Total No. of printed pages = 7

10/06/2019

CE 131604

Roll No. of candidate

2019

B.Tech 6th Semester End-Term Examination

GEOTECHNICAL ENGINEERING - I

Full Marks – 100 Time – Three hours

The figures in the margin indicate full marks for the questions.

Answer question No. 1 and any *six* from the rest.

1. Choose the correct option from the following : $(10 \times 1 = 10)$

   (i) For the better strength and stability, the fine grained soils and coarse grained soils are compacted respectively as
   (a) Dry of OMC and wet of OMC
   (b) Wet of OMC and dry of OMC
   (c) Wet of OMC and wet of OMC
   (d) Dry of OMC and dry of OMC
   Where OMC is optimum moisture content

   (ii) The soil transported by flowing water is called
   (a) Aeolian soil
   (b) Marina Soil
   (c) Alluvial soil
   (d) Lacustrine soil

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(iii) The uniformity coefficient of soil is define as the ration of

(a) $\frac{D_{10}}{D_{20}}$ (b) $\frac{D_{20}}{D_{30}}$

(c) $\frac{D_{60}}{D_{10}}$ (d) $\frac{D_{40}}{D_{50}}$

(iv) A flow net fro seepage under a sheet pile wall has $n_f = 4$, $n_d = 4$ and the permeabilities of the soil in the horizontal and vertical directions are $K_h = 8 \times 10^{-5}$ m/sec and $K_v = 2 \times 10^{-5}$ m/sec. If the head loss through the soil is 2m, the quantity of seepage per meter length of the wall will be

(a) 2×10^{-5} m^3/sec

(b) 4×10^{-5} m^3/sec

(c) 8×10^{-5} m^3/sec

(d) 16×10^{-5} m^3/sec

(v) The coefficient of permeability is proportional to void ratio (e) as

(a) 1/e (b) e

(c) e^2 (d) $e^3/(1+e)$

(vi) The reduction of volume of a soil mass caused by the application of a sustained load to the mass and due to the adjustment of the internal structure of the soil mass is called

(a) Initial consolidation

(b) Final consolidation

(c) Primary consolidation

(d) Secondary consolidation

(vii) A soil has liquid limit of 0%, plastic limit 35%and shrinkage limit of 20% and it has a natural moisture content of 50%. The liquidity index of soil is

(a) 1.5 (b) 1.25

(c) 0.6 (d) 0.4

(viii) Shear strength of very plastic cohesive soil is found out by means of

(a) Cone test

(b) Penetration test

(c) Vane shear test

(d) Torsional shear test

(ix) Undistributed soil samples are required for

(a) Specific gravity test

(b) Hydrometer test

(c) Shrinkage limit test

(d) Consolidation test

(x) The porosity of a certain soil sample was found to be 80% and its specific gravity was 2.7; the critical hydraulic gradient will be estimated as

(a) 0.34 (b) 0.92

(c) 1.0 (d) 1.5

2. (a) A sample of clay has a water content 40% at full saturation. Its shrinkage limit is 15%. Assume G = 2.70, determine the degree of shrinkage. (5)

(b) What do you mean by uniformly graded, well graded and gap graded soil? Briefly explain with suitable grain size distribution curve. (5)

(c) Briefly explain the Atterberg limits of soil mass with suitable diagram. (5)

3. (a) A soil sample has a volume of 160cc and a mass of 304g when partially saturated and 269.28g when dry. the specific gravity of the solid particles is 2.64. Determine the porosity, the void ratio, the water content and the degree of saturation. (5)

(b) Explain and discuss the use of liquidity index, activity number and sensitivity of clay. (5)

(c) What are the index properties of soils? Why they are required? Discuss. (5)

4. (a) Discuss the procedure to determine the phreatic line of a homogenous earthen dam with horizontal graded filter. (7)

(b) In order to compute the seepage loss through the foundation of a coffer dam, flownets were constructed. The results of the flownet study gave $N_f = 6$, $N_d = 16$. The head of water loss during seepage was 6m. If the coefficient of permeability of the soil is $k = 4 \times 10^{-5}$ m/min, compute the seepage loss per meter length pf dam per day. (3)

