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Reg. No.....

FIFTH SEMESTER B.TECH. (ENGINEERING) DEGREE EXAMINATION,
OCTOBER 2012

CE 09 504—GEOTECHNICAL ENGINEERING—I

(2009 Scheme)

Time : Three Hours Maximum : 70 Marks

Part A

Answer **all** *questions.*

1. Give the block diagram for the three phase system and specify its use.
2. Explain the significance of a grain size distribution curve.
3. State Darcy's law. What are its limitations ?
4. Bring out the difference between compaction and consolidation.
5. Derive an expression for earth pressure at rest.

(5 × 2 = 10 marks)

Part B

Answer any **four** *questions.*

6. A sample of saturated soil has a water content of 25 % and a bulk unit weight of 20 kN/m^3. Determine the dry unit weight, void ratio and the specific gravity of the solids. What would be the bulk unit weight of the soil void if the above soil is compacted to the same void ratio, but has a degree of saturation of 90 % ?
7. A soil has the liquid limit and plastic limit of 47 % and 33 % respectively. If the volumetric shrinkage at the liquid limit and plastic limit are 44 % and 29 %, determine the shrinkage limit.
8. The water table in a deposit of sand 8 m. thick is at a depth of 3 m. below the surface. Above the water table, the sand is saturated with capillary water. The bulk density of sand is 19.62 kN/m^3. Calculate the effective pressure at 1 m. 3 m. and 8 m. below the surface. Hence plot the variation of total pressure, neutral pressure and effective pressure over the depth of 8 m.
9. Two identical specimens of a soil were tested in traxial apparatus. The first specimen failed at a deviator stress 770 kN/m^2. When the cell pressure was 200 kN/m^2, while the second specimen failed at a deviactor stress of 1370 kN/m^2. under a cell pressure of 400 kN/m^2. Determine the value of C and ϕ for the soil. If the same soil is tested in a direct shear apparatus, estimate the shear at which the sample will fail under a normal stress of 600 kN/m^2.

Turn over

10. A clay Stratum 2.5 m. thick lies over a sandy stratum and has drainage as both sides. Calcualte the values of the pore water pressure and the effective stress at the middle of the clay stratum when 60 % of consolidation has taken place under an increment of load from 5 kg/cm^2. to 25 kg / cm^2.

11. A retaining wall has vertical back and is 8 m high. The back face of the wall is smooth and the upper surface of the fill is horizontal. Determine the thrust on the wall per metre length. Take $c = 1\,t/m^2$, $\gamma = 1.8\ t/m^3$, and $\phi = 20°$. Neglect tension.

(4 × 5 = 20 marks)

Part C

Answer **one** *question from each module.*

12. (a) Prove that the degree of saturation of a partially saturated soil can be expressed as :

$$S = \frac{w}{\frac{\gamma_w}{\gamma}(1+w) - \frac{1}{G}}$$

where γ = bulk unit weight, G = specific gravity of solids, W = water content.

(b) A cylindrical specimen of soil in 7.5 cm. long and 3.75 cm. in diameter and weighs 175 g. If the water content is 18 % and the specific gravity of solids is 2.68, determine the degree of saturation. What would be the error in the degree of saturation, if these had been an error of 1 mm. in measuring the length.

(4 + 6 = 10 marks)

Or

13. (a) What are the different methods for the determination of liquid limit of a soil ? Explain the merits of the method.

(b) An undisturbed saturated specimen of clay has a volume of 18.9 cm^3. and a mass of 30.2 gm. On over drying the mass reduces to 18 g. The volume of dry specimen as determined by displacement of mercury is 9.9 cm^3. Determine shrinkage limit, specific gravity, shrinkage ratio and volumetric shrinkage.

(4 + 6 = 10 marks)

14. (a) In a falling head permiameter test the initial head is 40 cm. The head drops by 5 cm. in 10 minutes. Calculate the time required to run the test for the final head to be at 20 cm. If the sample is 6 cm. in height and 50 cm^2. in cross-sectional area, calculate the coefficient of permeability, taking area of stand pipe is 0.5 cm^2.

(b) A stratified soil deposit consists of four layers of equal thickness. The coefficient of permeability of the second, third and fourth layers are respectively $\frac{1}{3}, \frac{1}{2}$ and 2 times the coefficient of permeability of the top layer. Compute the average permeabilities of the deposit, parallel and perpendicular to the direction of the stratification in terms of the permeability of the top layer.

(4 + 6 = 10 marks)

Or

15. A vane of 80 mm. diameter and 160 mm. height has been pushed into an in situ soft clay at the bottom of a bore hole. The torque required to rotate the vane was 76 Nm. Determine the undrained shear strength of the clay. After the test, the vane was rotated several times and the ultimate torque was found to be 50 Nm. Estimate the sensitivity of the clay.

(10 marks)

16. (a) Discuss Terzaghi's theory of consolidation, stating the various assumptions and their validity.

(4 marks)

(b) A soil has a compression index C_c of 0.28. At a stress of 120 kN/m^2. the void ratio was 1.02. Calculate :

(i) the void ratio if the stress on the soil is increased to 180 KN/m^2. and

(ii) the total settlement of the stratum of 6 m thickness.

(6 marks)

Or

17. (a) What is the effect of compaction on the engineering properties of the soil ? How would you decide whether the soil should be compacted the dry of optimum or the wet of optimum.

(5 marks)

(b) What are the different methods of compaction adopted in the field ? How would you select the type of roller to be used ?

(5 marks)

18. (a) Give a critical comparison of the Coulomb and Rankine earth pressure theories.

(4 marks)

(b) A retaining wall is 7 m. high, with its back face smooth and vertical. It retains sand with its surface horizontal. Using Rankine's theory, determine active earth pressure at the base when the backfill is (i) dry ; (ii) saturated and (iii) submerged, with water table at the surface. Take $\gamma = 1.8\ t/m^3$, and $\phi = 30°$, $\gamma_{sat} = 2.10\ t/m^3$.

(6 marks)

Or

19. (a) Explain the various causes of failure of earth slopes. (4 marks)

(b) A temporary cutting 8 m. deep is to be made in a clay having a unit weight of 18 kN/m^3, and an average cohesion of 20 kN/m^2. A hard stratum of rock exists at a depth of 12 m. below the ground surface. Use Taylor's stability curves to estimate if a 30° slope is safe. If a factor of safety of 1.25 is considered necessary, find the safe slope angle.

(6 marks)

[4 × 10 = 40 marks]