CBCS SCHEME

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21CV54

Fifth Semester B.E./B.Tech. Degree Examination, June/July 2025
Geotechnical Engineering

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. With the help of 3-phase diagram explain (i) Bulk Density (ii) Voids ratio (iii) Degree of saturation (iv) Water content. **(06 Marks)**

b. With usual notation, derive the relationship $\gamma_d = \frac{(1-\eta_a)G.\gamma_w}{1+WG}$. **(06 Marks)**

c. A soil sample has a porosity of 40%. The specific gravity of solids is 2.70. Calculate (i) Voids ratio (ii) Dry density (iii) Unit weight if the soil is 50% saturated and (iv) Unit weight if the soil is completely saturated. **(08 Marks)**

OR

2 a. Following are the results of the liquid limit test on clay sample whose natural water content is 60% and plastic limit 22%.

Number of Blows (N)	34	22	19	12
Water Content (%)	44.6	49.4	51.4	55.6

Plot the flow curve and obtain (i) Liquid limit (ii) Plasticity Index (iii) Flow index (iv) Consistency Index. **(08 Marks)**

b. Explain with the help of particle size distribution curves the following type soils :
(i) Well Graded soil (ii) Poorly graded soil (iii) Uniformly graded soil. **(06 Marks)**

c. With a neat sketch explain Plasticity Chart and its use in classifying fine grained soils. **(06 Marks)**

Module-2

3 a. Derive an expression for the determination of coefficient of permeability by Falling Head method. **(06 Marks)**

b. Discuss the factors affecting the permeability of soil? **(06 Marks)**

c. The following data refers to the falling head permeability tests performed of two different soils.
Areas of sample = 2800 mm^2 ; Area of stand pipe = 400 mm^2 ; Sample Height = 50 mm ;
h_1 = 1000 mm ; h_2 = 200 mm .
Time required for fall of water head in stand pipe for
Sample 'A' = 500 seconds
Sample 'B' = 15 seconds
Determine permeability for both samples and also find permeability along horizontal and vertical to bedding planes. **(08 Marks)**

OR

4 a. Explain the following terms :
(i) Total stress
(ii) Neutral stress
(iii) Effective stress **(06 Marks)**

b. Explain briefly Quick Sand Phenomena. **(06 Marks)**

c. The water table in a certain area is at a depth of 4 m below the ground surface. To a depth of 12 m, the soil consists of very fine sand having an average voids ratio of 0.7. Above the water table the sand has an average degree of saturation of 50%. Calculate the effective pressure on a horizontal plane at a depth 10 m below the ground surface. What will be the increase in the effective pressure if the soil gets saturated by capillary upto a height of 1 m above the water table? G = 2.65. **(08 Marks)**

Module-3

5 a. Differentiate between Standard Proctor test and Modified Proctor test. **(06 Marks)**

b. List and explain briefly various types of field compaction equipments. **(06 Marks)**

c. A standard proctor compaction test conducted on a soil yielded the following results:

Bulk Density (KN/m^3)	18	19	19.6	20.45	21.0	20.50	20.1
Water Content (%)	9.6	11.0	12.5	14.0	16.0	18.0	19.5

If G = 2.70 , find the MDD and OMC by plotting the compaction curve. Also plot 100% and 80% saturation line. **(08 Marks)**

OR

6 a. In a consolidation test the voids ratio of soil sample decreases from 1.20 to 1.10 when the pressure is increased from 160 to 320 KN/m^2. Calculate the coefficient of consolidation if the coefficient of permeability is 8×10^{-7} mm/sec. **(06 Marks)**

b. Explain the Casagrande's method of determination of pre-consolidation. **(06 Marks)**

c. A saturated soil of 5 m thick lies above an impervious below a pervious stratum if it has a compression index of 0.25 and k is 3.2×10^{-10} m/sec. Its void ratio at a stress of 147 KN/m^2 is 1.9. Calculate (i) the change in voids ratio due to increase of stress to 190 KN/m^2 (ii) Coefficient of volume compressibility (iii) Coefficient of consolidation (iv) Time required for 50% consolidation. **(08 Marks)**

Module-4

7 a. Explain Mohr's – Coulomb's shear strength theory. **(06 Marks)**

b. Explain : (i) Sensitivity (ii) Thixotropy **(06 Marks)**

c. A direct shear test on sand (C = 0) gave a failure shear stress of 70 KN/m^2 when the normal load was 200 KN/m^2. Draw the Mohr's circle and Mohr's envelop and find the principal stresses at failure and the orientation of the principal planes. **(08 Marks)**

OR

8 a. A cylindrical specimen of saturated clay, 4 cm in diameter and 9 cm in overall length is tested in an unconfined compression tester. The specimen has coned ends and its length between the apices of cones is 8 cm. Find the unconfined compressive strength of clay, if the specimen fails under an axial load of 46.5 N. The change in the length of specimen at failure is 1 cm. **(06 Marks)**

b. Explain briefly with a neat sketch unconfined compression test. **(06 Marks)**

c. Two samples of a soil were tested in a triaxial machine the all round pressure maintained for the first sample was 200 KN/m^2 and failure occurred at an additional axial stress of 770 KN/m^2. For the second sample, these values were 500 KN/m^2 and 1370 KN/m^2 respectively. Find C and ϕ for the soil. **(08 Marks)**

Module-5

9 a. Explain briefly Terzaghi's bearing capacity theory. **(06 Marks)**

b. A square footing 2.5 m by 2.5 m is built in a homogeneous bed of sand of unit weight 20 KN/m^3 and having an angle of shearing resistance of 36°. The depth of the base of footing is 1.5 m below the ground surface. Calculate the safe load that can be carried by a footing with a F.O.S of 3 against complete shear failure. Use Terzaghi's analysis [$N_c = 65.4$; $N_q = 49.4$ and $N_\gamma = 54.0$] **(06 Marks)**

c. A strip footing 2 m wide carries a load intensity of 400 KN/m^2 at a depth of 1.2 m in sand. The saturated unit weight of sand is 19.5 KN/m^3 and unit weight above water table is 16.8 KN/m^3.The shear strength parameters are C = 0; $\phi = 35°$. Determine the factor of safety with respect to shear failure for the following cases of location of water table :
(i) Water table is 4 m below G.L.
(ii) Water table at the ground level.
[For $\phi = 35°$; $N_q = 41.4$; and $N\gamma = 42.4$] **(08 Marks)**

OR

10 a. A layer of clay 8 m thick underlies a proposed new building. The existing overburden pressure at the centre of clay layer is 300 KN/m^2 and the load due to construction of new building increases by 150 KN/m^2. The liquid limit of the soil is 65%, water content is 50% and specific gravity is 2.65. Estimate the consolidation settlement. **(08 Marks)**

b. Estimate the immediate settlement of a concrete footing 1 m × 1.5 m in size. It is founded at a depth of 1 m in silty soil, whose compression modulus is 9000 KN/m^2 , footing is expected to transmit unit pressure of 200 KN/m^2. Assume $I_F = 1.06$; $\mu = 0.3$. **(06 Marks)**

c. Explain briefly :
(i) Total settlement (ii) Immediate settlement (iii) Consolidation settlement **(06 Marks)**

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