(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 2130 Roll No. | | | | | | | | | | |

B.Tech.

(SEM. V) ODD SEMESTER THEORY EXAMINATION 2013-14

GEOTECHNICAL ENGINEERING

Time : 3 Hours *Total Marks : 100*

Note :– Attempt **all** questions. All questions carry equal marks. If required any missing data; then choose suitably.

1. Attempt any **four** parts of the following : **(5×4=20)**

(a) What are the three basic factors which influence the characteristics of a transported soil ? What factors determine the characteristics of a residual soil ?

(b) What is a 'silica tetrahedron' and an 'aluminum octahedron' ? How are silica sheet and alumina sheet formed ? Show their schematic representation.

(c) Establish the following relationship :

$$n_a = \{e (1 - S)\} / (1 + e)$$

where n_a = Percentage air voids

S = Degree of saturation

e = Void ratio.

(d) A partially saturated sample from a borrow pit has a natural moisture content of 15% and bulk unit weight of 1.9 g/cc. The specific gravity of solids is 2.70. Determine the degree of saturation and void ratio. What will be the unit weight of the sample on saturation ?

(e) What is plasticity index and how will you classify the soil with the help of Plasticity Chart ? Also write the equation of the 'A Line' in this plasticity chart.

(f) Data from the grain size analysis for a soil is tabulated below :

Diameter in mm	2.0	1.4	0.600	0.425	0.250	0.150	0.075
Percent Finer	100	94	68	54	30	16	4

(i) Plot the Grain Size Distribution Curve for this soil.

(ii) Classify the soil.

(iii) Calculate C_u and C_c value for the soil.

2. Attempt any **four** parts of the following : **(5×4=20)**

(a) Why is there more likelihood of 'quick' condition in sands than in clays ? Also derive the expression for the critical hydraulic gradient.

(b) Relate the various methods of determination of coefficient of permeability with the soil types for which they are best suited. How will you find out the permeability in the laboratory through the constant head permeability test ?

(c) What are the properties of a flow net ? Also derive an expression for the Laplace's equation of continuity for the two dimensional seepage flow.

(d) Explain the *Dupuit's solution* for the calculation of seepage through an earth dam resting on an impervious base.

(e) How will you perform the Proctor's needle test in a site for controlling the degree of compaction ?

(f) The in situ void ratio of a granular soil deposit is 0.50. The maximum and minimum void ratios of the soil were determined to be 0.75 and 0.35. $G_s = 2.67$. Determine the relative density and relative compaction of the deposit.

3. Attempt any **two** parts of the following : **(10×2=20)**

(a) State the assumptions implied in the use of the Boussinesq's theory to determine the vertical stress in a soil due to a point load and discuss their validity.

An elevated structure with a total weight of 10,000 kN is supported on a tower with 4 legs. The legs rest on piers located at the corners of a square 6 m on a side. What is the vertical stress increment due to this loading at a point 7 m beneath the centre of the structure ?

(b) Briefly differentiate between :

- *Normally consolidated soils and over consolidated soils.*
- *Compression index, swelling index and recompression index.*
- *Coefficient of consolidation and degree of consolidation.*
- *Laboratory consolidation curve and field consolidation relationship.*

(c) A clay soil, tested in a consolidometer, showed a decrease in void ratio from 1.20 to 1.10 when the pressure was increased from 0.25 to 0.50 kgf/cm^2. Calculate the coefficient of compressibility (a_v) and the coefficient of volume compressibility (m_v). If the coefficient of consolidation (c_v) determined in the test for the given stress increment was 10 m^2/year, calculate the permeability in cm/sec.

If the sample tested at the site was taken from a clay layer 3.0 m in thickness, determine the consolidation settlement resulting from the given stress increment.

4. Attempt any **two** parts of the following : **(10×2=20)**

(a) According to Mohr – Coulomb criterion, how is the failure plane recognized and how is shear strength defined ?

The effective stress shear strength parameters of completely saturated clay are : c' = 20 kN/m^2, φ' 25°. A sample of this clay was tested in a unconsolidated

undrained test under a cell pressure of 200 kN/m^2 and the principal stress difference at failure was 110 kN/m^2. What was the value of pore water pressure at failure ?

(b) What is the significance of the pore pressure coefficients ? Illustrate the answer by an example. How are the pore pressure parameters A and B determined ?

(c) For a clay backfill behind a retaining wall, what is the depth of tension crack ? How is the total active earth pressure calculated ?

An excavation was made in saturated, soft clay ($\varphi_u = 0$), with its sides more or less vertical. When the excavation reached 6m, the sides caved in ? What was the approximate value of cohesion of the clay soil ? Take unit weight of clay = 20 kN/m^3.

5. Attempt any **two** parts of the following : **(10×2=20)**

(a) List the field test commonly used in subsurface investigation. What are the corrections that must be applied to the field N – values for sand before they are used in design charts and empirical correlations ?

(b) Determine the ultimate bearing capacity of a strip footing 2 m in width, with its base at a depth of 1.5 m below the ground surface and resting on a saturated clay soil with the following properties :

Y_{sat} = 20 kN/m^3; c_u = 40kN/m^2; $\varphi_u = 0$

c' = 10 kN/m^2; $\varphi = 20^o$

For $\varphi = 20^o$; $N_c = 17.7$, $N_q = 7.4$, $N_y = 5.0$

The natural water table is at 1 m depth below the ground level. Ignore the depth factors.

(c) What are the basic characteristics of the failure mechanisms in general shear failure, local shear failure and punching shear failure ? Also differentiate between ultimate bearing capacity, safe bearing capacity, safe bearing pressure and allowable bearing pressure.