(b) (i) An embankment 10 m high is inclined at 35° to the horizontal. A stability analysis by the method of slices gave the following forces: Total normal force = 900 kN; Total tangential force = 420 kN; Total neutral force = 200 kN. If the length of the failure arc is 23 m, find the factor of safety with respect to shear strength The soil has $c = 20$ kN/m² and $\phi = 15°$. (8)

(ii) Explain Taylor's stability number in slope stability analysis. (5)

PART C — (1 × 15 = 15 marks)

16. (a) A thin layer of silt exists at a depth of 18 m below the surface of the ground. The soil above this level has an average dry unit weight of 15 kN/m³ and an average water content of 36%. The water table is almost at the ground surface level. Tests on undisturbed samples of the silt indicate the following values: $c_u = 45$ kN/m², $\phi_u = 18°$, $c' = 36$ kN/m² and $\phi' = 27°$. Estimate the shearing resistance of the silt on a horizontal plane when (i) the shear stress builds up rapidly, and (ii) the shear stress builds up slowly. (10 + 5)

Or

(b) (i) A cylindrical sample of soil having a cohesion of 80 kN/m² and an angle of internal friction of 20° is subjected to a cell pressure of 100 kN/m² Determine (1) the maximum deviator stress at which the sample will fail, and (2) the angle made by the failure plane with the axis of the sample. (10)

(ii) Sketch and discuss the stress-strain relationship for dense and loose sand. (5)

Reg. No. : | | | | | | | | | | | | |

Question Paper Code : 80083

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2019.

Fourth Semester

Civil Engineering

CE 8491 — SOIL MECHANICS

(Regulation 2017)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Draw the phase diagram for completely dry and fully saturated soil mass.

2. List various factors affecting compaction.

3. The internal diameter of a tube is 0.1mm. What will be the maximum capillary rise when it is held vertical with bottom end dipped in pure water taken in a trough? Take surface tension of water = 72.8×10^{-6} kN/m.

4. Write typical range of co-efficient of permeability for gravel, sand, silt and clay.

5. Draw the typical vertical stress distribution due to point load (a) on a horizontal plane at a depth of Z from the ground surface and (b) on a vertical plane at a radial distance of r from the point of loading.

6. Define preconsolidation pressure and state its importance.

7. Draw typical sketches of failure envelopes of saturated clay as obtained from undrained and drained shear tests.

8. On which type of soil vane shear test is conducted? How shear strength is determined in this test?

9. A cutting is to be made in clay for which the cohesion is 350 kN/m²; Bulk unit weight is 20 kN/m³; Find the maximum depth for a cutting of side slope 1.5 to 1. Factor of safety to be 1.5. Take the stability number as 0.17.

10. Mention different modes of slope failure.

PART B — (5 × 13 = 65 marks)

11. (a) (i) A sample of saturated soil has a water content at 25% arid bulk unit weight of 20 kN/m³. Determine the dry unit weight, void ratio and specific gravity of solids. What will be the value of bulk unit weight, if the degree at saturation is 80%. (8)

(ii) Listing the various factors that influence the compaction of soils, show their influence with illustrative sketches of compaction curves. (5)

Or

(b) The following results are obtained from a soil sample: Percentage passing 4.75 mm sieve: 35, Percentage passing 75 micron mm sieve: 8, Size corresponding to 10% finer = 0.8 mm; 30% finer 3.0 mm; 60% finer = 6.0 mm; Liquid limit = 25% Plastic limit = 17% Classify the soil as per IS soil classification System. (13)

12. (a) (i) A layer of fine sand 3 m in thickness rests on a bed at soft Cay and the water table is at a depth of 2 m below the ground level. The bulk unit weight and saturated unit weight of sand is 16 kN/m³ and 18 kN/m³ respectively. The saturated unit weight of clay is 19 kN/m³. Draw the variation of effective stress upto a depth of 7 m from the ground level. (7)

(ii) Derive Laplace's equation of continuity for two-dimensional steady flow of water through an isotropic soil. (6)

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} m² 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} m². 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) Discuss briefly the uses of flow net. (5)

13. (a) (i) A circular ring foundation for an overhead tank transmits a contact pressure of 300 kN/m². Its internal diameter is 6 m and external diameter 10 m. Compute vertical stress on the center line of the footing due to the imposed load at a depth of 6.5 m below the ground level. The footing is founded at a depth of 2.5 m. (8)

(ii) Explain Taylor's square root time method for determining coefficient of consolidation. (5)

Or

(b) (i) Write a brief critical note on 'the concept of pressure bulb and its use in soil engineering practice'. (5)

(ii) A 20 mm thick undisturbed sample of saturated clay is tested in the laboratory with drainage being allowed both through top and bottom faces. The sample reaches 50% degree of consolidation in 60 minutes. If any clay layer from which the sample was obtained is 4 m thick and is free to drain through both top and bottom surfaces, calculate the time required by the clay layer to undergo the same degree of consolidation. What would have been the time of consolidation if the clay layer were free to drain only through its top surface? (8)

14. (a) Two samples of a soil were subjected to shear tests. The results were as follows :

Test No.	$\sigma 3$(kN/m²)	$\sigma 1$(kN/m²)
1	100	240
2	300	630

If a further sample of the same soil was tested under a minor principal stress of 200 kN/m², what value of major principal stress can be expected at failure? (13)

Or

(b) The results of a direct shear test on a 60 mm × 60 mm specimen are given below. Determine shear strength parameters. (13)

Normal load, N	300	400	500	600
Shear force at failure, N	195	263	324	399

15. (a) (i) A slope of very large extent of soil with properties c' = 0 and $\phi' = 32°$ is likely to be subjected to seepage parallel to the slope with water level at the surface. Determine the maximum angle of slope for a factor of safety of 1.5 treating it as an infinite slope. For this angle of slope, what will be the factor of safety if the water level were to come down well below the surface? The saturated unit weight of soil is 20 kN/m³. (8)

(ii) Discuss various slope protection measures. (5)

Or