Name : ....

Roll No. : ....

Invigilator's Signature : ....

CS/B.TECH (CE)/SEM-5/CE-501/2011-12

2011
SOIL MECHANICS - I

Time Allotted : 3 Hours   *Full 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

[Graph sheet(s) will be supplied by the institution on demand]

GROUP – A
(Multiple Choice Type Questions)

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

$$10 \times 1 = 10$$

i) Quantity of seepage is equal to

     a) $K\, N_f/N_d$ b) $Kh\, N_f/N_d$

     c) $Kh\, N_d/N_f$ d)   none of these.

ii) Equipotential lines are lines that intersect the flow lines at

     a)   Right angle   b)   angle 45°

     c)   Parallel   d)   none of these.

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    iii)   Laplace equation is

        a) $K_x \, \delta^2 h/\delta x^2 + K_z \, \delta^2 h/\delta z^2 = 0$

        b) $K_x \, \delta h/\delta x + K_z \, \delta h/\delta z = 0$

        c) $K_x \, (\delta h/\delta x)^2 + K_z \, (\delta h/\delta z)^2 = 0$

        d) $\delta h/\delta x + \delta h/\delta z = 0.$

    iv)   Boussinesq equation is

        a) $\sigma_z = 3Q/2\Pi \, z^2 \, \dfrac{1}{[1 + (r/z)^2]^{3/2}}$

        b) $\sigma_z = 3Q/2\Pi \, z^2 \, \dfrac{1}{[1 + (r/z)^2]^{/2}}$

        c) $\sigma_z = 3Q/2\Pi \, z \, \dfrac{1}{[1 + (r/z)]^{3/2}}$

        d)   None of thes

    v)   For clay soils, value of K is

        a) 10^{-1} cm/s   b) 10^{-3} cm/s

        c) 10^{5} cm/s   d) 10^{-7} cm/s.

    vi)   Plasticity index is

        a)   Liquid limit + Plastic limit

        b)   Liquid limit – plastic limit

        c)   Plastic limit – Liquid limit

        d)   None of these.

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vii) If the sand *in situ* is in its densest state, then the relative density of sand is

   a)   0

   b)   1

   c)   between 0 and 1

   d)   greater than 1.

viii) According to Atterberg the soil is said to be of medium plasticity if the plasticity index PI is

   a) $0 < PI < 7$ b) $7 < PI < 17$

   c) $17 < PI < 27$ d) $PI > 27$.

ix) When the plastic limit of a soil is greater than the liquid limit then the plasticity index is reported as

   a)   negative   b)   zero

   c)   non-plastic   d)   1.

x) The field density of a natural soil deposit or of a compacted soil can be determined by

   a)   sand replacement method

   b   core cutter method

   c)   water displacement method

   d)   any one of these.

xi) Composite correction for sedimentation analysis by hydrometer is

   a)   always positive   b)   always negative

   c)   positive or negative d)   none of these.

xii) When the natural state of cohesionless soil is in its loosest form then the density index is

a)   0   b)   1

c)   2   d)   none of these.

(xiii) Sedimentation analysis is required when soil fraction is finer than

a)   60μ   b)   65μ

c)   75μ   d)   none of th se.

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following.   3 × 5 = 15

2. Derive the expression : $\dfrac{e}{e_{max}} + \dfrac{I_D}{e_{max}}$ ($e_{max} - e_{min}$) = 1, where

e = natural void ratio of the deposit.
I_D = Relative dens ty, e_{max} = void ratio of the soil in loosest state. e_{min} = void ra io of the soil in densest state.

3. Sand lying belo a masonry dam has a porosity of 40% and a specific gravity of 2.67. Determine the maximum permissible upward gradient, if a factor of safety of 4 is considered.

4. An embankment having a total volume of 5000m³ has a water content of 12% and dry density of 1.85 g/cm³. If it was constructed from a borrow pit where the undisturbed soil has a water content of 15% and the void ratio of 0.55, calculate the quantity of soil which has excavated for the construction of the above embankment. Take specific gravity of soil solids as 2.67.

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5. What are the essential differences between Boussinesq's and Westergaard's theories ? What is the basic principle involved in the development of New mark's chart ? 2 + 3

6. Draw the plasticity chart IS 1498-1970.

7. The water table is lowered from a depth of 3.05m to a depth of 6.10m in a deposit of silt. All the silt is saturated even after the water table is lowered. Its water content is 26%. Estimate the increase in the effective pressure at a depth of 10.4m on account of lowering the water table. Assume G=2.7.

GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. 3 × 15 = 45

8. 500g of dry soil w s used for sieve analysis. The masses of soil retained on each sieve is given below :

ISSieve 4 75mm 2.40mm 1.20mm 600μ 425μ 300μ 150μ 75μ

Wt of soil

Retained 9.36 53.75 78.10 83.22 85.79 76.82 67.02 33.88

(gm)

Plot a grain size distribution curve and compute the following :

Percentages of gravel, coarse sand, medium sand, fine sand and silt as per IS1498.

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9. It is required to excavate a long trench in a sand deposit up to a depth of 3.5m below G.L. The sides of the trench should be vertical and are to be supported by steel sheet piles driven up to 1.5m below the bottom of the trench. The ground water table 1m below G.L. In order to have a dry working area, water accumulated in the trench will be continuously pumped out. If the sand has a void ratio of 0.72 and G = 2.66, check whether a quick sand condition is likely to occur. If so what remedial measures would you suggest ?

10. a) Derive the expression : $\sigma_z = q\left[1 - \left\{\dfrac{1}{1 + \left(\dfrac{R}{z}\right)^2}\right\}^{\frac{3}{2}}\right]$ for uniform load on circular Areas from Boussinesq equation.

    b) A concentrated load of 35kN acts on the surface of a homogeneous soil mass of large extent. Find the stress intensity at a depth of 8 m and (i) directly under the load ; (ii) at a horizontal distance of 6 m.   8 + 7

11. At a construction site, a 3 m thick clay layer is followed by a 4m thick gravel layer, which is resting on impervious rock. A load of 25kN/m2 is applied suddenly at the surface. The saturated unit weight of the soils are 19kN/m^3 and 20kN/m^3

for the clay and gravel layers, respectively. The water table is at the surface. Draw diagram showing variation with depth, of total neutral and effective stress in the layers.

$$5 + 2 \times 2\frac{1}{2} + 5$$

W.T.

SURCHARGE = 25 kN/sq. m

SATURATED CLAY

3 m

SATURATED GRAVEL

4 m

IMPERVIOUS ROCK
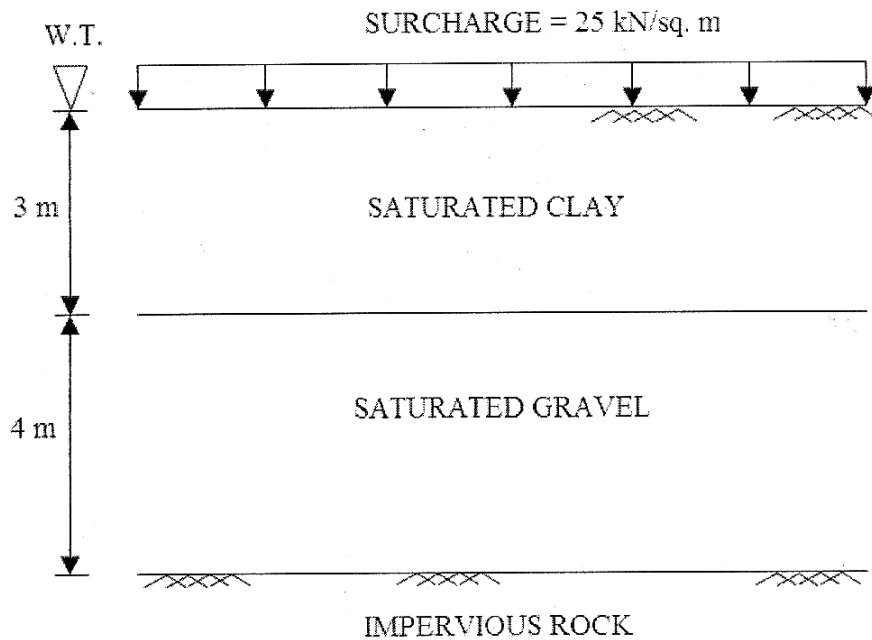
12. a) A horizontal stratified deposit consists of three uniform layers. The permeability of the layers are 6×10^{-4} cm/sec, 36×10^{-4} cm/sec and 18×10^{-4} cm/sec and their respective thicknesses are 8m, 2m and 16m. Calculate the average permeability of the deposit in horizontal and vertical directions.

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b) A single row of sheet piles is driven up to a depth of 4 m in a bed of clean sand having a co-efficient of permeability of 0.002 cm/sec. An impermeable layer of very stiff clay exists at a depth of 10 m above G.L. The sheet pile wall has to retain water up to 4 m above G.L. The height of water level on the downstream side is 0.5 m. Construct the flownet and determine quantity of seepage loss considering unit width of the sheet piles.

7 + 8