

Name :

Roll No. :

Invigilator's Signature :

CS/B.TECH(CE-N)/SEM-4/CE-403/2012

2012

SOIL MECHANICS

Time Allotted : 3 Hours

Ful Marks : 70

The figures in the margin indicate full marks

*Candidates are required to give their answers in their own words
as far as practicable.*

GROUP – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for any *ten* of the following :

10 × 1 = 10

- i) Silty clay is denoted by
 - a) CM
 - b) SM
 - c) MC
 - d) MS.
- ii) What is the effective stress below 10 m from water level of a pond which has a depth of 15 m ?
 - a) 10 kN/m²
 - b) 100 kN/m²
 - c) 0 kN/m²
 - d) –100 kN/m².
- iii) Which among the following clay minerals is most unstable ?
 - a) Kaolinite
 - b) Montmorillonite
 - c) Illite
 - d) Aluminium.

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iv) Dry density (γ_d) = ?

- a) $\frac{\gamma_b}{1+w}$ b) $\frac{\gamma_w}{1+w}$
 c) $\frac{\gamma_d}{1+w}$ d) $\frac{\gamma_c}{1+w}$.

v) $\gamma_{\text{sat}} - \gamma_w = ?$

- a) γ_{sub} b) γ_{eff}
 c) γ_{total} d) γ_d .

vi) According to Bousinesq's theory, the vertical stress at a point in a semi-infinite soil mass depends upon

- a) point load, coordinates of the point and modulus of elasticity of soil
 b) point load, coordinates of the point modulus of elasticity of soil and its Poisson's ratio
 c) point load & coordinates of the point
 d) point load, coordinates of the point modulus of elasticity of soil and its density.

vii) In a standard Proctor Compaction, the water content (w) and maximum dry density ($\gamma_{d \text{ max}}$) are related as

- a) $\gamma_{d \text{ m}}$ is linearly proportional to w
 b) w is inversely proportional to $\gamma_{d \text{ max}}$
 c) $\gamma_{d \text{ max}}$ corresponds to a unique value of w
 d) $\gamma_{d \text{ max}}$ corresponds to a $w = \frac{w_p + w_l}{2}$.

viii) Compression Index on a soil helps to determine

- a) total time required for consolidation
 b) time required for 50% consolidation
 c) total settlement of clay layer
 d) pre-consolidation pressure of clay.

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- ix) In a Triaxial Compression test when drainage is allowed during the first stage (i.e. application of cell pressure) only and not during the second stage (i.e. application of deviator stress at constant cell pressure), the test is known as
- Consolidated Drained Test
 - Consolidated Undrained Test
 - Unconsolidated Drained Test
 - Unconsolidated Undrained Test.
- x) Skempton's pore pressure coefficient B for saturated soil is
- 1
 - 0
 - between 0 & 1
 - greater than 1.
- xi) The coefficient of active earth pressure for loose sand having an angle of internal friction of 30° is
- $\frac{1}{3}$
 - 3
 - 1
 - $\frac{1}{2}$.
- xii) If the top surface of the backfill of a retaining wall is inclined to the horizontal at an angle β , then the coefficient of passive earth pressure is equal to
- $$\frac{\cos \beta \left(\cos \beta - \sqrt{\cos^2 \beta - \cos^2 \phi} \right)}{\cos \beta + \sqrt{\cos^2 \beta - \cos^2 \phi}}$$
 - $$\frac{\cos \beta \left(\cos \beta + \sqrt{\cos^2 \beta - \cos^2 \phi} \right)}{\cos \beta - \sqrt{\cos^2 \beta - \cos^2 \phi}}$$
 - $$\frac{\cos \beta + \sqrt{\cos^2 \beta - \cos^2 \phi}}{\cos \beta \left(\cos \beta + \sqrt{\cos^2 \beta - \cos^2 \phi} \right)}$$
 - $$\frac{\cos \beta - \sqrt{\cos^2 \beta - \cos^2 \phi}}{\cos \beta \left(\cos \beta + \sqrt{\cos^2 \beta - \cos^2 \phi} \right)},$$
- where ϕ is the angle of internal friction of soil.

