**53 (CE 403) GTEN**

**2017**

# GEOTECHNICAL ENGINEERING

Paper : CE 403

*Full Marks : 100*

Time : Three hours

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

1. *(a)* Differentiate between residual and transported soil. In what way does this knowledge help in soil engineering practice ? 5

   *(b)* Write critical notes on texture and structure of soils. 6

   *(c)* Determine the *(i)* Water content *(ii)* Dry density *(iii)* Bulk density *(iv)* Void ratio *(v)* Degree of saturation from the following data : 9

Sample size = 3·81*cm (diameter)* × 7·62*cm (height)*

Wet weight = 166·8*g*

Dry weight = 140*g*

Specific gravity = 2·7

*Contd.*

2. *(a)* Why is classification of soils required ? How do you distinguish between, gravels, sand, silt and clay ? 4

*(b)* How do you use the *A*-line to distinguish between various types of clays ? 2

*(c)* How would you distinguish if a material is *GW, SP, SM & CL.* 4

*(d)* *(i)* A dry soil has a void ratio of 0·65 and its specific gravity is 2·8. What is its unit weight ?

*(ii)* Water is added to the sample so that its degree of saturation is 60% without any change in void ratio. Determine the water content and unit weight.

*(iii)* The sample is next placed below water. Determine the unit weight at 95% saturation.

10

3. *(a)* Explain the significance of permiability of soils. How the permeability of soil is affected by various factors ? 6

*(b)* What is Darcy's Law ? 2

*(c)* A saturated specimen of undisturbed inorganic clay has volume of $19{\cdot}2 cm^3$ and mass $32{\cdot}5g$. After oven drying at $105°C$ for 24 hrs, the mass reduces to $20{\cdot}9g$. For the soil in the natural state, Find *(i)* $W$ *(ii)* $G$ *(iii)* $e$ *(iv)* $Y_{sat}$ and $Y_d$. 12

4. *(a)* Define critical hydraulic gradient and explain how piping is produced. 5

*(b)* What are the principles of a flow net ? 3

*(c)* A sample in a variable head permeameter is $8cm$ is diameter and $10cm$ high. The permeability of the sample is estimated to be $10\times10^{-4} cm/s$. If it is desired that the head in the stand pipe should fall from $24cm$ to $12cm$ in $3min$. Determine the size of the standpipe which should be used. 8

(d) What will be the gradient of soil deposit if a factor of safety of 2 is provided against piping ? Given $G = 2{\cdot}65$ and porosity of 35%. 4

5. (a) What is Virgin compression curve and recompression curve ? 4

(b) Compute the total, effective and pore pressure at a depth of 20*m* below the bottom of a lake 6*m* deep. The bottom of the lake consists of soft clay with a thickness of 20*m*. The average water content of the clay is 35% and specific gravity of the soil is 2·65. 16

6. (a) What are the effects of compaction ? 3

(b) With the help of a suitable diagram show and explain the effect of compactive effort on compaction characteristics. 3

(c) The following data were obtained in a compaction test. 14

| Moisture content (%) | 2 | 4·2 | 5·5 | 6·6 | 7·5 | 10 |
|---|---|---|---|---|---|---|
| Wet density $(g/cm^3)$ | 2·02 | 2·08 | 2·17 | 2·2 | 2·21 | 2·2 |

Determine the OMC and MDD and draw 65% saturation line.

Given $G = 2{\cdot}65$

7. *(a)* A wall $5{\cdot}4m$ high, retains sand. In the loose state the sand has a void ratio of $0{\cdot}63$ and $\phi = 27°$, while in the dense state, the corresponding values of void ratio and $\phi$ are $0{\cdot}36$ and $45°$ respectively. Compare the ratio of active and passive earth pressure in the two cases.

Given $G = 2{\cdot}64$. 15

*(b)* Define Atterberg limits and show all the indices. 5