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Question Paper Code : 70283

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2021.

Fourth Semester

Civil Engineering

CE 6405 — SOIL MECHANICS

(Regulations – 2013)

(Common to PTCE 6405 – Soil Mechanics for B.E. (Part Time – Third Semester – Civil Engineering – Regulation 2014)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. Draw the phase diagram for Dry Soil and Saturated Soil.

2. List any four equipment / methods for Field Compaction of Soil.

3. What is the influence of temperature on the coefficient of Permeability of soils?

4. Flow net is drawn for a weir. The total lass of head is 5 m, the number of potential drops is 10 and the length of the flow line for the last square is 1 m. Calculate the exit gradient.

5. What is the basis of the construction of Newmarks's influence chart?

6. What are the factors that influence the compression behavior of soils?

7. Write the Mohr-Coulomb failure criterion for soils and explain the terms involved.

8. List the merits and demerits of triaxial test.

9. Differentiate the modes of failure of finite and infinite slopes.

10. What is the effect of depth of failure surface on the stability of infinite slope in cohesionless soil?

PART B — ($5 \times 13 = 65$ marks)

11. (a) (i) Derive the relationship between Porosity (n) and Void Ratio (e). (7)

(ii) A partially saturated sample from a borrow pit has a natural moisture content of 15% and bulk unit weight of 1.9 g / cc. The specific gravity of solids is 2.70. Determine the degree of Saturation and void ratio. What will be the unit weight of the soil if it gets saturated? (6)

Or

(b) (i) Describe the proctor Compaction Test in detail. (5)

(ii) Draw the diagram for the three Atterberg Limits of a soil and mark the various soil phases. (4)

(iii) Define Sensitivity and Thixotropy for a soil. (4)

12. (a) (i) In a site reclamation project, 2.5 m of graded fill (γ = 22 kN/m^3) were laid in compacted layers over an existing layer of silty clay (γ = 18 kN/m^3) which was 3 m thick. This was underlain by a 2 m thick layer of gravel (γ = 20 kN/m3). Assuming that the water table remains at the surface of the silty clay draw the effective stress profiles for case.

(1) before the fill is placed and case. (8)

(2) after the fill has been placed.

(ii) Explain about various factors affecting coefficient of permeability of a soil. (5)

Or

(b) (i) In a falling head permeability test the length and area of cross section of soil specimen are 0.17 m and 21.8×10^{-4} m^2 respectively. Calculate the time required for the head to drop from 0.25 m to 0.10 m. The area of cross section of stand pipe is 2.0×10^{-4}. The sample has three layers with permeabilities 3×10^{-5} m/sec for first 0.06 m, 4×10^{-5} m/sec for second 0.06 m and 6×10^{-5} m/sec for the third 0.05 m thickness. Assume the flow is taking place perpendicular to the bedding plane. (8)

(ii) Define flow net, Discuss about its uses. (5)

13. (a) (i) A rectangular foundation 1.5 m × 3.5 m transmits a uniform pressure of 350 kN/m^2 to the underlying soil. Determine the vertical stress at a depth of 1.5 m below a point within the loaded area 1.0 m away from short edge and 0.5 m away from long edge. (7)

(ii) Derive Terzaghi's equation for one-dimensional consolidation stating clearly the assumptions made. (6)

Or

(b) (i) Subsurface exploration at the site of a proposed building reveals the existence of 2.4 m thick layer of 5oft clay below a stratum of coarse sand which is 4 m thick and extends from the ground surface upto the top of the clay layer. The ground water table is at 2.5 m below the ground surface. Laboratory tests indicate the natural water content of the clay as 40%, average liquid limit as 45% and specific gravity of solids as 2.75. The unit weight of the sand above and below water table is 17.8 kN/m^3 and 21 kN/m^3 respectively Estimate the probable settlement of the building, if its construction increases average vertical pressure on the clay layer by 71 kpa. (8)

(ii) Explain with sketch Taylors $\sqrt{t}$ method for the determination of coefficient of consolidation. (5)

14. (a) (i) An earthen embankment is constructed in a soil having a cohesion $C = 45\ KN/m^2$ and $\phi' = 26^\circ$. Determine the total and effective shear strength of the soil on a horizontal plane at a depth of 10 m below the top of an embankment having a bulk unit weight of soil γ_{bulk} = 21 kN/m^3 and the pore water pressure at this depth is 15 kN/m^2. (7)

(ii) Draw the Mohr-Coulomb failure envelops of CU, CD and UU tests sandy soils and comment on the shear strength parameter. (6)

Or

(b) (i) An unconfined compression test was carried out on a sample of clay had a diameter of 38mm and a length of 76 mm. The load at failure measure by the proving ring was 45 N and the axial deformation of the sample at failure was 15 mm. Estimate the unconfined compressive strength, undrained shear strength and undrained cohesion of the clay sample. (7)

(ii) How do you find the shear strength of soil using 'Vane shear test'? and derive the formula used to calculate shear strength. Where this test is mostly used? (2+2+2=6)

15. (a) An infinite slope with a slope angle of 28° is 4.5 m high. The soil has cohesion of 30 kPa, angle of internal friction of 20° and unit weight of 19 kN/m^3. Find the factor of safety with respect to cohesion. Derive the equation used if any.

Or

(b) (i) Explain with sketches, the different ways by which a finite slope may fail. State the situations where each failure is likely to happen. (6)

(ii) A purely cohesive soil has a unit weight of 18 kN/m^3 and an average cohesion of 22 kPa. A hard stratum exists only at infinite depth below the ground level. A 4-m deep cutting is to be made. Find the factor of safety if the slope angle is

(1) 90° (2) 53°. (7)

PART C — (1 × 15 = 15 marks)

16. (a) The unit weight of a soil at 50% and 80% saturation is 17.60 kM/m^3 and 18.81 kN/m^3 respectively. Find.

(i) Specific gravity of solids

(ii) Void ratio

(iii) Porosity

(iv) Dry unit weight

(v) Saturated unit weight

(vi) Submerged unit weight

(vii) Water content corresponding to 100% saturation.

When a disturbed sample of the same soil was subjected to classification tests, the following results were obtained :

Percentage finer than 4.75 mm : 80

Percentage finer than 0.075 mm : 9

Liquid limit : 23%

Plastic limit :15%

Size corresponding to 10 % finer : 0.09 mm

Size corresponding to 30% finer : 1.2 mm

Size corresponding to 60% finer : 3.4 mm

Classify the soil as per IS 1498.

Or

(b) A soil profile consists of 4-m thick sand underlain by 3-m thick clay. The clay layer overlies hard rock. A square foundation of size 2 m carrying a load of 800 kN is founded at a depth of 1.5m from the ground level. The ground water table is at the base of the foundation. The specific gravity of solids and void ratio of the sand are 2.7 and 0.7 respectively. The degree of saturation above the water table can be assumed as 30%. The liquid limit, water content and specific gravity of solids of the clay are 40%, 27% and 2.66 respectively. Estimate the probable consolidation settlement of the clay layer, assuming the clay to be normally consolidated. For calculation of additional vertical stress, equivalent point load approach shall be adopted (dividing the total area into four area units).

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