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GROUP – B**(Short Answer Type Questions)**Answer any *three* of the following. $3 \times 5 = 15$

2. Prove that seepage velocity is greater than discharge velocity.
3. What are the differences between compaction and consolidation ?
4. Write short notes on the different types of roller and their uses.
5. Define total stress, effective stress and pore water pressure in soil.
6. Define Density index of soil. Derive the expression of density index from a hypothetical plot of Density index and Void ratio.
7. A stratified soil deposit consists of four layers of equal thickness. The coefficient of permeability of the second, third and fourth layers are respectively $\frac{1}{3}$, $\frac{1}{2}$ & twice the coefficient of permeability of the top layer. Compute the average permeability of the deposit parallel and perpendicular to the bedding plane, in terms of the permeability of the top layer.

GROUP – C**(Long Answer Type Questions)**Answer any *three* of the following. $3 \times 15 = 45$

8. a) Prove that $n = \frac{e}{1+e}$.
- b) A clay sample originally 25 mm thick and at a void ratio of 1.20, was subjected to a compressive load. After fully consolidation, its thickness was measured to be 24 mm. Compute the final void ratio. $5 + 10$

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9. a) The following data refers to a compaction test as per Indian Standard (light compaction) :

Water content (%)	8.5	12.2	13.75	15.5	18.2	20.2
Wt. of wet sample (kg)	1.80	1.94	2.00	2.05	2.03	1.98

If the specific gravity of soil grains was 2.7,

- i) Plot the compaction curve and obtain the maximum dry unit weight and the optimum moisture content.
 - ii) Plot the 80% and 100% saturation lines.
 - iii) If it is proposed to secure a relative compaction of 95% in the field, what is the range of water content that can be allowed ? 9
- b) It is required to construct an embankment by compacting soil excavated from nearby borrow areas. The optimum moisture content and corresponding γ_d in laboratory is 20.8% and 1.71 gm/cc respectively. However, the natural moisture content and γ_b in field are 8.3% and 1.84 gm/cc respectively. Find out the quantity of soil to be excavated and the quantity of water to be added to it, for 125 m³ of finished embankment. 6

10. a) A clay layer whose settlement under a given loading is expected to be 16 cm settles 4 cm at the end of 2 months. How many months will be required to reach a settlement of 8 cm ? How much settlement will occur in 10 months ? 6

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- b) The soil profile at a building site consists of dense sand up to 3 m depth, normally loaded soft clay from 3 m to 7 m depth, and stiff impervious rock below 7 m depth. The ground-water table is at 0.40 m depth below ground level. The sand has a density of 18 kN/m^3 above water table and 19 kN/m^3 below it. For the clay, natural water content is 52%, liquid limit is 66% and specific gravity is 2.65. Calculate the probable ultimate settlement resulting from a uniformly distributed surface load of 42 kN/m^2 applied over an extensive area of the site. 6
- c) In a laboratory consolidation test with porous discs on either side of the soil sample, the 25 mm thick sample took 84 minutes for 90% primary compression. Calculate the value of coefficient of consolidation for the sample. 3
11. a) A CU test was conducted on a normally consolidated clay for which it can be assumed that $C' = C_u = 0$. A sample failed at a deviator stress of 50 kN/m^2 , when the cell pressure was 100 kN/m^2 . What is the value of ϕ_u ? If $\phi' = 32^\circ$ for the soil, what was the pore water pressure at failure? 6

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- b) The results of a direct shear test performed on a soil sample in a shear box of 6 cm × 6 cm size are given below :

Normal Load (kg)	30	40	50	60
Shear force at failure (kg)	18.1	25.8	33.1	39.8

Plot the failure envelope for the soil and determine its shear parameters. 9

12. Write short note on the following : 10 × 1½

- a) Void ratio
- b) Porosity
- c) Saturated Density
- d) Submerged Density
- e) Bulk Density
- f) Water content
- g) Dry Density
- h) Density of Solids
- i) Specific Gravity
- j) Air Content.

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