

Code : 011509

B.Tech. 5th Semester Exam., 2014

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 option (any seven) .

- (a) Swelling of clayey soil directly depends on the
 - (i) percentage of clay fraction
 - (ii) plasticity index of the soil
 - (iii) types of clay mineral
 - (iv) liquid limit of the soil

- (b) For a fine grained soil with plasticity index of 15% to 40%, the degree of plasticity is referred to as
 - (i) non-plastic
 - (ii) moderately plastic
 - (iii) plastic
 - (iv) highly plastic
- (c) An increase in compactive effort in laboratory compaction causes the OMC to
 - (i) remain the same,
 - (ii) decrease
 - (iii) increase by 5%
 - (iv) decrease by 5%
- (d) Artesian conditions are said to exist when the piezometric surface lies
 - (i) below ground level
 - (ii) between ground level and the aquifer
 - (iii) above ground level
 - (iv) below groundwater level
- (e) In order to prevent piping, the exit gradient should be
 - (i) equal to the critical gradient
 - (ii) much less than the critical gradient
 - (iii) greater than the critical gradient
 - (iv) not a function of the critical gradient

- (f) As the depth of the stress isobar increases, the intensity of stress
- increases
 - decreases
 - remains constant
 - initially decreases and then increases
- (g) Which of the following soil parameters is considered as a measure of the degree of overconsolidation?
- Pre-consolidation pressure
 - Compression index
 - Overconsolidation ratio
 - Coefficient of consolidation
- (h) Piping in soils occurs when
- the effective pressure becomes zero
 - a sudden change of permeability takes place
 - the soil is fissured and cracked
 - the soil is highly porous
- (i) Volume change occurs in saturated soils not when the total stress increases but when the effective stress increases.
- True
 - False

- (j) The amount of consolidation in saturated soils equals the amount of water that flows out of the soil voids.
- True
 - False
2. (a) Derive a relation between void ratio and porosity for—
- dry soil mass;
 - fully saturated soil mass.
- (b) A soil sample with porosity of 38% has degree of saturation of 50%. Taking $G = 2.67$, compute dry unit weight, saturated unit weight, submerged unit weight and bulk unit weight.
3. (a) List any five index properties of soils. Explain them.
- (b) The in situ bulk density of a sandy stratum is 1.9 gm/cc and it has a water content of 8%. For determining the density index, dried sand from stratum was first filled loosely in a 300 cc mould and then vibrated to give maximum density. The loose dry weight in the mould was 478 gm and the dense dry weight at maximum compaction was 572 gm. Calculate the density index of the stratum. [Take $G = 2.70$]

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(Continued)

4. (a) Explain briefly the type of soil structure recognized in coarse-grained soil deposits and fine-grained soil deposits.
- (b) A soil profile consists of a surface layer of sand 3.5 m thick with unit weight of 16.5 kN/m^3 , intermediate layer of clayey sand 2.5 m thick with unit weight of 19 kN/m^3 and bottom layer of clay 3.5 m thick with unit weight of 19.5 kN/m^3 . The water table is at the top of intermediate layer. Draw the effective stress, pore pressure and total stress diagrams for all the three layers.
5. (a) What are the different methods to determine the permeability of a soil sample? Discuss briefly their merits and demerits and special applications.
- (b) A falling head permeability test is to be conducted on a soil whose permeability is estimated to be $3 \times 10^{-7} \text{ cm/sec}$. What diameter of stand pipe would you use, if the head had to drop from 27.5 cm to 20 cm, in 5 minutes? Assume cross-section of specimen = 15 cm^2 and its length = 0.5 cm.

6. (a) A flow net has a total head of 5.0 m, causing flow. The potential drop in each field is 0.5 m. Calculate the hydraulic potential after 4 falls.
- (b) The discharge through a pervious soil is 216 cc/day. The flow net shows 5 flow channels and 10 equipotential drops. The head causing the flow is 2.0 m. Calculate the permeability of the soil.
7. (a) A concentrated load of 800 kN acts at the ground surface. Compute the vertical stresses at 8 m depth for the following conditions :
- (i) On the axis of the load
- (ii) 2.0 m away from the axis
- (b) How will you control the quality of compaction in field?
8. The following observations were made in a standard proctor test :

Trial No.	1	2	3	4	5	6
Mass of wet soil (kg)	1.7	1.89	2.03	1.99	1.96	1.92
Water content	7.7	11.5	14.6	17.5	19.7	21.2

Volume of mould = 945 cm^3 , $G = 2.67$

- (a) Determine the maximum dry density and optimum moisture content.
- (b) Also plot zero-air void line

9. (a) Discuss the spring analogy for primary consolidation. What are its uses?
- (b) In a consolidation test, a fully saturated clay sample was subjected to a load of 500 kN/m^2 . After 12 hrs., the average pore pressure was found to be 200 kN/m^2 . Find out the time required for 50% consolidation to take place.

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