

(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 2130

Roll No.

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B.Tech.

(SEM. V) ODD SEMESTER THEORY
EXAMINATION 2012–13

GEO-TECHNICAL ENGINEERING

Time : 3 Hours

Total Marks : 100

Note :— Attempt **all** questions. All questions carry equal marks. If required any missing data then choose suitably.

1. Attempt any **four** parts of the following : **(5×4=20)**

- What do you understand by residual soils and transported soils ? Give the grain size ranges of different soil types according to IS specifications.
- Illustrate by schematic diagrams, how the clay minerals kaolinite, illite and montmorillonite are formed.
- Establish the following relationship :

$$\gamma_d = (1 - n) G_s \gamma_w$$

Where γ_d = Dry unit weight of soil

n = Porosity

G_s = Specific gravity of solids

γ_w = Unit weight of water

- (d) An oven dry soil sample of volume 250 cc weighs 430 g. If the specific gravity of solids is 2.70, what is the water content when the soil becomes fully saturated without any change in its volume ? What will be the water content which will fully saturate the sample and also cause an increase in volume equal to 10% of the original dry volume ?
- (e) If the material of the base of the liquid limit apparatus on which the bowl containing soil drops is made of sponge, will the measured value of liquid limit of the soil be lower or higher than that measured using the standard apparatus which has a base made of hard rubber ? Discuss this result.
- (f) Classify soils A to E as completely as possible on the basis of information given below :

Soil	Liquid Limit	Plasticity Index	% Clay Size	% Silt Size	% Sand Size
A	500	450	80	20	0
B	32	7	10	80	0
C	40	20	70	30	0
D	—	0	60	40	0
E	—	0	0	10	90

2. Attempt any **four** parts of the following : (5×4=20)

- (a) Explain how upward flow of seepage water causes the effective stress. What is the role of the pore water pressure in the quick sand condition ?
- (b) Give the expressions of the equivalent permeability for horizontal and vertical flow of water in soil medium.
- (c) Flow passes from one stratum of permeability k_1 to another stratum of permeability k_2 . If the deflection angle of the flow line at the interface is α_1 in the first stratum and the angle of deflection in the second stratum is α_2 . Then derive a relation between k_1 , k_2 , α_1 and α_2 .
- (d) As a geotechnical engineer for the design of a filter of an earth dam, the proper selection of filter material is required to prevent the piping failure; so what are the conditions, you will keep in your mind at the time of filter design ?
- (e) Let us suppose as a geotechnical expert, you have a challenge to control the compaction in a site; so how will you control the compaction by the Proctor's needle method ?
- (f) During the construction of an embankment, the density attained by field compaction was investigated by the sand jar method. A test pit was excavated in the newly compacted soil and was filled up by pouring sand. The following were

the observations : Weight of soil excavated from pit = 2883 gm; Weight of sand required to fill the pit = 2356 gm; Bulk density of sand = 1.52 gm/cc and moisture content of embankment soil = 16%. Determine the dry density of the compacted soil.

Attempt any **two** parts of the following : (10×2=20)

- (a) For a sedimentary soil deposit, which solution is more appropriate—Boussinesq's or Westergaard's ? Why ? State the assumptions involved in the Westergaard's theory.

A concentrated load of 40 kN acts on the surface of a soil. Determine the vertical stress increment at points directly beneath the load upto a depth of 10 m and draw a plot for the vertical stress variation upto depth of 10 m.

- (b) How is consolidation different from compaction ? What do you understand by the terms : immediate settlement, primary consolidation and secondary consolidation ?

Representative samples of a layer of silty clay, 5 m thick, were tested in a consolidometer and the following results were obtained : initial void ratio = 0.90; Preconsolidation stress = 120 kN/m²; Recompression

index = 0.03 and Compression index = 0.27. Estimate the consolidation settlement if the present average overburden stress of the layer is 70 kN/m^2 and the increase in average stress in the layer is 80 kN/m^2 .

- (c) Give the assumptions of the Terzaghi's theory for calculating the rate of 1 – D consolidation and prove that :

$$\frac{\partial u}{\partial t} = c_v \cdot \frac{\partial^2 u}{\partial z^2}.$$

4. Attempt any **two** parts of the following : **(10×2=20)**

- (a) A series of consolidated undrained tests on a soil gave the following results : $C_{cu} = C'_{cu} = 0$; $\phi_{cu} = 15^\circ$; $\phi'_{cu} = 30^\circ$;

A sample of this soil was tested in a consolidated undrained test under a cell pressure of 150 kN/m^2 . Determine :

- (i) *Deviator stress at failure*
- (ii) *Pore water pressure at failure*
- (iii) *Minor principal effective stress at failure*
- (iv) *Major principal effective stress at failure*
- (v) *The magnitude of A_f .*

- (b) Write about the consolidated – undrained test for finding out the shear strength parameters. Also show and explain the curves between the deviator stress versus axial strain (for loose and dense sand both) and variation of pore water pressure versus axial strain (for loose and dense sand both).
- (c) How Culmann's graphical method is convenient for determining the active earth pressure for soils having no cohesion ? Discuss all the steps of this method.

5. Attempt any **two** parts of the following : (10×2=20)

- (a) Write short notes on; undisturbed sample, representative sample, area ratio, recovery ratio and rock quality designation. How the static cone penetration test is different from standard penetration test ?
- (b) Calculate the net ultimate bearing capacity of rectangular footing $2\text{ m} \times 4\text{ m}$ in plan, founded at a depth of 1.5 m below the ground surface. The load on the footing acts at an angle of 15° to the vertical and is eccentric in the direction of width by 15 cm . The saturated unit weight of the soil is 18 kN/m^3 . The rate of loading is slow and hence the effective stress shear strength parameters can be used in the analysis; $C' = 15\text{ kN/m}^2$ and $\phi = 25^\circ$. Natural water

table is at a depth of 2 m below the ground surface. Use IS recommendations for the bearing capacity of shallow foundations. For $\phi = 25^\circ$: $N_c = 20.7$, $N_q = 10.7$ and $N_y = 10.9$.

- (c) Differentiate between gross and net bearing capacity. What are the assumptions made in the Terzaghi's bearing capacity theory? Also discuss the failure zones in Terzaghi's theory with the help of its neat sketch.

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