Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

M. E. - SEMESTER – I • EXAMINATION – WINTER 2012

Subject code: 714301N Date: 08-01-2013

Subject Name: Advanced Geotechnical Engineering - I

Time: 02.30 pm – 05.00 pm Total Marks: 70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1 **(a)** What is Mohr- Coulomb's strength theory for soils? Sketch typical strength envelopes for a clean sand. **07**

(b) Write and explain the Boussinesq's equation for stress distribution in soil for (i) a point load and (ii) Line load. **07**

Q.2 **(a)** Classify the shear tests based on drainage conditions. Explain how the pore water pressure variation and volume change take place during these tests. Also enumerate the field conditions which necessitate each of these tests. **07**

(b) A saturated clay sample was obtained from field without allowing the water content and void ratio to change. The sample was subjected to the following stresses in the field: C = 240 kN/m^2 ; u = 140 kN/m^2 ; σ′=100 kN/m^2 **07**

(i) On sampling, what are the stresses acting on it?

(ii) The sample was placed in a triaxial cell and was subjected to a cell pressure of 100 kN/m^{2}under undrained condition. What are the stresses acting on it now?

(iii) The cell pressure was raised to 320 kN/m^2 with the drainage valve closed. What ate the stresses now?

(iv) The drainage valve was opened and the soil allowed to consolidate under the cell pressure. What are stresses now?

(v) Comment on the nature of change in water content and degree of saturation of the soil sample after consolidation.

(vi) The drainage valve was closed and additional axial stress was applied with the cell pressure held constant, when the additional axial stress was 100 kN/m^2, the pore water pressure was found to be equal to 80 kN/m^2. What is the value of pore pressure parameter 'A' at this stage of the test?

OR

(b) The effective shear strength parameters of a soil used in the construction of an earthen bund are: c = 68 kN/m^2 and Φ = 20º. Its unit weight is 18.2 kN/m^3. The pore pressure parameters, found from a triaxial test pore pressure measuring device are A = 0.45, B = 0.85.If the height of the fill has been raised from 2m to 5m, find the shear strength of the soil at the base of the bund. Assume the lateral pressure at any point as one-third of the vertical pressure. The dissipation of pore pressure during the construction is negligible. **07**

Q.3 **(a)** Explain how the results of a consolidation test can be used to predict the settlement of a structure caused by the consolidation of clay soil below the foundation **07**

(b) Representative samples of a layer of silty clay, 5 m thick, were tested in a consolidometer and following results were obtained: Initial void ratio = 0.90 ; Preconsolidation stress $\sigma_{c'}$ =120 kN/m^2; Recompression index Cr = 0.03; Compression index Cc = 0.27 Estimate the consolidation settlement if the present average overburden stress of the layer, σ'_o= 70 kN/m^2 and the increase in average **07**

stress in the layer is 80 kN/m^2

OR

Q.3 **(a)** Describe sand drains. How are these designed? Discuss their use. What is the effect of smear? **07**

(b) Strata of normally consolidated clay of thickness 3 m is drained on both sides. It has a coefficient of permeability k= 5x 10^{-8} cm/sec and a coefficient of of volume compressibility m_v =125x10^{-2} cm^2/kN. Determine the ultimate value of the compression of the strata by assuming a uniformly distributed load of 250 kN/m^2 and also determine the time required for 20% and 80% consolidation. **07**

Q.4 **(a)** Write note on flownet. **07**

(b) A rectangular raft of size 30x 12 m founded at a depth of 2.5 below the ground surface and is subjected to uniform pressure of 150 kPa. Assume the centre of the area is the origin of coordinates of (0,0), and the corners have coordinates (6,15). Calculate stresses at a depth of 20 m below the foundation level by the methods of (a) Boussinesq, and (b) Westergaard at coordinates of (0,0), (0,15), (6,0), (6,15) and (10,25). Neglect the effect of foundation depth on the stresses. Tabulate your answer. **07**

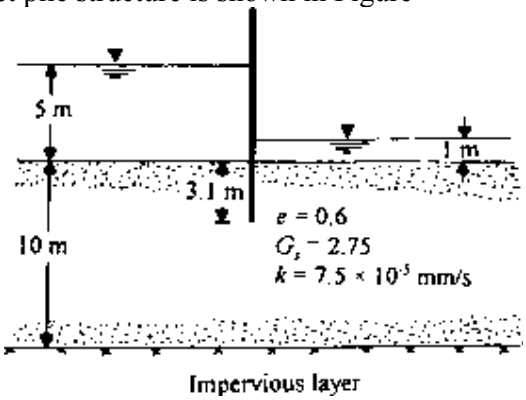
OR

Q.4 **(a)** What do you understand by contact pressure? What are the factors that affect the contact pressure distribution? Draw the contact pressure distribution diagram for flexible and rigid footing on sand and clayey soils **07**

(b) Three parallel strip footings 3m wide each and 5m apart centre to centre transmit contact pressures of 200, 150 and100 kN/m^2 respectively. Calculate the vertical stress due to the combined loads beneath the centers of each footing at a depth of 3 m below the base. Assume the footings are placed at a depth of 2 m below the ground surface. Use Boussinesq method for line loads **07**

Q.5 **(a)** Which test you will perform to find out "k" for fine grained soil. Derive the equation for the same. **07**

(b) A single row of sheet pile structure is shown in Figure **07**



a. Draw the flow net.

b. Calculate the rate of seepage.

c. Calculate the factor of safety against piping

OR

Q.5 **(a)** Discuss factors affecting permeability in detail. **07**

(b) A 20 m high earthen bund has the following dimensions. **07**

Free board=2m; Top width= 3m; U/S slope=2.5:1 ; D/S slope= 2:1

A horizontal filter extends to a distance of 15m from the D/S toe. The material of bund has a vertical permeability of 1x10^{-4} cm/s and a horizontal permeability of 9 times that of vertical permeability. Draw the top flowline and sketch a flownet for steady seepage. Determine the seepage loss per m length of the bund.

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