

**B.Tech 5th Semester Exam., 2021**

( New Course )

**GEOTECHNICAL ENGINEERING—I**

Time : 3 hours

Full Marks : 70

Instructions :

- (i) The marks are indicated in the right-hand margin.
- (ii) There are **NINE** questions in this paper.
- (iii) Attempt **FIVE** questions in all.
- (iv) Question No. 1 is compulsory.

1. Choose the correct answer of the following  
(any seven) : 2×7=14

(a) Chemical weathering of rocks is characterized by

- 1. change in chemical and mineralogical composition
- 2. disappearance of some minerals
- 3. formation of new secondary minerals

Correct answer is

- (i) 1 only
- (ii) 1 and 2 only
- (iii) 2 and 3 only
- (iv) 1, 2 and 3

(b) The bulk density of a soil mass below ground water table is equal to

- (i) saturated density
- (ii) submerged density
- (iii) dry density
- (iv) relative density

(c) The volume of a density bottle is usually

- (i) 25 ml
- (ii) 50 ml
- (iii) 900 ml
- (iv) 1000 ml

(d) Soil is in plastic state when the water content is between

- (i) liquid limit and plastic limit
- (ii) plastic limit and shrinkage limit
- (iii) liquid limit and shrinkage limit
- (iv) shrinkage limit and zero

(e) Wet sieve analysis is done for the soil passing

- (i) 75  $\mu$ m
- (ii) 4.75  $\mu$ m
- (iii) 10 mm
- (iv) 20 mm

- (f) The maximum particle size for which Darcy's law is applicable is
- 75  $\mu\text{m}$
  - 0.2 mm
  - 0.5 mm
  - 1.0 mm
- (g) A soil has a discharge velocity of  $6 \times 10^{-6}$  m/s and the porosity of 0.40. Its seepage velocity is
- $150 \times 10^{-6}$  m/s
  - $1.5 \times 10^{-6}$  m/s
  - $2.4 \times 10^{-6}$  m/s
  - $6 \times 10^{-6}$  m/s
- (h) Quick sand is
- a type of sand
  - a condition in which a cohesionless soil loses its strength because of upward flow of water
  - a condition in which a cohesive soil loses its strength
  - None of the above

- (i) The soil sample taken for IS light compaction test usually should pass through
- 4.75 mm IS sieve
  - 10 mm IS sieve
  - 20 mm IS sieve
  - 40 mm IS sieve
- (j) A point load of 700 kN is applied on the surface of a thick layer of saturated clay. Using Boussinesq's equation, the estimated vertical stress at a depth of 2 m and a radial distance of 1.0 m from the point of application of the load is
- 47.5 kPa
  - 47.7 kPa
  - 47.6 kPa
  - 47.8 kPa
2. (a) Explain the phenomena of formation and transportation of soils. 7
- (b) Explain the method of determination of liquid limit of soil by Casagrande's apparatus. What are the limitations of the method? 7
3. (a) From fundamental, derive an expression for dry density in terms of bulk unit weight and water content. 7

- (b) An earthen embankment under construction has a bulk unit weight of  $17 \text{ kN/m}^3$  and a moisture content of 12%. Compute the quantity of water in liters required to be added per cubic meter of earth to raise the moisture content to 16% at the same void ratio. 7

4. (a) Describe the Indian system of soil classification. When would you use dual symbols for soils? 7

- (b) Two soils  $S_1$  and  $S_2$  are tested in the laboratory for the consistency limits. The data available is as follows :

	Soil $S_1$	Soil $S_2$
Plastic limit	21%	25%
Liquid limit	45%	65%
Flow index	8	10
Natural moisture content	40%	50%

- (i) Which one is more plastic?  
 (ii) Which one is better foundation material when remoulded?  
 (iii) Which one has better strength as a function of water content?  
 (iv) Which one has better strength at the plastic limit? 7

5. (a) What is flow net? Discuss the characteristics and uses of flow net. 7

- (b) The following data were recorded in a constant head permeability test : 7

Internal diameter of permeameter = 7.5 cm

Head loss over a sample length of 18 cm = 24.7 cm

Quantity of water collected in 100 sec = 1000 ml

Porosity of soil sample was 45%

Calculate the coefficient of permeability and discharge velocity.

6. (a) Explain the mechanism of piping in hydraulic structures. What methods are used to increase the factor of safety against piping? 6

- (b) A silt deposit consists of two layers. The top layer is 2.5 m thick (Unit weight =  $18 \text{ kN/m}^3$ ) and the bottom layer is 6.0 m thick (Unit weight =  $19 \text{ kN/m}^3$ ). The water table is at a depth of 4.0 m from the top. Draw the diagram showing the variation of total stress, neutral stress and effective stress. 8

7. (a) How the compaction improve the engineering properties of soil? 7

(b) The following data is obtained in a compaction test : 7

Bulk density (gm/cc)	1.97	2.11	2.30	2.41	2.42	2.32
Moisture content (%)	5.02	8.81	11.25	14.05	17.40	19.25

Determine optimum moisture content and maximum dry density. Draw zero-air-void line. Assume  $G = 2.68$ .

8. (a) Determine the vertical stress under a uniform circular load of intensity  $Q$  and radius  $a$  using Westergaard's equation. 7

(b) The wall of a building foundation of width 4 m and length 30 m carries a uniformly distributed load  $300 \text{ kN/m}^2$ . Compute the vertical stress along the centre of the foundation at a depth 4.0 m below the bottom of the foundation. Ignore the surcharge effect of the soil over the base level of the foundation. 7

9. Write short notes on any four of the following : 14

- (a) Black cotton soils
- (b) Silt and clay
- (c) Plasticity chart
- (d) Piping
- (e) Field compaction control
- (f) Importance of pressure bulb

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