

**Fifth Semester B.E. Degree Examination, Jan./Feb. 2021**  
**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. Define : i) Void ratio ii) Porosity iii) Degree of saturation iv) Water content  
v) Dry unit weight vi) Unit weight of soil solids  
vii) Air content with the help of a three phase diagram viii) %ge of air voids. (05 Marks)
- b. With usual notations derive the relationship:  $S_e = W.G.$  (05 Marks)
- c. The volume of an undisturbed clay sample having a natural water content of 40% is  $25.6 \times 10^{-6} \text{ m}^3$  and its weight is 0.435N. Calculate the void ratio and degree of saturation of the sample, if specific gravity is 2.75. Solve by first principles. (10 Marks)
- 2 a. With the help of particle size distribution curve explain :  
i) Well graded soil ii) Uniformly graded soil iii) Gap grades soil. (06 Marks)
- b. A soil sample, consisting of particles size ranging from 0.5 mm to 0.01 mm, is put on the surface of still water tank 5 meters deep. Calculate the time of settlement of the coarsest and finest particles of the sample to the bottom of the tank. Assume average sp. gravity of soil particles as 2.66 and viscosity of water as 0.01 poise. (06 Marks)
- c. The results of a liquid limit test are given below :

No. of blows	48	38	29	20	14
Water content (%)	32.1	35.9	40.9	46.1	52.8

The plastic limit of the soil is 23%. Plot the flow curve and determine :

- i) Liquid limit ii) Plasticity index iii) Flow index and iv) Toughness index. (08 Marks)
- 3 a. With a neat sketch, explain plasticity chart and describe its use in classifying fine grained soil. (06 Marks)
- b. Explain with neat sketches, the structure of the following minerals :  
i) Kaolinite ii) Montmorillonite. (06 Marks)
- c. Following are the results obtained from the tests conducted on two soils A and B. Classify them as per IS classification system. Show the salient steps involved. (08 Marks)

Soil	LL	PL	% Retained on IS 75 $\mu\text{m}$ Sieve	% Retained on IS 4.75 mm Sieve	Cu	Cc
A	110	50	40	Zero	-	-
B	-	-	97	05	7	2

- 4 a. List and explain the factors affecting the permeability of soils. (06 Marks)
- b. A permeameter of 82mm diameter contains a sample of soil of length 350mm. It can be used for either constant head or falling head tests. The stand pipe used for the latter has a diameter of 25mm. In the constant head test the loss of head was 1160mm measured on a length of 250mm. When the rate of flow was 2.73 ml/sec. Find the coefficient of permeability of the soil. If a falling head test was then conducted, how much time would be taken for the head to drop from 1.5m to 1.0m? (08 Marks)
- c. The effective sizes of two sands are 0.09mm and 0.54mm. The capillary rise of water in the first sand is 480mm. What is the capillary rise in second sand, if void ratio is same for both sands? (06 Marks)

**PART - B**

- 5 a. Explain the types of shear test based on different drainage conditions. (06 Marks)  
 b. What are the advantages and limitations of direct shear test? (06 Marks)  
 c. A consolidated undrained test was conducted on a clay sample and the following results are obtained.

Cell pressure (kN/m <sup>2</sup> )	200	400	600
Deviator stress at failure (kN/m <sup>2</sup> )	118	240	352
Pore water pressure at failure (kN/m <sup>2</sup> )	110	220	320

Determine the shear strength parameters with respect to i) total stresses ii) effective stresses. (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 spring analogy theory of consolidation of soil. (07 Marks)  
 b. What is pre consolidation pressure? How it is determined by Casagrande's graphical method? (07 Marks)  
 c. Explain Pre consolidated, Normally consolidated and Under consolidated soil. (06 Marks)
- 8 a. With a neat sketch, explain the square root of time fitting method of determining coefficient of consolidation. (06 Marks)  
 b. Explain how the shear tests are classified based on sample drainage conditions. (06 Marks)  
 c. A bed of compressible clay of 4m thickness has pervious sand on top and impervious rock at the bottom. In a consolidation test on an undisturbed specimen of clay from this deposit, 90% settlement was reached in 4 hrs. The specimen was 20mm thick. Estimate the time in years for a building founded over this deposit to reach 90% of its final settlement. (08 Marks)

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