



**Fifth Semester B.E. Degree Examination, Dec.2019/Jan.2020**

**Geotechnical Engineering - I**

Max. Marks:100

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

**PART - A**

- 1 a. With the help of soil three-phase diagram explain: (i) Water content (ii) Air content  
(iii) Degree of saturation (iv) Relative density (08 Marks)
- b. With usual notations, derive the relationship  

$$\gamma_d = \frac{(1 - n_a)G\gamma_w}{1 + \omega G}$$
 (06 Marks)
- c. A fully saturated soil sample has a water content of 35% and specific gravity of 2.65. Determine its porosity, saturated unit weight and dry unit weight. (06 Marks)
- 2 a. Define: i) Liquid limit; ii) Plastic limit; iii) Shrinkage limit; iv) Relative consistency; v) Toughness index; vi) Slenderness ratio. (06 Marks)
- b. A  $100 \times 10^{-6} \text{ m}^3$  clay sample has a natural water content of 30%. Its shrinkage limit is 18%. If the sp.gr. of solids is 2.72, what will be the volume of sample at a water content of 15%? (04 Marks)
- c. In a liquid limit test specimens of certain sample of clay following readings are obtained:

Water content (%)	31.93	27.62	25.51	23.30
No. of blows	5	16	23	42

The plastic limit of clay is 13% natural water content is 18%. Determine liquid limit, plasticity index, liquidity index, relative consistency, flow index and toughness index of soil. (10 Marks)

- 3 a. Explain field identification of soils. (08 Marks)
- b. What are the different types of clay minerals commonly found in soils? Explain any one with their structure. (06 Marks)
- c. Classify the following soils with IS system of classification:  
 Soil A : Liquid limit = 38% and Plastic limit = 20%  
 Soil B : Liquid limit = 18% and Plastic limit = 12%  
 Soil C : Passing through 4.75 mm IS sieve = 70%  
           Passing through 0.075 mm IS sieve = 08%  
 $C_U = 7, C_C = 3$  and  $I_P = 3$  (06 Marks)
- 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)

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.  
2. Any revealing of identification, appeal to evaluator and /or equations written eg. 42+8 = 50, will be treated as malpractice.

## PART – B

- 5 a. Discuss the effect of compaction on different properties of soil. (08 Marks)  
 b. Differentiate between standard and modified proctor tests. (04 Marks)  
 c. The observations of a standard proctor test are given below :

Dry density $\text{kN/m}^3$	16.16	17.06	18.61	18.95	18.78	17.13
Water content (%)	5.02	8.81	11.25	13.05	14.40	19.25

- (i) Plot the compaction curve and determine optimum moisture content.  
 (ii) Also compute the void-ratio and degree of saturation at optimum condition. Take  $G = 2.77$  (08 Marks)

- 6 a. Explain the factors affecting compaction of soils. (08 Marks)  
 b. Following are the result of standard proctor test:

Trial No.	1	2	3	4	5
Moisture content (%)	8.30	10.50	11.30	13.40	13.80
Bulk unit wt ( $\text{kN/m}^3$ )	19.8	21.3	21.6	21.2	20.8

The sp.gr. of soil particles is 2.65.

Plot the following and determine OMC and MDD:

- i) Moisture density curve.  
 ii) Zero airvoids curve.  
 iii) Ten percent air content curve. (12 Marks)

- 7 a. Briefly explain consolidation using spring analogy. (06 Marks)  
 b. Explain Casagrande's method of determination of preconsolidation pressure. (06 Marks)  
 c. In a consolidation test, voids ratio decreased from 0.80 to 0.65, when the pressure was changed from  $100\text{kN/m}^2$  to  $200\text{kN/m}^2$ . Determine i) Compression Index ii) Coefficient of compressibility and iii) Coefficient of volume change. (08 Marks)

- 8 a. Explain the merits and demerits of direct shear test. (06 Marks)  
 b. A laboratory consolidation test was performed on a specimen of clay 25mm thick, drained both at top and bottom. The time required for 50% consolidation was 12 minutes. Determine the coefficient of consolidation of clay. Also calculate the time required for same degree of consolidation (50%) for this clay deposit 5m thick and drained at top end only. (06 Marks)  
 c. The following results were obtained from a consolidated undrained test on a normally consolidated clay. Plot the strength envelope in terms of total stresses and effective stresses and determine cohesion intercept and angle of shearing resistance.

Sl. No	Cell Pressure ( $\text{kN/m}^2$ )	Deviator stress ( $\text{kN/m}^2$ )	Pore water Pressure ( $\text{kN/m}^2$ )
1	250	152	120
2	500	300	250
3	750	455	350

(08 Marks)

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