

B.Tech. 5th Semester Exam., 2013

SOIL MECHANICS

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.
- (v) Assume missing data, if any, suitably.

1. Choose the correct answer (any seven) :

- (a) Void ratio of a micaceous sand sample in the densest and the loosest conditions are 0.4 and 1.2 respectively. The relative density of the soil for the in-place void ratio of 0.6 will be
- (i) 60%
 - (ii) 75%
 - (iii) 65%
 - (iv) 80%

- (b) A clay is identified as a normal clay if the activity range is between
- (i) 0.25 and 0.75
 - (ii) 0.75 and 1.25
 - (iii) 1.25 and 3.0
 - (iv) 0.15 and 0.25
- (c) A loam is a mixture of
- (i) gravel and sand
 - (ii) sand and silt
 - (iii) sand, silt and clay
 - (iv) sand and clay
- (d) The strength of a soil in dry state is an indicator of high amount of
- (i) sand
 - (ii) silt
 - (iii) clay
 - (iv) gravel
- (e) The soil structure at the dry side of optimum is
- (i) partially flocculated
 - (ii) fully flocculated
 - (iii) fully dispersed
 - (iv) None of the above

- (f) In the light compaction test, the number of blows used per layer is
- 15
 - 25
 - 30
 - 35
- (g) The use of sheep's foot rollers to compact cohesionless soils is
- very effective
 - moderately effective
 - effective
 - ineffective
- (h) The correct range of permeability (m/s) of a soil whose degree of permeability is low, is
- 10^{-8} to 10^{-9}
 - 10^{-3} to 10^{-5}
 - 10^{-5} to 10^{-7}
 - 10^{-1} to 10^{-3}
- (i) When consolidation of saturated soil sample takes place, the degree of saturation
- decreases
 - increases
 - remains constant
 - decreases initially and then increases

2. (a) With the usual notations, prove that

$$S_r = \frac{w}{\frac{Y_w}{Y}(1+w) - \frac{1}{G}}$$

- (b) The following results refer to liquid limit test :

No. of blows	:	33	23	18	11
Water constant		41.5	49.5	51.5	55.6

The plastic limit is 23.5%. Determine the plasticity index and toughness index for the soil.

3. (a) What are the building blocks of clay minerals? Explain the three common groups of clay minerals.
- (b) In a saturated soil stratum, water table exists at the surface. The effective stress in the soil, at a depth of 2.0 m is 20 kN/m^3 . If the water table rises by 0.50 m during floods, what will be the change in the effective stress?
4. (a) What are the main considerations while determining permeability of stratified soil deposits? Establish the relation between average permeability for flow parallel and that perpendicular to the bedding plane. Establish that the former is greater than the latter.

- (b) Prove that the seepage force per unit volume is given by the product of hydraulic gradient and unit weight of water.
5. (a) An annular ring footing of external and internal radii of 8 m and 4 m respectively transmits a pressure of 100 kN/m^2 . Compute the vertical stresses at depths 0.5 m, 1 m, 2 m, 4 m and 4 m below the centre. Draw the stress distribution curve with depth.
- (b) In a standard Procter test the mould of 1 litre capacity weighs 12.5 N when empty. Successive trials gave the following results :
- | | | | | | | |
|----------------------|---|------|------|------|------|------|
| Wt. of mould + | | | | | | |
| wet soil (in N) | : | 29.6 | 30.1 | 31.5 | 31.2 | 30.8 |
| Water content (in %) | : | 16.7 | 18.6 | 21.0 | 21.7 | 23.5 |
- Determine the maximum dry density and o.m.c. If $G = 2.7$, calculate the degree of saturation and percentage air voids at maximum dry density.
6. (a) Define the following :
- Compression index
 - Expansion index
 - Coefficient of volume compressibility
 - Coefficient of compressibility
 - Coefficient of consolidation

- (b) A soil sample 20 mm thick takes 20 minutes to reach 20% consolidation. Find the time taken for a clay layer 6 m thick to reach 40% consolidation. Assume double-drainage condition in both cases.
7. (a) List the assumptions made in deriving Terzaghi's one-dimensional consolidation theory.
- (b) Distinguish among/between the following :
- Underconsolidated, Normally consolidated and Overconsolidated soil deposits
 - Primary compression and Secondary compression
 - Degree of consolidation and Over-consolidation ratio
8. (a) What is mechanical stabilization? What are the factors that affect the mechanical stability of a mixed soil?
- (b) Discuss the use of lime stabilization of soils. What are the chemical and physical changes which take place in lime stabilization?

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

- (a) Newmark's influence chart
- (b) Quick-sand phenomenon
- (c) Protective filter
- (d) Specific surface
- (e) Casa Grande's plasticity chart