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**BTECH**  
**(SEM V) THEORY EXAMINATION 2022-23**  
**GEOTECHNICAL ENGINEERING**

Time: 3 Hours

Total Marks: 100

Note: Attempt all Sections. If you require any missing data, then choose suitably.

## SECTION A

1. Attempt *all* questions in brief. 2 x 10 = 20

- (a) What do you understand by index properties of soil?
- (b) Define “Thixotropy”.
- (c) Enlist the factors that affect the permeability of soil.
- (d) A loose uniform sand with rounded grains has effective grain size of 0.05cm. Determine the coefficient of permeability of sand.
- (e) Define Compressibility.
- (f) Discuss the nature of the pore pressure that can develop in dense sand and over consolidated clay.
- (g) Discuss about the isobar diagram.
- (h) Define Liquefaction.
- (i) Enlist various types of slope failure.
- (j) Write down the expression for vertical cut in clayey soil.

## SECTION B

2. Attempt any *three* of the following: 10 x 3 = 30

- (a) A soil has a bulk unit weight of 20.11 kN/m<sup>3</sup> and water content of 15%. Calculate the water content if the soil partially dries to a unit weight of 19.42 kN/m<sup>3</sup> and the void ratio remains unchanged.
- (b) Explain the Flow Net. Discuss its applications.
- (c) Explain the process involved in determination of compaction in IS Light Compaction Test.
- (d) Find the intensity of vertical and horizontal shear stress at a point 4m directly below a 20kN point load acting at a horizontal ground Surface. What will be vertical pressure at a point 2m horizontally away from axis of loading but at same depth.
- (e) An unsupported excavation is made to maximum possible depth in a clay soil having bulk density 18kN/m<sup>3</sup>,  $C = 100\text{kN/m}^2$ , angle of internal friction = 30°. Determine active earth pressure according to Rankine’s theory at the base level of excavation.

## SECTION C

3. Attempt any *one* part of the following: 10 x 1 = 10

- (a) If a soil sample has a dry unit weight of 18 KN/m<sup>3</sup>, moisture content of 10% and a specific gravity of solids particles is 2.7. Calculate the following:
  - i) The void ratio.
  - ii) Moisture and saturated unit weight.
  - iii) The mass of water to be added to cubic meter of soil to reach 80% saturation.
- (b) The in-situ void ratio of a granular soil deposit is 0.50. The maximum and minimum void ratios are 0.75 and 0.35. If  $G_s = 2.7$  determine the relative density and relative compaction of the deposit.

4. **Attempt any one part of the following:** **10 x 1 = 10**
- (a) The water table in a deposit of sand 8m thick, is at a depth of 3m below the surface. Above the water table, the sand is saturated with capillary water. The bulk density of sand is  $19.62 \text{ kN/m}^3$ . Calculate the effective pressure at 1m, 3m, and 8m below the surface.
- (b) Define piping failure and its measure for rectification.
5. **Attempt any one part of the following:** **10 x 1 = 10**
- (a) An undisturbed sample of clay, 24mm thick, consolidated 50% in 20 minutes, when tested in the laboratory with double drainage. The clay layer from which the sample was obtained, is 4m thick in the field. How much time will it take to consolidate 50% with double drainage?
- (b) Derive the expression for Terzaghi's one dimensional consolidation.
6. **Attempt any one part of the following:** **10 x 1 = 10**
- (a) An embankment 5m high is made of up of soil whose effective stress parameter are  $c$  &  $\Phi$   $39^\circ$ ;  $c = 50 \text{ kN/m}^2$  and  $\Phi = 16^\circ$  and  $Y = 16 \text{ kN/m}^3$ . The pore pressure parameters as found from triaxial tests are  $A = 0.4$  and  $B = 0.49$ . Find the shear strength of soil at base of the embankment just after the soil has been raised from 5m to 8m. Assume the dissipation of pore pressure to be negligible and that lateral pressure at any point is half of vertical pressure.
- (b) Derive an expression for vertical stress under uniformly loaded circular area.
7. **Attempt any one part of the following:** **10 x 1 = 10**
- (a) Compute the intensities of active and passive earth pressure at depth of 8 m in dry cohesion less sand with an angle of internal friction of 30 degree and unit weight of  $18 \text{ kN/m}^3$ . What will be the intensities of active and passive earth pressure if the water level rises to the ground level?  $\gamma_{\text{sand}} = 20 \text{ kN/m}^3$ .
- (b) A slope is to be constructed in a soil for which  $c = 0$  and  $\phi = 36^\circ$ . It is to be assumed that the water level may occasionally reach the surface of a slope, with seepage taking place parallel to the slope. Determine the maximum slope angle for a factor of safety 1.5, assuming a potential failure surface parallel to the slope. What would be the factor of safety of the slope, constructed at this angle, if the water table should be well below the surface? The saturated unit weight of the soil is  $20 \text{ kN/m}^3$ .