Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/B.TECH (CE)/SEM-5/CE-501/2009-10

2009

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.

GROUP – A

(Multiple Choice Type Questions)

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

10 × 1 = 10

i) If the flow occurs in the downward direction, the effective pressure

a) decreases

b) remains constant

c) increases

d) first decreases then increases.

ii) The hydraulic head that would produce a quick condition in a sand stratum of thickness 1·7 m, specific gravity 2·68 and void ratio 0·61 is equal to

a) 2·01 m b) 1·04 m

c) 3·06 m d) 1·08 m.

iii) Which of the following parameters has no influence on permeability of soil ?

a) Void ratio b) Degree of saturation

c) Pressure head d) Grain size.

iv) Influence factor for line load at a point vertically below the line load at a depth Z is

a) 0·637 b) 0·583

c) 0·693 d) 0·525.

v) The relation between discharge velocity (v) and seepage velocity (v_s) is given by

a) $v_s = \left(\frac{e}{1+e} \right) v$ b) $v_s = \left(\frac{1+e}{e} \right) v$

c) $v_s = e.v$ d) $v_s = (1 + e) v$.

vi) The critical hydraulic gradient at quick condition is

a) $i_c = \gamma_w \cdot \gamma'$ b) $i_c = \gamma' / \gamma_w$

c) $i_c = \gamma_w / \gamma'$ d) none of these.

vii) 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.

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

a) solid state b) semi-solid state

c) plastic state d) liquid state.

ix) 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 methods.

x) The ratio of the volume of voids to the total volume of the soil mass is known as

a) voids ratio b) porosity

c) percentage air voids d) none 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) Sedimentation analysis is required when soil fraction is finer than

a) 60 μ b) 65 μ

c) 75 μ d) none of these.

GROUP – B

(Short Answer Type Questions)

Answer any *three* from the following. $3 \times 5 = 15$

2. What is montmorilonite ? Why is it expansive by nature ? Draw neat sketch of its structure.

3. a) Prove that $es = wG$.

b) What is plasticity chart ? $2\frac{1}{2} + 2\frac{1}{2}$

4. a) What do you understand by critical hydraulic gradient ?

   b) Find out the value of critical hydraulic gradient for the soil, having its sp. gravity equal to 2·68 and void ratio equal to 0·67. $2\frac{1}{2} + 2\frac{1}{2}$

5. A cylindrical mould of diameter 7·5 cm contains a 15 cm long sample of fine sand. When water flows through the soil under constant head at a rate of 58 c.c./min, the loss of heat between two points 8 cm apart is found to be 12·1 cm. Determine the coefficient of permeability of the soil.

6. A soil sample has a total unit weight of 16·97 kN/m^3 and a void ratio of 0·84, specific gravity of the soil particles is 2·70. Determine the moisture content, dry unit weight and degree of saturation.

GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. $3 \times 15 = 45$

7. a) A partially saturated soil sample has a natural moisture content of 17% and a bulk density of 2·05 gm/c.c. If the specific gravity of soil solids be 2·66, determine the void ratio, porosity, degree of saturation, air content and dry density of the soil. What will be the bulk density of the soil if it is 65% saturated ?

   b) Differentiate between True Specific Gravity and Mass Specific Gravity.

   b) Sketch grain size distribution curves for various uniformly graded, well graded and gap graded soils and discuss their characteristics. 8 + 3 + 4

8. a) Two soils *A* and *B* are compared by means of consistency limits. The following data were obtained in the laboratory :

	Soil-A	***Soil-B***
Liquid limit	37·5%	59%
Plastic limit	21%	21%
Natural moisture content	41%	49%
Flow index	11·2	4·3

i) Which soil has higher degree of plasticity ? Explain.

ii) Which soil will most probably be better foundation material when recommended and why ?

iii) Which soil will have better strength at the plastic limit ?

b) The liquid and plastic limits of a given soil sample were 55 per cent & 26 per cent respectively. Classify the soil as per IS classification systems. 8 + 7

9. a) Sketch the simplified crystal structure of three principlal clay minerals and differentiate the characteristics of them.

b) Write short notes on the following :

i) Flocculent structure

ii) Dispersed structure

iii) Consistency Index. 9 + 6

10. a) State and discuss the variables on which the permeability of a soil depends.

b) Explain with a neat sketch, the method for determining the coefficient of permeability for clay soil in the laboratory.

c) Calculate the coefficient of permeability of a soil sample 6 cm in height and 50 cm^2 in cross-sectional area, if a quantity of water equal to 500 ml passed down in 10 minutes under an effective constant head of 45 cm. If the void ratio is 0·606, then calculate the seepage velocity of water during the test. 5 + 5 + 5

11. a) Discuss in brief how stratification of soil affects the permeability of soil.

b) What do you understand by critical hydraulic gradient ?

c) What is sand boiling ?

d) Establish the relationship :

$$i_c = (G - 1) / (1 + e)$$

where G = specific gravity of soil particle

e = void ratio

i_c = critical gradient. 5 + 3 + 2 + 5

12. a) What are Isobar and Pressure bulb ?

b) What factors affect the distribution of contact pressure between a footing and subsoil ?

c) The base of a tower consists of an equilateral triangular frame, on the corners of which the three legs of the tower are supported. The total weight of the tower is 600 kN, which is equally carried by all the three legs. Compute the increase in the vertical stress in the soil caused at a point 5 m below one of the legs.

d) Write short notes on design of filter. 4 + 3 + 4 + 4