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B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2015.

Fourth Semester

Civil Engineering

CE 6405 — SOIL MECHANICS

(Regulations 2013)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. The natural water content of an excavated soil from the borrow bit is 35%. Its liquid limit is 65% and plasticity limit is 25%. Determine the Liquidity Index (I_L) of the soil and comment about the consistency of the soil.

2. State whether the following statement is true or false and justify your answer. The efficiency of compaction improves with increase in compactive effort.

3. What is the difference between discharge velocity and seepage velocity?

4. List the various uses of flow net in engineering practice.

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. Give one example each of the use of CU strength and CD strength results in engineering practice.

8. What do you understand the term called 'Liquefaction of Soil'?

9. State the influence of tension crack in factor of safety if the cracks are filled with water and without water.

10. How Taylor's stability Number is utilised for slope stability analysis?

PART B — (5 × 16 = 80 marks)

11. (a) (i) Discuss in detail the engineering significance of the consistency limits of soil. (8)

(ii) Explain the IS soil classification system for classifying fine grained soil. (8)

Or

(b) (i) A partially saturated soil samples collected from a pit has a natural moisture content of 18 % and bulk unit weight of 20 kN/m³. The specific gravity of soil is 2.68. Estimate the void ratio and degree of saturation. What will be the unit weight of the soil sample on saturation? (8)

(ii) Discuss the engineering behavior of compacted cohesive soils. (8)

12. (a) (i) Name the various methods of laboratory determination of permeability with the soil type in which they are best suited and explain any one method in details. (8)

(ii) A field pumping test has been carried out in a well was sunk through a horizontal stratum of sand 15 m thick and underlain by a clay stratum. Two observation wells were sunk at horizontal distances of 18 m and 35 m respectively from the pumping well. The initial position of the water table was 2.5 m below the ground level. At a steady state pumping rate of 925 litres/min. the drawdown curves in the observation wells were found to be 2.50 m and 1.50 m respectively. Estimate the coefficient of permeability of the sand. (8)

Or

(b) (i) A drainage pipe beneath a dam has become clogged with sand; coefficient of permeability of the sand is 7.5 m/day. The average difference in head water and tail water elevation is 21 m and it has been observed that there is a flow of 160 litres per day through the pipe. The pipe is 97 m long and has a cross-sectional area of 0.02 m². Find out up to what length of the pipe is filled with sand? (8)

(ii) A flow net analysis was performed for estimating the seepage loss through the foundation of a coffer dam, results of the flow net analysis gave a number of flow line 'N_f'=6 and number of drops 'N_d'=16. The head of water lost during seepage was 5 m. Assume the coefficient of permeability of the soil is 'k'=4×10^{-5} m/min. Estimate the seepage loss per meter length of the coffer dam per day. Also estimate the exit gradient if the average length of the last flow field is 0.9 m. (8)

13. (a) (i) A water tank has supported by a circular foundation of diameter 10.5 m is resting on a soil stratum. The total weight of the tank including the foundation is 17,700 kN. Estimate the stress due to the above load at 0.5 m and 2.5 m depth at the center of the water tank. (8)

(ii) Explain in details of the determination of coefficient of consolidation using log t method. (8)

Or

(b) (i) For a single concentrated load 1,000 kN acting on the ground surface construct an isobar for $\sigma_z = 40 kN/m^2$. (10)

(ii) A 8m thick clay layer with single drainage settles by 120 mm in 2 years the co-efficient of consolidation of thin clay was found to be $6\times10^{-3}\ cm^2/\text{sec}$. Calculate the likely ultimate consolidation settlement and find how long it will take to undergo 90% of this settlement. (6)

14. (a) An earthen embankment is constructed in a soil having a cohesion $C = 45 KN/m^2$ and $\phi' = 26°$. 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. (8)

(ii) Draw the Mohr – Coulomb failure envelops of CU, CD and UU tests sandy soils and comment on the shear strength parameter (8)

Or

(b) (i) An unconfined compression test was carried out on a sample of clay had a diameter of 38 mm 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. (8)

(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. (3+3+2 =8)

15. (a) (i) Discuss in details of stability analysis of the slope using method of slices. (8)

(ii) An infinite sandy soil slope has a saturated unit weight of γ_{sat} = 19.5 kN/m^3 and angle of internal friction ϕ = 35. The minimum factor of safety needed for the slope against failure is 1.3, estimate the safe angle of the slope (1) when the slope is dry without seepage (2) if seepage occurs at and parallel to surface of the slope. (4+4 = 8)

Or

(b) (i) Explain in details the concept of Friction circle method of analysis for design of the slopes. (8)

(ii) Discuss in details the various slope protection measures are used to stabilize the slope against failure. (8)