

Code : 011509

B.Tech 5th Semester Exam., 2018

SOIL MECHANICS—I

Time : 3 hours

Full Marks : 70

Instructions :

- (i) **All** questions carry equal marks.
- (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 (any seven) :

- (a) In a liquid limit test, the moisture content at 15 blows was 70% and that at 40 blows was 20%. The liquid limit of the soil is
 - (i) 35%
 - (ii) 50%
 - (iii) 65%
 - (iv) None of the above

- (b) The number of hydroxyl ions of an aluminium octahedron shared with neighbouring octahedra in an alumina sheet is
 - (i) 2
 - (ii) 4
 - (iii) 6 —
 - (iv) 8

- (c) A soil sample having liquid limit and plasticity index values are 60% and 35% respectively. The soil is classified on plasticity chart as
 - (i) CH —
 - (ii) MH
 - (iii) OH
 - (iv) MI

- (d) At what value of saturation does the zero air voids curve in compaction test represent the dry density?
 - (i) 0%
 - (ii) 80%
 - (iii) 100% —
 - (iv) 50%

(3)

(e) To provide safety against piping failure with a factor of safety 5 for a hydraulic structure, what will be maximum permissible exit gradient for soil with specific gravity 2.5 and porosity of 0.4?

(i) 0.125

(ii) 0.145

(iii) 0.160

(iv) 0.180 —

(f) A normally consolidated clay settled by 2 cm when the effective stress was increased from 100 kPa to 200 kPa. When the effective stress increased to 400 kPa, then the total settlement will be

(i) 4 cm —

(ii) 6 cm

(iii) 8 cm

(iv) 10 cm

(g) A constant-head test is used for

(i) coarse-grained soils —

(ii) silty soils

(iii) clayey soils

(iv) organic soils

(4)

(h) The effective stress controls which of the following properties of soils?

(i) Shear strength

(ii) Compressibility

(iii) Permeability

(iv) All of the above

(i) An isobar is a curve which

(i) joins points of equal horizontal stress

~~(ii) joins points of equal vertical stress~~

(iii) joins points of zero vertical stress

(iv) joins points of maximum vertical stress

(j) The Westergaard's analysis is used for

(i) homogeneous soils

(ii) cohesive soils

(iii) sandy soils

(iv) stratified soils —

2. (a) Discuss the spring analogy for primary consolidation. What are its uses?
- (b) There is a clay layer 8 m thick with a layer of sand on either side. An undisturbed sample 2.5 cm thick of the clay when tested in the laboratory required 25 minutes to reach 50% consolidation ($T_v = 0.20$). It is proposed to construct a building at the above site. Estimate the time required for 90% consolidation to take place ($T_v = 0.85$).
3. (a) Derive an expression for the vertical stress at a point due to a point load, using the Boussinesq's theory.
- (b) A monument weighing 15 MN is erected on the ground surface. Considering as a concentrated one, determine the vertical pressure directly under the monument at a depth of 8 m below the ground surface.
4. (a) Discuss the different methods for determination of the coefficient of permeability.
- (b) Determine the coefficient of permeability of a confined aquifer 5 m thick which gives a steady discharge of 20 litres/sec through a well of 0.3 m radius. The height of water in the well which was 10 m above the base before pumping dropped to 8 m. Take the radius of influence as 300 m.

5. (a) What are different types of soil structures which can occur in nature? Discuss in brief.
- (b) A fully saturated clay has a water content of 40% and mass specific gravity of 1.85. After oven-drying, the mass specific gravity reduces to 1.75. Determine the specific gravity of solids and the shrinkage limit.
6. (a) Determine the seepage discharge through the foundation of an earthen dam if the flow net has 10 equipotential drops and 3.5 flow channels. The length of the dam is 300 m and the coefficient of permeability of the soil is 2.5×10^{-4} cm/sec. The level of water above the base of the dam is 12 m on the upstream and 4 m on the downstream.
- (b) Explain the mechanics of piping in hydraulic structures. What methods are used to increase factor of safety against piping?
7. (a) What is the use of classification of soils? Discuss Indian Standard Classification system.
- (b) Draw the complete A-line chart and classify the soil, as per the BIS, passing through the 75 μ m IS sieve and having a liquid limit of 19% and a plastic limit of 13%.

8. (a) What is soil stabilization? What are its uses?
- (b) The unit weight of a compacted sand backfill was determined by field measurement to be 1738 kg/m^3 . The water content and void ratio of the laboratory compacted soil was 10.2% and 60.7%. What was degree of compaction achieved in field? Assume water content remain constant ($G = 2.7$).

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

- (a) Thermal stabilization
- (b) Quicksand condition
- (c) Difference between consolidation and compaction
- (d) Base exchange capacity
- (e) Compression index
- (f) Importance of Atterberg's limits
