

B. Tech 4th Semester Examination
Geotechnical Engineering-I (NS)

CE-222

Time : 3 Hours

Max. Marks : 100

The candidates shall limit their answers precisely within the answer-book (40 pages) issued to them and no supplementary/continuation sheet will be issued.

Note : Attempt five questions selecting one question from each section A, B, C and D. Question 9 section E is compulsory. All questions carry equal marks. Non-programmable calculator is allowed.

SECTION - A

1. (a) What do you mean by residual and transported soils? Explain the process of their formation.
(b) A particle size analysis on a soil sample yields the following data:

Sieve size (mm)	4.75	2.0	0.84	0.25	0.075	Pan
Mass retained (grams)	310	580	380	260	680	210

- (a) Plot particle size distribution curve (b) Determine the amount of coarse-grained and fine engained soils in the sample (c) If the liquid limit and plasticity index of soil is 30% and 15% respectively classify the soil. (10+10=20)

OR

2. (a) How would you distinguish if a material is:
(i) GW or GP or GM or GC
(ii) SW or SP or SM or SC
(b) With the use of three phase diagram prove the $S = \frac{wG_s(1-n)}{n}$ relationship

[P.T.O.]

- (c) A soil mass in its natural state is partially saturated having a water content of 17.5% and a void ratio of 0.87. Determine the degree of saturation, total unit weight, dry unit weight, percentage air voids. What is the weight of water required to saturate a mass of 10m³ volume? Assume G = 2.69. (6+6+8=20)

SECTION - B

3. (a) State the principle of Darcy's law for laminar flow of water through saturated soil. Also mention the conditions necessary for Darcy's law to be applicable.
(b) If k_1, k_2, k_3 are the permeabilities of layers h_1, h_2, h_3 , thick, what is its equivalent permeability in the horizontal and vertical directions?
(c) A clay stratum 8.0 m thick is located at a depth of 6 m from the ground surface. The natural moisture content of the clay is 56% and G = 2.75. The soil stratum between the ground surface and the clay consists of fine sand. The water table is located at a depth of 2m below the ground surface. The submerged unit weight of fine sand is 10.5 kN/m³, and its moist unit weight above the water table is 18.68 kN/m³. Calculate the (a) the total pressure, (b) the pore water pressure and (c) the effective pressure at depths 0, 2, 10 and 14.0 m from the ground surface, and draw the pressure distribution diagram. (5+5+10=20)

OR

4. (a) Explain the concept of pressure bulb and its use in soil engineering practice.
(b) A long masonry wall footing carries a uniformly distributed load of 200 kN/m². If the width of the footing is 4 m, determine the vertical pressures at a depth of 3 m below the (i) center, and (ii) edge of the footing.
(c) A concrete dam retains water to a height of 9 m. It has rows of sheet piling at both heel and toe which extend half way down to an impervious stratum. From a flow net sketched on a transformed section, it is found that there are four flow channels and sixteen head drops. The average horizontal and vertical permeabilities of the soil are 6×10^{-3} mm/s and 2×10^{-3} mm/s, respectively. What is the seepage per day, if the length of the dam is 150 metres? (8+5+7=20)

SECTION - C

5. (a) Write short notes on:
- Field compaction using rollers.
 - Field compaction control.
- (b) Plot the dry unit weight versus water content using the following data. Assume suitable value of G .

Water content (%)	4	5	8	10	12
Degree of saturation S (%)	20	30	60	70	75

Determine the maximum dry unit weight and optimum water content.
(10+10=20)

OR

6. (a) Explain Terzaghi's theory of one-dimensional consolidation of soils. State clearly some of the assumptions followed in this theory.
- (b) A normally consolidated clay layer is 3 m thick (one-way drainage). From the application of a given pressure, the total anticipated primary consolidation settlement will be 80 mm.
- What is the average degree of consolidation for the clay layer when the settlement is 25 mm?
 - If the average value of c_v for the pressure range is $0.002 \text{ cm}^2/\text{sec}$, how long will it take for 50% settlement to occur?
 - How long will it take for 50% consolidation to occur if the clay layer is drained at both top and bottom?
- (10+10=20)

SECTION - D

7. (a) Explain the principle of direct shear and triaxial test. Also write the advantages and limitations of direct shear and triaxial test

[P.T.O.]

- (b) The following result were obtained from a series of undrained triaxial tests carried out on undisturbed samples of soil.

Cell pressure kN/m^2	200	400	600
Additional axial load at Failure (N)	270	330	390

Each sample, originally 36 mm diameter and 72 mm high, had a vertical deformation of 5.4 mm. Determine total stress shear strength parameters.
(10+10=20)

OR

8. (a) Write a note on chemical stabilisation in soils
- (b) Describe the different steps involved in the process of soil stabilisation using cement as the additive.
(10+10=20)

SECTION - E

9. (a) Define and explain the terms 'air content' and 'Percentage air voids'.
- (b) Distinguish between flocculated and dispersed structure in soils.
- (c) Define flow index and plasticity index.
- (d) Define 'neutral' and 'effective' stress in soils.
- (e) What is Critical hydraulic gradient and quick sand condition?
- (f) Define the terms preconsolidation pressure, normally consolidated and overconsolidated soils.
- (g) Write the principle behind unconfined compressive strength test.
- (h) Define the term soil bitumen and sand bitumen
- (i) Calculate the compaction energy in standard and modified proctor test.
- (j) Uses of flow net.
(10×2=20)