Total No. of Questions—**6**] [Total No. of Printed Pages—**4+2**

[3762]-105

S.E. EXAMINATION, 2010

GEOTECHNICAL ENGINEERING

Time : Three Hours **Maximum Marks : 100**

N.B. :— (*i*) Answers to the two sections should be written in separate answer-books.

(*ii*) Neat diagrams must be drawn wherever necessary.

(*iii*) Figures to the right indicate full marks.

(*iv*) Use of logarithmic tables, slide rule, Mollier charts, electronic pocket calculator and steam tables is allowed.

SECTION I

1. (*a*) With respect to the following explain the application of geotechnical engineering :

(*i*) Design of retaining wall

(*ii*) Embankment for roadway. [6]

(*b*) What is the objective of soil exploration ? List the methods adopted for soil exploration. [6]

(*c*) Explain how plastic limit is determined. [5]

P.T.O.

Or

(*a*) Define the terms : water content, voids ratio, porosity, degree of saturation, density index and liquid limit. [6]

(*b*) Explain how field density is determined by sand replacement method. [6]

(*c*) A saturated soil sample, weighing 178 gm, has a volume of 96 cc. If G = 2.67, determine the voids ratio, water content and unit weight of the soil. [5]

2. (*a*) State Darcy's law and define coefficient of permeability. [6]

(*b*) Explain, with a neat sketch, falling head method to find coefficient of permeability of soil. [6]

(*c*) The void ratio of a sand sample at the loosest and densest possible states are found to be 0.55 and 0.98 respectively. If G = 2.67, determine the corresponding values of the critical hydraulic gradient. [5]

Or

(*a*) With a neat sketch explain a flow net and mention its uses. [6]

(*b*) With a neat sketch explain quick sand phenomenon. [6]

(*c*) 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 cc/min, the loss of head between two points 8 cm apart is found to be 12.1 cm. Determine the coefficient of permeability of the soil. [5]

3. (*a*) In a tabular form give the difference between standard proctor and modified proctor test. [6]

(*b*) Explain how compaction is controlled in the field. [4]

(*c*) The results of a laboratory proctor test are as shown below :

No. of Tests	**Wt of Mould and Soil** (kg)	**Water Content** (%)
1	3.526	8.33
2	3.711	10.4
3	3.797	12.23
4	3.906	16.20
5	3.924	17.92
6	3.882	20.39

The mould is 12.7 cm high and has an internal diameter of 10 cm. The weight of empty mould is 1.89 kg. Plot the moisture content *Vs.* dry density curve and determine the optimum moisture content and the maximum dry density. [6]

Or

(*a*) State Boussinesq's equation for point load and explain the terms in it. [4]

(*b*) With a neat sketch explain pressure bulb and its significance. [6]

(c) Determine the vertical stress intensity at a depth of 5 m below the centre of a rectangular loaded base 3 m × 4 m, carrying a loading of 200 kN/m^2, using Westergaard theory and equivalent point load method. [6]

SECTION II

4. (a) State the factors affecting shear strength of soil. [4]

(b) Explain unconfined compression test procedure with neat sketches. [6]

(c) Determine the shear strength in terms of effective stress on a plane within a saturated soil mass at a point where the total normal stress is 200 kN/m^2 and the pore water pressure is 80 kN/m^2. The effective stress shear strength parameters for the soil are $c' = 16$ kN/m^2 and $\phi' = 30°$. [6]

Or

(a) Define the terms, pore pressure, total stress and effective stress. State their inter-relation. [4]

(b) What are the three standard triaxial shear tests with respect to drainage conditions ? Explain with reasons the situations for which test is to be performed. [6]

(c) A vane shear test was carried out in the field to determine the shearing strength of a deep-seated layer of soft clay. The vane was 11.25 cm high and 7.5 cm across the blades. The equivalent torque recorded at the torque head at failure was 417.5 kg cm. The vane was then rotated very rapidly in order to completely remould the soil. It was found that the remoulded soil can be sheared by applying a torque of 283.2 kg-cm.

Determine the shear strength of the soil in the undisturbed and remoulded states and its sensitivity. [6]

5. (a) Differentiate between Rankine's and Coulomb's theories of earth pressure. [4]

(b) What is stability number ? What is its utility in the analysis of stability of slopes ? [6]

(c) A 5 m high rigid retaining wall has to retain a backfill of dry, cohesionless soil having the following properties :

$\phi = 30°$, $e = 0.74$, $G = 2.68$, $\mu = 0.36$

(i) Plot the distribution of lateral earth pressure on the wall.

(ii) Determine the magnitude and point of application of the resultant thrust. [6]

Or

(a) Write short note on modes of failure for finite slopes. [4]

(b) Discuss Culmann's graphical method for the determination of active earth pressure. [6]

(*c*) Determine the factor of safety for a cohesive soil ($\phi = 0$) 7m high, if its stability number is known to be 0.156. The slope material has cohesion = 25 kN/m^2 and unit weight 18.5 kN/m^3. [6]

6. (*a*) Explain tests for determination of shear strength of rocks. [9]

(*b*) What are the different modes of failures of rocks. Give examples of each. [9]

Or

(*a*) List out various index properties of rocks ? What is their significance ? [8]

(*b*) Write a short note on Hardness of Rock. [5]

(*c*) Explain point load strength for rock. [5]