

B.Tech 5th Semester Exam., 2019

SOIL MECHANICS—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) : $2 \times 7 = 14$

(a) Geological cycle for the formation of soil is

(i) Upheaval—Transportation—
Deposition—Weathering

(ii) Weathering—Upheaval—
Transportation—Deposition

(iii) Transportation—Upheaval—
Weathering—Deposition

(iv) Weathering—Transportation—
Deposition—Upheaval

- (b) The initial and final void ratios of a clay sample in a consolidation test are 1.0 and 0.6 respectively. If the initial thickness of sample is 3.0 cm, then its final thickness will be

(i) 1.8 cm

(ii) 2.4 cm

(iii) 2.9 cm

(iv) 3.0 cm

- (c) Which of the following is not a clay mineral?

(i) Alite

(ii) Montmorillonite

(iii) Illite

(iv) Kaolinite

- (d) In a pumping out test, the drawdown is 5 m. If the coefficient of permeability of the soil is 10^{-4} m/s, then the radius of influence will be about

(i) 250 m

(ii) 300 m

(iii) 150 m

(iv) 200 m

- (e) If the flow net of coffer dam foundation has $h = 6$, $N_f = 6$ and $N_d = 18$, $k = 4 \times 10^{-5}$ m/min, then the seepage discharge (in m^3/day) per m length is

- (i) 0.2304
- ~~(ii) 0.1152~~
- (iii) 1.0368
- (iv) 2.304

- (f) If a soil suffers a change in shape and volume by application of external loads over it but recovers its shape and volume immediately when the load is removed, then the property of the soil is said to be

- (i) resilience of soils
- (ii) elasticity of soils
- (iii) compressibility of soils
- (iv) None of the above

- (g) If the sensitivity of a soil is between 4 and 8, then it will be called as

- (i) insensitive soil
- (ii) less sensitive soil
- (iii) sensitive soil
- (iv) extra sensitive soil

- (h) According to IS classification, soil can be classified into

- (i) 16 groups
- (ii) 18 groups
- (iii) 12 groups
- ~~(iv) 8 groups~~

- (i) What is the use of sonoscope?

- (i) Checking the accuracy of water metres
- (ii) Regulating the fire hydrants
- (iii) As a replacement of venturimeter for discharge measurements
- (iv) Detection of leakage in underground water mains

- (j) Coefficient of consolidation is measured in

- (i) cm^2/g
- (ii) cm^2/sec
- (iii) $\text{g}/\text{cm}^2/\text{sec}$
- (iv) $\text{g}/\text{cm}/\text{sec}$

2. (a) A granular soil deposit is 7 m deep over an impermeable layer. The ground-water table is 4 m below the ground

surface. The deposit has zone of capillary rise of 1.2 m with a saturation of 50%. Plot the variation of total stress, pore water pressure and effective stress with the depth of deposit, $e = 0.6$ and $G_s = 2.65$.

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- (b) A stratified soil deposit consists of four layers of equal thickness. The coefficient of permeability of the second, third and fourth layers are respectively $\frac{1}{3}$ rd, $\frac{1}{2}$ and twice of the coefficient of permeability of the top layer. Compute the average permeability of the deposit, parallel and perpendicular to the direction of the stratification in terms of the permeability of the top layer.

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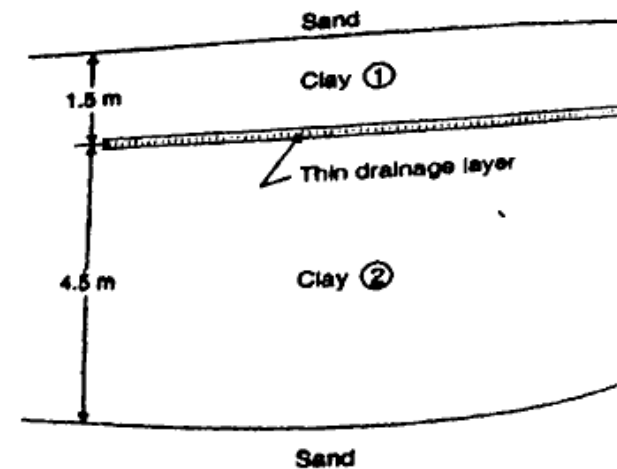
3. (a) Derive an expression for the vertical stress at a point due to a point load using Boussinesq's theory.

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- (b) A water tower is constructed on a circular raft 5 m in diameter at a depth of 2 m below ground level in sand having bulk unit weight of 20 kN/m^3 . The gross intensity of pressure at the base of the raft is 140 kN/m^2 . What will be the increase in vertical stress due to raft at a point 4 m beneath the centre of the raft?

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4. (a) Explain Terzaghi's 1-D consolidation theory and also write its assumptions. 5
- (b) A 6.0 m thick layer of clay is located between 2 layers of free draining sand. Also, there is a thin drainage layer within the clay at a depth of 1.50 m from its top surface. The average value of C_v is found as $4.92 \times 10^{-2} \text{ mm}^2/\text{sec}$.



If a structure is constructed above the clay layer, how many days would be required for it to attain half the ultimate settlement? Assume that the expression $T = \pi/4U^2$ is applicable for the entire range of consolidation.

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5. (a) What is mechanical stabilization? What are the factors that affect the mechanical stability of a mixed soil? 5
- (b) The following results were obtained from a standard compaction test on a sample of soil :

Water content (%)	0.12	0.14	0.16	0.18	0.20	0.22
Mass of wet soil (kg)	1.68	1.85	1.91	1.87	1.87	1.85

The volume of mould used was 950 ml. Make the necessary calculations and plot the compaction curve and obtain maximum dry density and OMC. Also calculate the void ratio, degree of saturation and the theoretical maximum dry density. ($G = 2.70$) 9

6. (a) With the help of the three-phase diagram, derive the relation

$$\gamma_d = \frac{(1 - n_a)G_s\gamma_w}{1 + wG_s} \quad 6$$

- (b) A liquid limit test conducted on a soil sample in the cup device gave the following results :

Number of blow	10	19	23	27	40
Water content (%)	60.00	45.20	39.80	36.50	25.20

Two determinations for the plastic limit gave the water content of 20.30% and 20.80%. Determine—

- (i) the liquid limit and plastic limit;
(ii) the plasticity index;
(iii) the liquidity index if the natural water content is 27.40%. 8

7. (a) What is the use of classifications of soils? Name various classification systems and discuss the IS classification system. 7
- (b) What is flow net? Describe its properties and applications. 7
8. (a) Explain clay mineralogy with neat sketches. http://www.akubihar.com 8
- (b) Define the terms 'compression index', 'coefficient of consolidation' and 'coefficient of compressibility', and indicate their units and symbols. 6
9. Write short notes on any four of the following : $3\frac{1}{2} \times 4 = 14$
- Cement stabilization
 - Zero air void line
 - Base exchange capacity
 - Black cotton soil
 - Coefficient of volume change
 - Smooth wheel rollers
