

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 1.2×10^{-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

$$k \propto \frac{e^3}{1+e} \quad [5]$$

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 4×10^{-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/m³. The sand layer is underlain by a 4 m thick layer of soft clay having unit weight of 17.2 kN/m³. 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 Shear Stress at Failure

(kN/m²) (kN/m²)

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/m² ? [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/cm² and $\phi = 21^\circ$. 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/cm². [6]

5. (a) Explain Rankine's earth pressure theory for cohesionless soils. [5]
- (b) Explain Rehmann'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 $\phi = 30^\circ$ and the rest has a unit weight of 24 kN/m^3 and $\phi = 20^\circ$. 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]