10.a) Derive an expression of axial stress using cell pressure, cohesion and angle of internal friction. Also derive the value of failure angle.

b) In a CD triaxial test, a soil element undergoes a failure axial stress of  $300 \text{ kN/m}^2$  and a cell pressure of  $120 \text{ kN/m}^2$ . Determine the normal and shear stress on the failure plane. Also determine the angle of friction considering the soil as NC clay. [5+5]

**OR**

11.a) What are the different types of triaxial tests performed to find out the shear strength of soil? Draw the Mohr's circles and failure envelopes for all types of triaxial tests.

b) A soil sample of normally consolidated clay was subjected to a consolidated undrained triaxial compression test that was carried out until the specimen failed at a deviator stress of 50 kPa. The pore water pressure at failure was recorded to be 20 kPa and confining pressure of 50 kPa was used in the test. Determine the consolidated undrained shear strength parameters. [5+5]

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