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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.***

***Answer any five questions.***

1. (a) Differentiate between residual and transported soils. In what way does this knowledge help in soil engineering practice? 5
- (b) Explain the meaning of texture and structure of a soil. 3
- (c) A sample of saturated soil has a water content of 35%. The specific gravity of solids is 2.65. Determine its void ratio, porosity, saturated unit weight and dry unit weight. 12

*Contd.*

2. (a) Why is classification of soils required? 3
- (b) What are common classification tests? 3
- (c) How do you classify a soil by the ISSCS? 3
- (d) How would you distinguish if a material is
- (i) GW? 2
- (ii) SP? 2
- (e) The dry unit weight of a sand sample in the loosest state is  $13.34 \text{ kN/m}^3$  and in the densest state, it is  $21.19 \text{ kN/m}^3$ . Determine the density index of this sand when it has a porosity of 33%. Assume the grain specific gravity as 2.68. 9
3. (a) Explain the significance of permeability of soils. 3
- (b) What is Darcy's Law? 3
- (c) What is the critical gradient of a sand deposit of specific gravity 2.65 and void ratio 0.5? 4

(d) 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? Derive the formulae. 10

4. (a) Differentiate between : 12

(i) Compaction and Consolidation.

(ii) Primary consolidation and Secondary consolidation.

(iii) Normally consolidated and Over consolidated soil.

(iv) Undisturbed and Remoulded soil sample.

(b) For a homogeneous earth dam 32m high and 2m free board, a flow net was constructed with four flow channels. The number of potential drops was 20. The dam has a horizontal filter at the base near the toe. The coefficient of permeability of the soil was  $9 \times 10^{-2} \text{ mm/s}$ . Determine the anticipated seepage if the length of the dam is 100m. 8

5. (a) What is effective pressure and pore pressure? Also show the relationship between them. 5

(b) A retaining wall, 7.5m high, retains a cohesionless backfill. The top 3m of the fill has a unit weight of  $18\text{kN/m}^3$  and  $\phi = 30^\circ$  and the rest has a unit weight of  $24\text{kN/m}^3$  and  $\phi = 20^\circ$ . Determine

(i) Total active thrust (Pa) per metre run of the wall.

(ii) The height of the point of application of the thrust.

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6. The following data have been obtained in a standard laboratory proctor compaction test on glacial till.

Water content (%)	5.02	8.81	11.25	13.05	14.4	19.25
Weight of container and compacted soil (kg)	3.58	3.73	3.932	4.0	4.007	3.907

The specific gravity of the soil particles is 2.77. The container is  $944\text{cm}^3$  in volume and its weight is  $1.978\text{kg}$ . Plot the compaction curve and determine the optimum moisture content. Also compute the void ratio, and degree of saturation at optimum condition. 20

7. Two soils  $S_1$  and  $S_2$  are tested in the laboratory for the consistency limits. The data available is as follows : 20

	$S_1$	$S_2$
Plastic limit, $W_p$	18%	20%
Liquid limit, $W_l$	38%	60%
Flow index, $I_f$	10	5
Natural moisture Content, $W$	40%	50%

- (i) Which soil is more plastic ?
  - (ii) Which soil is better foundation material when remoulded ?
  - (iii) Which soil has better strength as a function of water content ?
  - (iv) Which soil has better strength at the plastic limit ?
  - (v) Would organic material be present in these soils ?
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