

Reg No : Name :

**MAR ATHANASIOUS COLLEGE OF ENGINEERING, KOTHAMANGALAM**

(Govt. Aided Autonomous Institution)

Fourth Semester B.Tech. Degree Examination, May, 2026

Course Code: B24CE2T05

Course Name: SOIL MECHANICS

Max. Marks: 100

Duration:3 Hours

PART - A: 30 Marks (10 Qns x 3 Marks)**Answer all questions**

1. What are the advantages of core cutter method over sand replacement method?
2. Define air content and degree of saturation. Write their mathematical expressions.
3. Distinguish between the Flow Index and the Toughness Index.
4. Define Group Index and explain why a higher GI indicates a poorer subgrade material.
5. A saturated clay layer lies below the groundwater table at a depth of 3 m. At a depth of 8 m below ground level, the total vertical stress is 160 kPa and the pore water pressure is 80 kPa. What is the effective vertical stress at 8 m depth? Support your answer with necessary equations and figures.
6. Write any three practical applications of determining permeability of soil.
7. In the logarithm of time fitting method, explain how the 0% and 100% consolidation points are established and how t_{50} is obtained to compute C_v .
8. Define primary consolidation and secondary compression. Mention the main assumptions made in Terzaghi's one-dimensional consolidation theory.
9. What are shear parameters?
10. What is the modified Mohr- Coulomb equation for shear strength?

PART - B: 70 Marks (5 Qns x 14 Marks)**Answer any One full question from each module.****Module 1**

11. a) A soil sample has total volume = 0.008 m^3 , Wet weight = 145 kN/m^3 , Water content = 20%, $G_s = 2.70$, Determine: a) Dry unit weight b) Void ratio c) Porosity d) Degree of saturation (8 Marks)

b) Define specific gravity of soil solids and explain its engineering significance. (6 Marks)

OR

12. a) Explain residual and transported soils with examples. (8 Marks)

b) Classify transported soils based on mode of transportation. (6 Marks)

Module 2

13. a) Explain Casagrande's apparatus for Liquid Limit determination. (8 Marks)

b) Discuss factors affecting Liquid Limit. (6 Marks)

OR

14.

The following results were obtained from a Standard Proctor Test:

Water Content (%) Dry Density (kN/m^3)

8	16.5
10	17.8
12	18.6
14	18.2
16	17.5

Plot the compaction curve, Determine the Optimum Moisture Content (OMC). Determine the Maximum Dry Density (MDD).

Module 3

15. a) A soil deposit is 10 m thick and overlies a bed of soft clay. The groundwater table is 3 m below the ground surface. If the sand above the water table has a degree of saturation of 45%, plot the diagram showing the variation of total, neutral and effective stresses. The void ratio of the sand is 0.7. Take $G = 2.65$. (10 marks)

b) Determine the increase in the effective pressure at 10 m depth in the above question, when the water table is lowered by 5 m. Assume the soil above the water table has $S = 45\%$ throughout. (4 marks)

OR

16. a) Explain the physical mechanism of the quicksand condition (boiling sand) under upward seepage flow, including the role of effective stress becoming zero. Illustrate with a neat sketch. (8 marks)

b) A soil sample has $G = 2.70$, $e = 0.75$. Compute the factor of safety against quicksand if the applied upward hydraulic gradient is 0.85. (6 marks)

Module 4

17. a) A stratum of clay 8 m deep has a liquid limit of 45%. The surface of clay is at 10 m below the ground level, water content = 40% and $G = 2.78$ for clay. Between the ground surface and clay, the subsoil consists of fine sand. The groundwater level is 4.5 m below the ground level. The average submerged unit weight of sand is 10.4 kN/m^3 , and the unit weight of sand above the groundwater level is 17 kN/m^3 . The clay is normally consolidated. The weight of the structure coming on top of the sand above the clay increases the overburden pressure on the clay by 40 kN/m^2 . Estimate the settlement of the building. (8 marks)
- b) Explain the compression index, expansion index and recompression index of soil. (6 marks)

OR

18. Explain Terzaghi's theory of one-dimensional consolidation of soil. Also, write the assumptions considered in deriving the theory and the limitations of the consolidation theory.

Module 5

19. Which test is conducted to determine the shear strength of soil in the field? Derive an equation for shear strength of the soil using this apparatus. Also, write any two advantages and disadvantages of the test.

OR

20. a) Two drained tests were performed on the given soil. In the first test, the all-round pressure was 200 kPa, and the failure occurred at an added axial stress of 600 kPa. In the second test, all-round pressure was 350 kPa, and failure occurred at an added axial stress of 1050 kPa. What are the values of cohesion and angle of internal friction corresponding to these results? (8 marks)
- b) When a UCS test is conducted on a cylinder of soil, it fails under axial stress of 1.2 kg/cm^2 . The angle of the failure plane was found to be 50° with the horizontal. Determine the cohesion and angle of internal friction of the soil. (6 marks)
