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B. TECH.

(SEM V) THEORY EXAMINATION 2017-18

GEOTECHNICAL ENGINEERING

Time: 3 Hours ***Total Marks: 100***

Note: Attempt all Sections. If require any missing data; then choose suitably.

SECTION A

1. Attempt *all* questions in brief. 2 x 10 = 20

a. What do you understand about index properties?

b. What is meant by 'primary valence bond' and 'secondary valence bond'?

c. Write methods to determine the water content.

d. Define bulk unit weigh. Write the relation between bulk unit weight and dry unit weight.

e. What is Muck?

f. Define Consistency limits.

g. Differentiate between Activity and Sensitivity.

h. Differentiate Active and passive earth pressure.

i. What are the assumptions made in the derivation of Terzaghi's bearing capacity theory?

j. What is Mohr's circle? Discuss its important characteristics.

SECTION B

2. Attempt any *three* of the following: 10 x 3 = 30

a. Determine the ultimate bearing capacity of a strip footing, 1.20 m wide, and having the depth of foundation of 1.0 m. Use Terzaghi's theory and assume general shear failure. Take $\phi=35^o$ $\Upsilon=18kN/m^3$, and $c'=15\ kN/m^2$.

b. What are the basic characteristics of the failure mechanisms in general shear failure, local shear failure and punching shear failure? Also differentiate between ultimate bearing capacity, safe bearing capacity, safe bearing pressure and allowable bearing pressure.

c. For a sedimentary soil deposit, which solution is more appropriate— Boussinesq's or Westergaard's. Why? State the assumptions involved in the Westergaard's theory. A concentrated load of 40 kN acts on the surface of a soil. Determine the vertical stress increment at points directly beneath the load upto a depth of 10 m and draw a plot for the vertical stress variation upto depth of 10 m.

d. i. Let us suppose as a geotechnical expert, you have a challenge to control the compaction in a site; so how will you control the compaction by the Proctor's needle method?

ii. As a geotechnical engineer for the design of a filter of an earth dam, the proper selection of filter material is required to prevent the piping failure; so what are the conditions, you will keep in your mind at the time of filter design?

e. i. What do you understand by residual soils and transported soils? Give the grain size ranges of different soil types according to IS specifications.

ii. Establish the following relationship

$$Se=WG$$

where S = degree of saturation
e = void ratio
W = water content
G = sp. gravity of soil solids

SECTION C

3. Attempt any *one* part of the following: 10 x 1 = 10

(a) A mass of soil is coated with thin layer of max. weight of soil and wax is 690.6gm. Soil alone has 683 gm. When this sample is immersed in water it displaces 350 ml of water. Sp. Gravity of solids is 2.73 and that of wax 0.89. Find Void ratio and degree of saturation if water content in the soil is 17%.

(b) i. Illustrate by schematic diagrams, how the clay minerals kaolinite, illite and montmorillonite are formed.

ii. An oven dry soil sample of volume 250 cc weighs 430 g. If the specific gravity of solids is 2.70, what is the water content when the soil becomes fully saturated without any change in its volume ? What will be the water content which will fully saturate the sample and also cause an increase in volume equal to 10% of the original dry volume?

4. Attempt any *one* part of the following: 10 x 1 = 10

(a) What are different methods for determination of the coefficient of permeability in a laboratory? Discuss their limitations.

(b) Explain how upward flow of seepage water causes the effective stress. What is the role of the pore water pressure in the quick sand condition ?.

5. Attempt any *one* part of the following: 10 x 1 = 10

(a) Derive an expression for the vertical stress under a circular area. Determine the vertical stress at a point P which is 3m below and at a radial distance of 3 m from the vertical load of 100 kN. Use Westergaard's solution.

(b) Give the assumptions of the Terzaghi's theory for calculating the rate of 1-consolidation and prove that

$$\frac{\partial u}{\partial t} = c_v \cdot \frac{\partial^2 u}{\partial z^2}$$

6. Attempt any *one* part of the following: 10 x 1 = 10

(a) According to Mohr – Coulomb criterion, how is the failure plane recognized and how is shear strength defined? The effective stress shear strength parameters of completely saturated clay are: c' = 20 kN/m^2, φ' 25^o. A sample of this clay was tested in a unconsolidated undrained test under a cell pressure of 200 kN/m^2 and the principal stress difference at failure was 110 kN/m^2. What was the value of pore water pressure at failure

(b) In an in situ vane shear test on saturated clay, a torque of 35Nm was required to shear the soil. The diameter of the vane was 50 mm and length 100 mm. Calculate the undrained shear strength of the clay.

The vane was then rotated rapidly to cause remoulding of the soil. The torque Required to shear the soil in the remoulded state was 5Nm. Determine the sensitivity of the clay.

7. Attempt any *one* part of the following: 10 x 1 = 10

(a) Differentiate between gross and net bearing capacity. What are the assumptions made in the Terzaghi's bearing capacity theory? Also discuss the failure zones in Terzaghi's theory with the help of its neat sketch.

(b) Determine the ultimate bearing capacity of a strip footing 2 m in width, with its base at a depth of 1.5 m below the ground surface and resting on a saturated clay soil with the following properties :

Y_{sat} = 20 kN/m^3; C_u= 40 kN/m^2 ; φ_u=0 c'= 10 kN/m^2 ; φ=20^o

For φ = 20^o; Nc = 17.7, Nq = 7.4, Ny = 5.0

The natural water table is at 1 m depth below the ground level. Ignore the depth factors.