(c) A concrete dam is constructed across a river over a permeable stratum of soil of limited thickness. The water heads are upstream side 16m and 2m on the downstream side. The flownet constructed under the dam gives $N_f = 7$ and $N_d = 12$. Calculate the seepage loss through the subsoil if the average value of the hydraulic conductivity is 6×10^{-3}cm/sec horizontally and 3×10^{-4}cm/sec vertically. Calculate the exit gradient if the average length of the last field is 0.9 m. (5)

5. (a) State the Darcy's law of permeability of soil mass. (2)

(b) The sand sample of 35 m^2 cross-sectional area and 20 cm long was tested in a constant head permeameter. Under a head of 60cm,the discharge was 120 ml in 6 min. The dry weight of sand used for the test was 1120 g, and G = 2.68. Determine (i) the coefficient of permeability in cm/sec, (ii) the discharge velocity, and (iii) the seepage velocity. (5)

(c) The data given below relate to two falling head permeability test performed on two different soil samples:

(i) stand pipe area = $4cm^2$ (ii) sample area =$28cm^2$ (iii) sample height= 5cm (iv) initial head in the stand pipe= 100cm (v) final head=20cm (vi) time required for the fall of water level in test 1, t= 500 sec (vii) for test 2, t=l5sec.

Determine the values of k for each of the sample. If these two types of soil form adjacent layers in a natural state with the flow (I) in the horizontal direction and (II) in the vertical direction. Determine the average permeability for both the cases by assuming that the thickness of each layer is equal to 150 cm. (8)

6. (a) Briefly explain the various factors affecting compaction of soil mass? (5)

(b) What is Optimum Moisture Content? What is its significance? (3)

(c) How to control compaction of soil in the field? (3)

(d) A laboratory compaction test on soil having specific gravity equal to 2.68 gave a maximum dry density 1.82 g/cm^3 and a water content of

17%. Determine the degree of saturation, air content, percentage air voids at maximum dry density. What would be the theoretical dry density corresponding to zero air voids at the optimum water content. (4)

7. (a) What do you mean by primary and secondary consolidation of soil? (3)

(b) What are the different components of total settlements? (3)

(c) During a consolidation test, sample of fully saturated clay 3 cm thick is consolidated under a pressure increment 200kN/m^2. When equilibrium is reached, the sample thickness is reduced to 2.60cm. The pressure is then removed and the sample is allowed to exapnd and absorb water. The final thickness is observed as 2.8cm and the final moisture content is 24%. If the specific gravity of the soil solid is 2.70, find the void ratio of the sample before and after consolidation. (5)

(d) A soil sample has a compression index is 0.3. If the void ratio at a stress 1.4kg/m^2 is 0.5, compute (i) the void ratio if the stress is increased to 2.0 kg/m^2 ; and (ii) the settlement of the soil stratum 4m thick. (4)

8. (a) What is Columb's equation for shear strength of soil? Discuss the factors that affect the shear strength parameters of soil. (5)

(b) A triaxial compression test on a cylindrical cohesive sample gave the following effective stresses

(i) Major principal stress = 6895 kN/m^2

(ii) Minor principal stress = 1379 kN/m^2

(iii) The angle of inclination of rupture plane = 60° with the horizontal

Determine analytically the (1) normal stress (2) the shear stress (3) the resultant stress on the rupture plane through a point, and (4) the angle of obliquity of the resultant stress with the shear plan. (6)

(c) A cylindrical sample of soil having a cohesion of 80 kN/m^2 and an angle of internal friction of 20° is subjected to a cell pressure of 100 kN/m^2. Determine (i) the maximum deviator stress at which the sample will fail, and (ii) the angle made by the failure plan with the axis of sample. (4)

9. (a) Explain the friction circle method of slope stability analysis. (10)

(b) Find the critical height of infinite slope having a slope angle of 30°. The slope is made of stiff clay having a cohesion 20 kN/m^2, angle of internal friction 20°, void ratio 0.7 and specific gravity 2.7. Consider the following cases for the analysis : (5)

(i) The soil is dry.

(ii) The water seeps parallel to the surface of the slope.

(iii) The slope is submerged.