CBCS SCHEME

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18CV54

Fifth Semester B.E. Degree Examination, Dec.2023/Jan.2024
Basic Geotechnical Engineering

Time: 3 hrs. Max. Marks: 100

Note: 1. ***Answer any FIVE full questions, choosing ONE full question from each module.***
2. Missing data, if any, may be suitably assumed.

Module-1

1 a. With the help of three phase diagram, define the terms : degree of saturation, water content, voids ratio and specific gravity of soil. Establish the phase relation among them. **(10 Marks)**

b. State Stoke's law. Enlist the limitations of the same as applied to soil particle analysis. **(06 Marks)**

c. A soil sample having bulk unit weight of 16kN/m^3 has a water content of 25%. The specific gravity of soil particles is 2.7. Determine :
i) Dry unit weight
ii) Voids ratio
iii) Porosity
iv) Degree of saturation. **(04 Marks)**

OR

2 a. With a neat sketch, explain plasticity chart and its use in classification of fine grained soils. **(06 Marks)**

b. Following are the results of liquid limit test on a clay sample having plastic limit of 20%. Plot the flow-curve and obtain :
i) Liquid limit
ii) Flow index
iii) Consistency index,
If natural water content of soil is 18%.

Number of blows	12	18	22	34
Water content (%)	56	52	50	45

(08 Marks)

c. With a neat sketch, explain the particle size distribution characteristic of : well graded, poorly graded and gap graded soils. **(06 Marks)**

Module-2

3 a. List the clay minerals and explain any two with their structures. **(08 Marks)**

b. Briefly explain the following :
i) Dispersed and flocculated structure
ii) Diffused double layer theory
iii) Base – exchange phenomenon. **(12 Marks)**

OR

4 a. Distinguish between standard and modified proctor compaction test. (06 Marks)
b. Briefly discuss the factors affecting compaction. (06 Marks)
c. The following data refers to standard proctor compaction test on a soil. Plot the compaction curve and determine MDD and corresponding DMC. Mark zero air voids line. Assume G = 2.7.

Water content (%)	9.5	11	12	14	16	18	19.5
Bulk unit weight (kN/m^3)	18	19	19.6	20.5	21	20.5	20

(08 Marks)

Module-3

5 a. State Darcy's law and its limitations as applied to flow through soils. (06 Marks)
b. Derive an expression for coefficient of permeability by variable head test. (06 Marks)
c. A clay sample is 80mm in diameter and 100mm in height. The permeability of the sample is estimated to be 10×10^{-3}mm/sec. If, in the test, the head in a standing pipe falls from 240mm to 120mm in 3 minutes, determine the diameter of standing pipe used in the test. (08 Marks)

OR

6 a. Derive an expression for effective stress for a saturated soil and hence define total stress, effective stress and neutral pressure. (06 Marks)
b. What are flow nets? List its characteristics and uses. (06 Marks)
c. Sub soil at a site consists of 3m thick dry sand (G = 2.67, e = 0.85) which is under lain by a 3.5m thick clay stratum (G = 2.72, ∞ = 28%) followed by rock. The ground water table is located at a depth of 1.5m below ground surface. The sand layer is saturated by capillary rise of 0.42m above water-table. Plot the distribution of total, neutral and effective stress. (08 Marks)

Module-4

7 a. List the assumptions of Mohr-coulomb shear strength theory. Express shear strength equation for soils with all its notations. (06 Marks)
b. Enlist drainage conditions that can be simulated in triaxial test and how these simulates field problems. (06 Marks)
c. The direct shear test conducted on a soil specimen gave the following results at failure. Draw Mohr's envelope and determine shear parameters. For the test result on first specimen, determine orientation of principal planes and magnitude of principal stresses.

Test number	1	2	3
Normal stress (kN/m^2)	100	150	200
Shear stress (kN/m^2)	50	70	90

(08 Marks)

OR

8 a. Derive the relationship between principle stress at failure and shear parameter C and ϕ. **(06 Marks)**

b. Briefly enlist the merits and demerits of 'Direct shear test'. **(06 Marks)**

c. A particular soil failed under a major principal stress of 288kN/m^2 with corresponding minor principal stress of 100kN.m^2, If for the same soil, the minor principal stress had been 200kN/m^2, determine graphically, what is the major principal stress at failure would have been if :

i) $\phi = 0$ and ii) $C = 0$ iii) $C = 12$kN/m^2. **(08 Marks)**

Module-5

9 a. Briefly explain spring analogy to explain principle of consolidation. **(06 Marks)**

b. List the assumptions of Terzaghi's one dimensional consolidation theory. **(06 Marks)**

c. During an Oedometer test, the voids ratio of eh sample decreased from 0.85 to 0.73 as the pressure increased from 1 to 2 kg/cm^2. If the coefficient of permeability of the soil is 3.3×10^{-4} cm/s, determine coefficient of volume change and coefficient of consolidation of soil. **(08 Marks)**

OR

10 a. Explain with neat sketch, Casagrande's method of determining pre consolidation pressure. **(06 Marks)**

b. Discuss the principle and procedure of determining coefficient of consolidation by square root time fitting method. **(06 Marks)**

c. In a laboratory test on the consolidation of clay sample of 20mm thick under double drainage, the time required for 50% consolidation was 30 minutes. Calculate coefficient of consolidation. Also, calculate the time required for 90% consolidation of the same clay in the field having 2m thick clay stratum and with drains on efface only. Take $T_{V_{50}} = 0.196$ and $T_{V_{90}} = 0.848$. **(08 Marks)**

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