Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/B.Tech(CE)/SEM-5/CE-501/2010-11

2010-11

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 i their own words as far as practicable

GROUP – A
(Multiple Choice Type Questions)

1. Choose the correct alternatives for any *ten* of the following : $10 \times 1 = 10$

i) Soil deposited from suspension in quiet freshwater is called

a) Alluvial soil b) Marine soil

c) Lacustrine soil d) Glacial soil.

ii) Particle size ranging between 0·002 to 0·075 are classified as

a) clay b) fine sand

c) silt d) medium sand.

iii) Hydrometer or pipette testing is done for soil passing through

a) 75 b) 2·00 mm

c) 0·002 mm d) 0·425 mm.

iv) Effective grain size of a soil is

a) D_{10} b) D_{20}

c) D_{30} d) D_{50} .

v) The ratio of the volume of void V_v to the total volume of soil mass is called V is called

a) void ratio b) specific gravity

c) moisture content d) porosity.

vi) In laboratory, c effic ent of permeability of relatively more permeable soi or coarse grained soil is generally determined by

a) constant head permeameter

b) failling head permeameter

c) consolidation test

d) seepage analysis.

vii) For a dense sand, the relative density is

a) between 65 and 85 b) between 35 and 65

c) between 85 and 100 d) greater than 100.

viii) Which of the following parameters has no influence on permeability of soils ?

a) Degree of saturation b) Void ratio

c) Pressure head d) Grain size.

ix) If the consistency index of soil exceeds unity, the soil is in

a) solid state b) semi-solid state

c) plastic state d) liquid state.

x) The relation between discharge velocity (V) and Seepage velocity (V_s) is given by

a) $V_s = eV$ b) $V_s (1 + e) V$

c) $V_s = \frac{e}{1 + V}$ d) none of these.

xi) In an anisotropic soil, the coefficient of permeability of soil $K' =$

a) $\sqrt{\frac{K_z}{K_x}}$ b) $\sqrt{\frac{K_x}{K_z}}$

c) $\sqrt{K_x}\ xK_z$ d) none of these.

xii) The wester guard analysis is used for

a) sandy soil b) stratified soil

c) homogeneous soil d) cohesive soil.

GROUP – B
(Short Answer Type Questions)

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

2. $\beta = \dfrac{w}{\dfrac{\gamma_w}{\gamma}(1 + w) - \dfrac{1}{G}}$ where, w = water content, γ_w = unit weight of water, γ = mass unit weight of soil, G = specific gravity of soil grains, β = degree of saturation.

3. The dry unit weights of a sand in the loosest and densest states are respectively 13·34 kN/m^3 and 21 40 kN/m^3. Assuming the specific gravity of the solids as 2 67, determine the relative density of sand with porosity of 30%.

4. The *pF* of a soil is 2·8. Calculate the capillary height and capillary potential for the soil

5. A horizontal stratified soil deposit consists of three layers each uniform itself. The permeability of the layer are $8 \infty 10^{-4}$, $50 \quad 10^{-4}$, $15 \infty 10^{-4}$ cm/sec and there thicknesses are 6, 3 and 12 m respectively. Find the effective average perm ability of the deposit in horizontal and vertical direction

6. A circular foundation rests on the horizontal upper surface of a semi-infinite soil mass, whose properties comply with the usual elasticity requirements and carries a load of 100 kN. The contact pressure is uniform and the foundation is flexible. The base of the foundation is frictionless. The diameter of the foundation is 3 m. Determine the vertical stress distribution on horizontal planes along the central axis of the foundation to the depth of 10 m below the surface.

