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Fifth Semester B.E. Degree Examination, Dec.2018/Jan.2019
Geotechnical Engineering – I

Time: 3 hrs.

Max. Marks:100

**Note: Answer any FIVE full questions, selecting
atleast TWO questions from each part.**

PART – A

- 1 a. What is phase diagram? Define the following with the help of three phase diagram.
 i) Porosity ii) air content iii) water content iv) bulk unit weight of soil v) unit weight of soil solids vi) percentage air voids vii) degree of saturation viii) void ratio. (06 Marks)
- b. with usual notations, derive the relation :
- $$\gamma' = \frac{(G - 1)\gamma_w}{1 + e} \quad (06 \text{ Marks})$$
- c. Soil has been compacted in an embankment at a bulk density of 21.5 kN/m³ and water content of 12%. The value of specific gravity of soil solid is 2.65. The water table is well below the foundation level. Estimate the dry density, void ratio, degree of saturation air content and percentage air voids of compacted soil. (08 Marks)

- 2 a. What is consistency of soil? List and define the various atterberg consistency limits. (06 Marks)
- b. What are the corrections to be made in hydrometer reading? Give the combined equation for corrected hydrometer reading. (04 Marks)
- c. Draw the particle size distribution curve and determine uniformity coefficient and coefficient of curvature of the soil for the data given below :
 Also state whether the sand given is well graded or poorly graded as per I.S recommendations :

Sieve size 'mm'	4.75	2.36	1.18	0.60	0.30	0.15	0.075	Pan
Mass of soil retained 'grams'	13	72	66	517	231	92	8	1

(10 Marks)

- 3 a. Explain with the help of the particle size distribution curve, well graded, uniformly graded and gap graded soil. (04 Marks)
- b. With neat sketch, explain the structure and salient details of clay minerals. (08 Marks)
- c. The following data refers to a sample of soil :
 Percentage passing 4.75mm IS sieve = 52
 Percentage passing 0.75mm IS sieve = 7
 Uniformity coefficient = 6.8
 Coefficient of curvature = 3.0
 Liquid limit of fine grained soil = 38%
 Plastic limit of fine grained soil = 12%
 Classify the soil. (08 Marks)

- 4 a. List and briefly explain the factors affecting the permeability of soils. (06 Marks)
- b. Explain quick sand phenomenon. (06 Marks)
- c. A sand sample of 35cm² cross-sectional area and 20cm long was tested in a constant head permeameter. Under a head of 60cm the discharge was 120ml in 6 minutes. The dry unit weight of the sand used for the test was 1120 grams and G = 2.68. Determine,
 i) Coefficient of permeability in cm/sec
 ii) The discharge velocity
 iii) The seepage velocity. (08 Marks)

PART – B

- 5 a. Explain briefly the Mohr-Coulomb theory applied to soils. (05 Marks)
 b. Explain sensitivity and thixotropy of clay. (05 Marks)
 c. A direct shear test was conducted on a remoulded soil sample of sand gave the following observations at the time of failure. Normal load, $\sigma = 288\text{N}$. Shear load = 173 N. The cross-sectional area of the sample = 36cm^2 . Determine,
 i) The angle of internal friction
 ii) The magnitude and direction of the principal stresses in the zone of failure, by using graphical method. (10 Marks)
- 6 a. List the differences between standard and modified proctors compaction test. (04 Marks)
 b. Explain the factors affecting the compaction of soils. (04 Marks)
 c. The following are the results of compaction test :

Mass of mould + wet soil (grams)	2925	3095	3150	3125	3070
Water content %	10	12	14.3	16.1	18.2

Volume of the mould = 1000ml
 Mass of the mould = 1000grams
 Specific gravity of solids = 2.70

- i) Plot the compaction curve and find the optimum moisture content and maximum dry density
 ii) Plot the zero air void line
 iii) Determine the degree of saturation at the maximum dry density. (12 Marks)
- 7 a. What are the assumptions made in Terzaghi's one dimensional consolidation theory? (08 Marks)
 b. Explain the determination of pre-consolidation pressure by casagrande method. (06 Marks)
 c. An undisturbed sample of a clay stratum 2m thick, was tested in the laboratory and the average value of coefficient of consolidation was found to be $2 \times 10^{-4}\text{cm}^2/\text{sec}$. If a structure is built on the clay stratum, how long will it take to attain half the ultimate settlement under the load of the structure? Assume double drainage. (06 Marks)
- 8 a. What are the curve fitting methods used in consolidation test? Explain logarithmic time curve fitting method with neat sketch. (08 Marks)
 b. What are the advantages of triaxial shear test over direct shear test? (04 Marks)
 c. A vane 10cm long and 8cm in diameter was pressed into soft clay at the bottom of a borehole. Torque was applied and gradually increased to 45 N-m when failure took place. Subsequently, the vane rotated rapidly so as to completely remould the soil and a torque of 18 N-m is required to shear this soil. Calculate cohesion of clay in natural and remoulded state. Also find sensitivity and mention the type and structure of clay based on this sensitivity. (08 Marks)
