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**Fifth Semester B.E. Degree Examination, July/August 2021**  
**Geotechnical Engineering – I**

Time: 3 hrs.

Max. Marks:100

**Note: Answer any FIVE full questions.**

- 1 a. With the help of a three phase diagram, define  
 (i) Voids ratio (ii) Water content (iii) Degree of saturation of a soil mass  
 Give the relationship for each. **(06 Marks)**
- b. With usual notations prove that  
 $\gamma = \gamma_d + S_r (\gamma_{sat} - \gamma_d)$  **(08 Marks)**
- c. A compacted sample of soil with a bulk density of 20 kN/m<sup>3</sup> has a water content of 15%. What are its dry density and degree of saturation? If the sample is allowed to get fully saturated without any increase in volume, what would be its bulk density? Assume G = 2.65. **(06 Marks)**

- 2 a. 500 gram of dry soil was subjected to a sieve analysis. The weight of soil retained on each sieve is as follows:

| IS sieve size | Wt. of soil, grams | IS sieve size | Wt of soil, gram |
|---------------|--------------------|---------------|------------------|
| 4.75mm        | 10                 | 212 $\mu$     | 40               |
| 2.00mm        | 165                | 150 $\mu$     | 30               |
| 1.00mm        | 100                | 75 $\mu$      | 50               |
| 425 $\mu$     | 85                 |               |                  |

Plot the grain size distribution curve and determine the following :

- (i) Effective size (ii) Uniformity coefficient (iii) Coefficient of curvature. **(08 Marks)**
- b. Explain the corrections to hydrometer reading in sedimentation analysis of soil. **(06 Marks)**
- c. Derive an expression to find shrinkage limit of soil from dry soil pat, when specific gravity G of soil is known. **(06 Marks)**
- 3 a. Explain any 4 tests on field identification of soil. **(08 Marks)**
- b. Give a detailed description on three clay minerals with neat diagram. **(06 Marks)**
- c. Draw a neat plasticity chart and explain its use to classify the soil. **(06 Marks)**
- 4 a. State Darcy's Law. With a neat sketch, derive an expression for the co-efficient of permeability of a soil in a falling head permeability test. **(08 Marks)**
- b. Explain the factors affecting the permeability of soil. **(06 Marks)**
- c. A sample of soil for constant head permeability test yielded the following data :  
 i) Diameter of sample = 7.6cm.  
 ii) Length of sample = 20cm.  
 iii) Head causing the flow = 15cm.  
 iv) Quantity of water collected in 10min = 150 CC.  
 Assume G = 2.65,  $\gamma_d = 18\text{kN/m}^3$ .  
 Determine : i) Co-efficient of Permeability ii) Discharge velocity iii) Seepage Velocity. **(06 Marks)**

- 5 a. Explain Mohr – Coulomb failure theory of soils. Sketch Coulomb failure envelope for pure sand and pure clay. (06 Marks)
- b. Explain the following terms : i) Sensitivity and Thixotropy of clay. (06 Marks)  
ii) Total, neutral and effective stresses in soils. (06 Marks)
- c. Two identical specimens 4cm diameter and 8cm height of partly saturated compacted soil are tested in a triaxial cell under undrained conditions. The first specimen failed at deviator load of 720N under a cell pressure of 100kN/m<sup>2</sup>. Second specimen failed at deviator load of 915N under a cell pressure of 200kN/m<sup>2</sup>. The increase in the volume of first specimen at failure is 1.2ml and shortens by 0.6cm. The increase in the volume of second specimen at failure is 1.6ml and shortens by 0.8cm. Determine apparent cohesion and angle of shearing resistance by analytical method. (08 Marks)

- 6 a. Obtain the value of compactive energy imported to the soil during Light compaction and Heavy compaction test. (04 Marks)
- b. What are the objectives of Compaction? Discuss the factors affecting compaction. (06 Marks)
- c. Following are the results obtained from a standard compaction test :

|  |      |      |      |    |      |
|--|------|------|------|----|------|
| Water content, W(%)                            | 13.5 | 20.2 | 25   | 35 | 45   |
| Bulk unit weight, $\gamma_b$ kN/m <sup>3</sup> | 16.3 | 19.4 | 18.8 | 18 | 17.2 |

Plot compaction curve and obtain maximum dry unit weight and OMC. Also plot 100% saturation line. Show specimen calculation.  $G = 2.65$ . (10 Marks)

- 7 a. Explain theory of consolidation with spring analogy concept. (06 Marks)
- b. Explain different types of deposits based on consolidation theory. (06 Marks)
- c. Define the following terms:  
i) Coefficient of compressibility. (08 Marks)  
ii) Coefficient of volume change.  
iii) Coefficient of compression index.

- 8 a. Explain tri axial shear test with a neat sketch. (06 Marks)
- b. List and explain the advantages and limitations of direct shear tests. (06 Marks)
- c. A footing 3.6m × 3.6m for a watch tower carries a load of 90kN and rests on dense sand of 9.0 m thickness overlaying a clay layer of 3.0 m depth. The depth of foundation is 1.5m. The clay layer overlies hard rock. The liquid limit of clay is 54percent, void ratio as 1-08. The saturated unit weights of sand and clay are 18.5 kN/m<sup>3</sup> and 17.5 kN/m<sup>3</sup> respectively. Assume the load distribution as 2V to 1H. Also the site is flooded. Determine the ultimate settlement of clay layer due consolidation. (08 Marks)

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