Total No. of Questions—**6**] [Total No. of Printed Pages—**8**

**[3862]-105**

**S.E. (Civil)(First Semester) EXAMINATION, 2010**

**GEOTECHNICAL ENGINEERING**

**(2008 COURSE)**

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

***N.B.*** :— (*i*) Answer *three* questions from Section I and *three* questions from Section II.

(*ii*) Answers to the two Sections should be written in separate answer-books.

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

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

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

(*vi*) Assume suitable data, if necessary.

## SECTION I

**1.** (*a*) Clearly explain the use of knowledge of geotechnical engineering in the construction of :

(*i*) embankment for road or railway

(*ii*) earth retaining wall. [6]

(*b*) Define the terms : water content, void ratio, degree of saturation, specific gravity and state different methods to find water content of a given soil with their suitability to different types of soil. [6]

P.T.O.

(c) Draw a neat sketch of particle size distribution curve for a well graded soil and explain how $C_c$ and $C_u$ are obtained. Give the IS criteria for classification of soil based on the values of $C_c$ and $C_u$. [5]

*Or*

(a) Draw a neat sketch to show change in the volume of soil due to change in the water content for a cohesive soil and define Atterberg limits. [6]

(b) Draw a neat sketch of plasticity chart as given by IS and classify the soil with liquid limit = 75% and plastic limit = 42% according to the chart. [6]

(c) A specimen of soil having a volume of 300 CC weighs 550 gm in wet condition. Determine voids ratio, degree of saturation, porosity and water content of the soil specimen if after oven drying at 105°C for 24 hours, its weight reduced to 472 gm. Take G = 2.67. [5]

**2.** (a) State Darcy's law, define coefficient of permeability and derive equation for coefficient of permeability used in constant head method. [6]

(b) With a neat sketch explain "quick sand condition" and derive expression for critical hydraulic gradient. [6]

(*c*) The void ratio of a soil is 0.76 while its coefficient of permeability is $1.2 \times 10^{-4}$ cm/sec. If, keeping all other factors constant, the soil is compacted so as to reduce the void ratio to 0.60, what will be the coefficient of permeability of the soil if $k \propto \left(\frac{e^3}{1+e}\right)$. [5]

*Or*

(*a*) Draw an illustrative flownet for a sheet pile and state any *four* properties of flownet. State equation used to calculate seepage through a dam using flownet and give the meaning of all the terms in the equation. [6]

(*b*) With a neat sketch, describe pumping out method for determination of coefficient of permeability of soil in the field, for unconfined aquifer and derive the equation for coefficient of permeability. [6]

(*c*) In order to compute the seepage loss through the foundation of a dam, flownet was drawn. The flownet study gave number of flow channels $N_f = 8$ and number of equipotential drops $N_d = 18$. The head of water lost during seepage was 6 m. If the coefficient of permeability of foundation soil is $4 \times 10^{-5}$ m/min, compute the seepage loss per meter length of dam per day. [5]

3. (*a*) State and explain any *four* factors which influence compaction of soil. [4]

(*b*) Explain how compaction control is achieved in the field using a Proctor needle. [4]

(*c*) In a standard compaction test, on a soil sample having specific gravity 2.7, the following test results were obtained :

| **Water Content** (%) | **Bulk Density** (gm/cc) |
|---|---|
| 5 | 1.89 |
| 8 | 2.13 |
| 10 | 2.2 |
| 12 | 2.21 |
| 15 | 2.16 |
| 20 | 2.08 |

Determine OMC, MDD, Void ratio, Porosity and Degree of saturation at OMC. [8]

*Or*

(*a*) State the formula for stress in a soil mass, due to a point load, at a point below ground level as given by Boussinesq and give the meaning of all the terms in it. [4]

(*b*) With a neat sketch, explain the use of Newmarks influence chart to find stress at a given point under a loaded area. [6]

(*c*) A 2 m × 2 m square footing carries a gross load of 550 kN. The footing rests at a depth of 1.5 m below ground level. The subsoil consists of a 2 m thick layer of sand having a unit weight of 18 kN/m$^3$. The sand layer is underlain by a 4 m thick layer of soft clay having unit weight of 17.2 kN/m$^3$. Compute the maximum vertical stress at the middle of the clay layer before and after the construction of the footing. Use Boussinesq's equation. [6]

## SECTION II

**4.** (*a*) Explain Mohr-Coulomb failure theory and state Coulomb's law of shearing strength in total and effective stress condition. [6]

(*b*) What are the advantages and disadvantages of triaxial compression test in comparison with the direct shear test ? [6]

(*c*) A direct shear test was carried out on a cohesive soil sample and the following results were obtained :

| Normal Stress ($kN/m^2$) | Shear Stress at Failure ($kN/m^2$) |
|---|---|
| 150 | 110 |
| 250 | 120 |

What would be the deviator stress at failure if a triaxial test is carried out on the same soil with cell pressure of 150 $kN/m^2$ ? [6]

*Or*

(*a*) State the factors affecting shear strength of soil and explain the terms sensitivity and thixotropy. [6]

(*b*) Write a note on Vane Shear Test. [6]

(*c*) The shear strength parameters of a given soil are, C = 0.26 $kg/cm^2$ and $\phi = 21°$. Undrained triaxial tests are to be carried out on specimens of this soil. Determine deviator stress at which failure will occur if the cell pressure be 2.5 $kg/cm^2$. [6]

5. (*a*) Explain Rankine's earth pressure theory for cohesionless soils. [5]

(*b*) Explain Rehbann's graphical method for evaluation of earth pressure. [5]

(*c*) A retaining wall 9 m high retains a cohesionless soil, with an angle of internal friction 33°. The surface is level with the top of the wall. The unit weight of the top 3 m of the fill is 2.1 t/m$^3$ and that of the rest is 2.7 t/m$^3$. Find the magnitude and point of application of the resultant active thrust. [6]

*Or*

(*a*) Explain active and passive states of plastic equilibrium. [5]

(*b*) State assumption in Rankine's earth pressure theory. [4]

(*c*) A retaining wall, 7.5 m high, retains a cohesionless backfill. The top 3 m of the fill has a unit weight of 18 kN/m$^3$ and $\phi$ = 30° and the rest has a unit weight of 24 kN/m$^3$ and $\phi$ = 20°. Determine the pressure distribution on the wall. [7]

6. (*a*) Describe with figures, the modes of failure for finite and infinite slopes. [8]

(*b*) Rock classification by RMR method. [4]

(*c*) Explain durability of rocks. [4]

*Or*

(*a*) Explain tests for determination of shear strength of rocks. [8]

(*b*) Write short notes on causes and remedial measures of Landslides. [8]