GROUP – C

(Long Answer Type Questions)

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

7. a) What do you understand by the following terms ?

   i) Uplift pressure

   ii) Exit gradient. 2 + 2

   b) A single row of sheet pile is driven upto a depth of 3 m in a bed of clean sand having a coefficient of permeability of 0·003 cm/sec. An impermeable layer of very stiff clay exists at a depth of 9 m below the G.L. The height of the water level in the downstream side is 0.4 m. Construct the lownet and determine the quantity of seepage loss considering unit width of the sheet piles. 8

   c) Explain the practical application of flownet. 3

8. a) A fully saturated soil sample has a volume of 24 cc. The sample was dried in oven and the weight of the dry soil pat was found to be 43·76 gm. Determine the void ratio, moisture content, saturated density and dry density of the soil mass. Given G = 2·68. 2 + 2 + 2 + 2

   b) What are the factors that influence the capillary rise in soil ? 2

   c) What are the limitations of Stoke's law ? 2

   d) What is the plasticity chart ? 3

9. a) Five different particle sizes are mixed in proportions shown below and water is added to make the volume of soil suspension exactly equal to 1000 cc.

Particle size (mm)	***Weight (gm)***
0·060	5
0·020	15
0·010	20
0·005	4
0·001	6

The particles have a specific gravity of 2·65 and the temperature of the soil suspension was 25°C. Unit weight of water can be taken as 1 0 gm/cc, viscosity of water 8·95 millipoises. The soi suspension thoroughly shaken and sedimentation allowed

i) What is the largest particle size present at a depth of 9 cm after 7 minutes of the start of sedimentation ?

ii) What is the specific gravity of the soil suspension at a dep h of 9 cm after 7 minutes of the start of sedimentation ?

iii) How l ng after the start of sedimentation will all particles have settled down below a depth of 9 cm ? 2 + 2 + 2

b) Calculate the coefficient of permeability of a soil sample, 7 cm in height and 40 cm^2 in cross-sectional area, if a quantity of water equal to 405 ml passed down in 8 minutes, under an effective constant head of 35 cm. On oven-drying, the test specimen has mass of 485 gm. Taking the specific gravity of soil solids as 2·65, calculate the seepage velocity of water during the test.

2 + 2

c) The subsoil at a site consists of a fine sand layer in between a clay layer at top and a silt layer at bottom. The coefficient of permeability of the sand is 90 times that of clay and 18 times that of silt, while the thickness of sand layers one-ninth that of clay and one third that of silt. Find out the equivalent coefficient of permeability of the deposit in the direction parallel and perpendicular to the bedding planes, in terms of the coefficient of permeability of the clay layer. $2\frac{1}{2} + 2\frac{1}{2}$

10. a) What is montmorilonite ? Why is it expensive by nature ? 2 + 1

b) Write short note on the following : 2 + 2

i) Flocculent structure

ii) Dispersed stru tur

c) The water table in a deposit of sand 10 m thick is at a depth of 4 m below the surface. Above the water table, the sand s saturated with capillary water. The bulk density of sand is 19·62 kN/m ^{3} . Calculate the effective pressure at 2 m, 4 m and 10 m below the surface. Hence plot the variation of total pressure, neutral pressure and effective pressure over the depth of 10 m. 8

11. a) What do you understand by the terms

i) Isobar and pressure bulb ?

ii) Line load, stripped load and trapezoidal load ? 3 + 3

b) What is the basis of the construction of the Newmark's influence chart ? 4

c) A long flexible strip footing of 3·5 m width having a smooth base, is subjected to a uniformly distributed load of 70 kN/m run. Determine the vertical stress intensities at a depth of 3 m below

i) Centre line of the footing

ii) Side face of the footing. $2\frac{1}{2} + 2\frac{1}{2}$

12. a) Write a short note on design o filter. What is an inverted filter ? 3 + 2

b) A concrete weir of 15 m length has to retain water upto 5 m above G.L. The foundation soil consist of a 12·5 thick stratum of sand having k = 0·015 cm/sec. The base has been put 1 m below the ground. In order to reduce the seepage loss, a 5 m deep vertical sheet pile cut-off wal is placed at the bottom of the Supstream fac of the weir.

i) Draw a flownet and determine the quantity of seepage loss that will occur in one day, if the width of the weir be 55 m.

ii) Determine the factor of safety against piping of the soil has G = 2·65 and e = 1·08. 7 + 3