Register No.: ..... Name: .....

SAINTGITS COLLEGE OF ENGINEERING (AUTONOMOUS)

(AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANANTHAPURAM)

FOURTH SEMESTER B.TECH DEGREE EXAMINATION (R), MAY 2023
CIVIL ENGINEERING
(2020 SCHEME)

Course Code : 20CET204

Course Name: Geotechnical Engineering - I

Max. Marks : 100 **Duration: 3 Hours**

Use of Plasticity Charts, IS 1498: Auxiliary Identification Charts, Newmarks Charts, Stability Charts are permitted.
Graphs sheets: Natural and Semi-log may be provided on request.

PART A

(Answer all questions. Each question carries 3 marks)

1. The bulk unit weight of a soil sample is 19.5 kN/m^3 at a water content of 24%. Compute the degree of saturation if the specific gravity is 2.7. Assume unit weight of water as 10 kN/m^3.
2. You are assigned with the task of computing the specific gravity of a clayey soil sample. Which test would you use for the purpose. Explain the test process.
3. Define Atterberg limits of soil.
4. Classify the soil with following properties according to IS Classification System.
   Liquid limit – 65%
   Plastic limit – 37%
   Percentage passing 4.75 mm IS sieve – 85%
   Percentage passing 75-micron sieve – 30%
5. Elaborate on quick sand condition of soil.
6. What are the limitations of Boussinesq's theory
7. Define the following
   a. Normally consolidated soil
   b. Over consolidated soil
   c. Under consolidated soil
8. Differentiate between compaction and consolidation of soils.
9. Explain principal planes. What are the different principal planes?
10. With sketches, explain different modes of failure of a finite slope.

PART B

(Answer one full question from each module, each question carries 14 marks)

MODULE I

11. a) Explain the process of determination of field density using Sand Replacement Method. (5)

    b) A sample of wet soil has a volume of 0.023m^3 and a mass of 37 kg and specific gravity of 2.7. Upon drying in a hot air oven, its mass reduced to 33.8 kg. Determine the bulk density, water content, dry density, saturated density, void ratio, porosity and degree of saturation (9)

OR

12. a) Explain the different soil structures for coarse grained and fine-grained soils. (5)

    b) There are two sites A and B with soil having void ratios of 0.85 and 0.72 respectively. The water content was determined to be 18% and 24% respectively. The embankment to be constructed must have a total volume of 18, 000m^3 and a bulk density of 2100 kg/m^3 at a water content of 20%. Compute the volume of soil required to be excavated from both areas if the specific gravity of soil is 2.68 and 2.76 respectively. If the cost of excavation and transportation is Rs. 980/- per 100m^3 in site A and Rs. 1050/- per 100m^3 in site B, which site would you recommend? (9)

MODULE II

13. a) Classify the soil from the following data. (5)

Sieve Size	4.75	2.36	1.18	0.6	0.3	0.150	0.075	pan
Weight Retained in gram	12	23	22	34	48	50	30	10

    b) Explain in detail with sufficient sketches to find the permeability of a soil in laboratory of a soil that is sufficiently permeable. (9)

OR

14. a) Comment on factors affecting permeability of soils (4)

b) A dry soil sample of mass 50 gram is mixed with distilled water to prepare a suspension of 1000 ml for hydrometer analysis. The reading of the hydrometer after 5 minutes was 24.5 and depth of centre of the bulb below the water surface when hydrometer was in the jar was 150mm. The volume of the hydrometer was 62 ml and the corss-sectional area of the jar was 55 cm^2. Compute the percentage finer and particle size diameter of the soil sample corresponding to the above data if the specific gravity of the soil is 2.68 and viscosity of water as 9.81 millipoise. Neglect the corrections of hydrometer. (10)

MODULE III

15. a) A concentrated load of 700 kN is applied at the ground surface. (5)
    i. Determine the vertical stress at a point P, which is 5m directly below the load.
    ii. At a point R at a depth 5 m but at a horizontal distance of 4 m from the axis of load.

    b) A layer of sand deposit, 6 m thick has water table, 3 m below the surface. The unit weight of sand above the water table is 17.5 kN/m^3 and 18.2 kN/m^3 below the water table. Plot total, neutral and effective stress diagrams upto 6 m below ground level. Consider the unit weight of water as $10kN/m^3$. (9)

OR

16. a) Compute the critical hydraulic gradient of sandy silt having the following properties. G= 2.65, e = 0.60 and k= $3x\ 10^{-6}$ cm/sec (5)

    b) A rectangular foundation 4.5 m x 3 m carries a uniform load of 45 kN/m^2. Determine the vertical stress at *P*, which is 4 m below the ground surface using equivalent point load method. (9)

MODULE IV

17. a) Give the assumptions of Terzaghi's theory of consolidation. (4)

    b) A standard proctors compaction test was conducted on a sample of soil and the results are tabulated below. (10)

Water content %	8	12	16	20	24	28
Mass of wet soil. kg	1.68	1.85	1.91	1.87	1.87	1.85

If the volume of the mould was 980 ml, draw a compaction curve and determine the maximum dry density and optimum water content. Compute the void ratio and degree of saturation as well. Assume the specific gravity of soil to be 2.75

OR

18. a) What is meant by preconsolidation pressure? Explain the Casagrande's method to find the preconsolidation pressure with necessary sketches. (5)

b) A 3 m x 3 m footing causes a pressure increment of 180 kN/m^2 at its base. Determine the consolidation settlement at the middle of the clay layer. Assume 2:1 pressure distribution at center of clay layer. Assume unit weight of water as 10kN/m^3. (9)

MODULE V

19. a) Direct shear tests were conducted on a soil sample till failure. The following results were obtained. (7)

Test Number	Normal Stress (kN/m^2)	Shear Stress (kN/m^2)
1	15	28
2	30	38
3	45	48

Determine the cohesion intercept and the angle of shearing resistance.

b) Explain the Mohr-Coulomb failure criterion (7)

OR

20. a) Elaborate the factors influencing shear strength of cohesive soils (5)

b) Compute the factor of safety of a slope with respect to cohesion using friction circle method. Height of the slope - 15m, unit weight – 18 kN/m^3, cohesion - 45 kN/m^2 and angle of slope - 45^o. Assume any circle passing through the toe and any missing data as well. (9)

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