CBCS SCHEME

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BCV502

Fifth Semester B.E/B.Tech. Degree Examination, Dec.2025/Jan.2026

Geotechnical Engineering

Time: 3 hrs.

Max. Marks: 100

Note: *1. Answer any FIVE full questions, choosing ONE full question from each module.*
2. M : Marks , L: Bloom's level , C: Course outcomes.

		Module – 1	M	L	C
1	a.	With the help of 3 phase diagram, explain void ratio, porosity and degree of saturation.	6	L2	CO1
	b.	Derive the relationship : $\gamma_d = \dfrac{\gamma}{1+w}$.	6	L2	CO1
	c.	A mass of soil coated with a thin layer of paraffin weighs 4.76×10^{-3} kN. When immersed in water it displaces 3.2×10^{-4} m^3 of water. The paraffin is peeled off and found to weigh 1.77×10^{-4} KN. The specific gravity of the soil particles is 2.7 and that of paraffin is 0.9. Determine the void ratio of the soil if its water content is 10%.	8	L3	CO1
		OR			
2	a.	With the help of particle size distribution curve define well graded, gap graded and poorly graded soil.	8	L3	CO1
	b.	With neat diagram explain different types of clay minerals.	6	L2	CO1
	c.	A soil sample consisting of particle size ranging from 0.5 mm to 0.01 mm, is put on the surface of still water tank 5mt deep. Calculate the time of settlement of the coarsest and finest particles of the sample, to the bottom of the tank. Assume average sp. Gravity of soil particles as 2.66 and viscosity of water as 0.01.	6	L2	CO1
		Module – 2			
3	a.	With a neat diagram explain the falling head permeability test.	6	L2	CO1
	b.	Explain the factors affecting permeability of soil.	6	L2	CO4
	c.	In a falling head permeability test, the initial head (t = 0) 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 co-efficient of permeability taking area of sand pipe = 0.5 cm^2.	8	L3	CO4

OR

4	a.	Explain total stress, neutral stress and effective stress.	6	L2	CO4
	b.	What is flow net? Mention its applications.	6	L2	CO4
	c.	A 10 mm thick bed of sand is underlain by a layer of clay of 6 m thickness. The water table which was originally at the ground surface is lowered by drainage to a depth of 4 m. Where upon the degree of saturation above the lowered water table reduces to 20%. Determine the increase in the magnitude of the vertical effective pressure at the middle of the clay layer due to lowering of water table. The saturated unit weights of sand and clay are respectively 20.6 kN/m^3 and 17.6 kN/m^3 and the dry unit weight of sand in 16.7 kN/m^3.	8	L3	CO4

Module – 3

5	a.	Differentiate between compaction and consolidation of soil.	8	L2	CO2
	b.	Explain Casagrande's graphical method to determine pre consolidation pressure.	6	L2	CO2
	c.	The following are the results of proctor compaction test.	6	L2	CO3

Mass of mould + wet soil (g)	2925	3095	3150	3125	3070
Water content (%)	10.0	12.0	14.3	16.1	18.2

Volume of mould = 1000 ml
Mass of mould = 1000 gm,
Sp gravity of solids = 2.70.

i) Find the compaction curve showing the optimum moisture content and maximum dry density.
ii) Plot the zero air void line
iii) Determine the degree of saturation.

OR

6	a.	With neat sketch explain mass spring analogy of consolidation theory.	8	L3	CO2
	b.	Explain preconsolidated, normally consolidated and under consolidated soil.	6	L2	CO2
	c.	The settlement analysis (based on the assumption of the clay layer draining from top and bottom surfaces) for a proposed structure shows 2.5 cm of settlement in 4 years and an ultimate settlement of 10 cm. However, detailed subsurface investigation reveals that there will be no drainage at the bottom. For this situation, determine the ultimate settlement and the time required for 2.5 cm settlement.	6	L2	CO2

Module – 4

7 a. Classify the shear tests based on drainage condition. — 6 — L2 — CO3

b. Explain the advantages of triaxial shear test over direct shear test. — 6 — L2 — CO3

c. A direct shear test was carried out on a cohesive soil sample and the following result were obtained. — 8 — L3 — CO3

Normal stress (kN/m^2)	150	250
Shear stress at failure (kN/m^2)	110	120

What would be the deviator stress at failure if a triaxial test is carried out on the same soil with cell pressure of 150 kN/m^2?

OR

8 a. Explain Mohr – Coulomb theory. — 6 — L2 — CO3

b. Explain the factors affecting shear strength of soil. — 6 — L2 — CO3

c. A consolidated undrained test was conducted on a clay sample and following results were obtained. — 8 — L3 — CO3

Cell pressure (kN/m^2)	200	400	600
Deviator stress at failure (kN/m^2)	118	240	352
Pure water P_r^2 at failure (kN/m^2)	110	220	320

Determine the shear strength parameters with respect to
i) Total stress ii) Effective stress and plot Mohr circles.

Module – 5

9 a. Briefly explain local shear failure, purchasing shear failure and general shear failure. — 8 — L2 — CO4

b. Explain effect of water table on bearing capacity. — 6 — L2 — CO4

c. A square footing 2.5 m × 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 base footing is 1.5m below the ground surface. Calculate the safe load that can be carried by a footing with a factor of safety 3 against shear failure. Take N_c, N_q, N_r values are 65.4, 49.4, 54. — 6 — L3 — CO4

OR

10 a. Explain primary and secondary settlement. — 6 — L2 — CO4

b. Explain assumptions of Terzaghi's bearing capacity theory. — 6 — L2 — CO4

c. A saturated soil has a compression index of 0.283., The void ratio at a stress of 12 kN/m^2 in 2.05. Compute : — 8 — L3 — CO4

i) Change in void ratio if the stress is increased to 21.6 kN/m^2
ii) The settlement if the soil stratum is 6 m thick.

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