53 (CE 403) GTEN

2018

GEOTECHNICAL ENGINEERING

Full Marks : 100

Time : Three hours

The figures in the margin indicate full marks for the questions.

*Answer **all** questions.*

1. *(a)* Define the following : 2×5=10

   (i) Void ratio

   (ii) Degree of saturation

   (iii) Porosity

   (iv) Water content

   (v) Specific gravity.

   (b) Derive the following relationships 5×2=10

   (i) $\gamma_t = \left(\frac{G_s + Se}{1+e}\right)\gamma_w$

   (ii) $eS_r = wG_s$

2. *(a)* In a proctor compaction test, the soil specimen of one of the observations had a bulk density of $19 kN/m^3$ with a moisture content of 15%. Find :

(i) Degree of saturation of the specimen if G_s=2·7

(ii) Additional moisture content required for saturating the soil specimen. 5

(b) Compare the compactive energy used in the IS heavy compaction test with that of the IS light compaction test. 5

(c) Explain the factors affecting compaction. 5

(d) A soil profile consists of a surface layer of sand 3·5m thick (γ =1·65 Mg/m^3), an intermediate layer of clay 3m thick (γ =1·95 Mg/m^3) and the bottom layer of gravel 3·5m thick (γ =1·925 Mg/m^3). The water table is at the upper surface of the clay layer. Determine the effective pressure at various levels immediately after placement of a surcharge load of 58·86 kN/m^2 to the ground surface. 5

3. *(a)* A layer of normally consolidated saturated silty clay of 1m thickness is subjected to one-dimensional consolidation under a pressure increment of 20kPa.

The properties of soil are :

specific gravity = 2·7, natural moisture content = 45%, compression index = 0·45 and recompression index = 0·05. The initial average effective stress within the layer is 100*kPa*. Determine the primary consolidation settlement. 5

(b) 1·5*m* layer of soil is subjected to an upward seepage head of 1·95*m*. What depth of coarse sand will be required above this soil to provide a factor of safety of 1·5 against piping? Coarse sand has specific gravity 2·67 and porosity 30%. 5

(c) Explain the factors affecting permeability. 5

(d) A falling head permeability test was carried out on a 15*cm* long silty clay. The diameter of the sample and the stand pipe were 9·8*cm* and 0·75*cm* respectively. The water level in the stand pipe was observed to fall from 70*cm* to 45*cm* in 12 minutes.

Determine :

(i) The coefficient of permeability of the soil in *m*/day

(ii) Height of water level in stand pipe after 20 minutes. 5

4. *(a)* What will be the ratio of average permeability in the horizontal direction to that in the vertical direction for a soil deposit consisting of three horizontal layers if the thickness and the permeability of the second layer are twice those of the first and those of the third layer twice those of the second ? 5

(b) Explain different methods to calculate permeability of soil. 5

(c) Write the differences between compaction and consolidation. 10

5. *(a)* What are the basic assumptions of Terzaghi's one-dimensional consolidation ? 5

(b) Explain the differences between UU, CU and CD tests. 5

(c) Explain different types of consistency limits. 5

(d) Explain different Methods to determine in situ unit weight of soil. 5
