

Total time: 3 hours

Total marks: 80

Note: Q.1. is compulsory.

Answer any 3 out of the remaining 5 questions.

Assume suitable data (if necessary).

Numbers on the right indicate full marks.

1. Answer any four:

- a) Explain relative density and relative compaction. 5
- b) Determine the shrinkage limit & specific gravity of a soil sample whose volume and mass reduced from 21.5 cc and 33 gm to 13 cc and 21 gm respectively upon over drying. 5
- c) Explain the calibrations applied in hydrometer. 5
- d) Derive the expression for average coefficient of permeability of soil when flow is perpendicular to the bedding planes. Draw a neat sketch. 5
- e) Explain quick sand condition. Draw a neat sketch. 5
- f) Explain the effects of compaction on properties of soil. 5

2. a) Derive the relation between bulk density and dry density using three phase diagram. 5
- b) An embankment having a total volume of 2000 m^3 is to be constructed having a bulk density of 1.98 gm/cm^3 and a placement water content of 18%. The soil is to be obtained either from borrow area A or B which has voids ratio of 0.78 and 0.69 respectively. Taking specific gravity of both the soil samples as 2.66, determine the volume of soil required to be excavated from each of the areas. If the cost of excavation is Rs. $35/\text{m}^3$, but the cost of transportation is Rs $32/\text{m}^3$ and Rs. $36/\text{m}^3$ respectively, which of the borrow areas is more economical? If one truck can carry 130 m^3 of soil, how many trucks will be required for the transportation? 10
- c) Explain thixotropy of clays. 5

3. a) The following observations were recorded in a liquid limit test in the lab: 10

Observation	1	2	3
Weight of (wet soil + container) in gm.	30.7	32.25	31.5
Weight of (dry soil + container) in gm.	22.43	23.15	22.3
No. of blows	43	32	22

If the weight of the empty container is 8 gm, determine the liquid limit and flow index.

- b) Explain the plasticity chart for the IS soil classification system with a neat sketch. 5
- c) State Darcy's law and explain its validity. 5

4. a) Sieve analysis was carried out on 500 gm of soil and the following information were obtained: 10

Size of sieve (mm)	4.75	2	1	0.425	0.212	0.15	0.075
Weight retained (gm)	10	165	100	85	40	30	50

Draw the particle size distribution curve and determine its IS classification.

- b) Explain how in-situ permeability is determined in case of unconfined aquifers by pumping out test. Draw a neat sketch. 5
- c) Explain the properties of flow nets. 5
5. a) A sand sample of 35 cm² cross-sectional area and 20 cm long was tested in a constant head permeameter under a head of 60 cm, the discharge was 120 ml in 6 minutes. The dry weight of sand used for the test was 1120 gm, and $G = 2.68$. Determine the coefficient of permeability in cm/sec, the discharge velocity and seepage velocity 10
- b) A granular soil deposit is 7 m deep over an impermeable layer. The groundwater table is 4 m below the ground surface. The deposit has a zone of capillary rise of 1 m. The unit weights of the soil in the dry zone, zone of capillary rise and saturated zone are 16.248 kN/m³, 18.087 kN/m³ and 19.927 kN/m³. Plot the variation of total stress, pore water pressure and effective stress with the depth of the deposit. 10
6. a) The results of an IS Standard Proctor Test are as follows: 10

Trial No.	1	2	3	4	5	6
Moisture content (%)	4	6	9	12	14	16
Bulk density (kg/m ³)	1600	1750	1800	1740	1650	1600

Plot the following: a) moisture content - dry density curve, b) zero air voids curve and c) 80% saturation line. Determine the optimum moisture content and the corresponding maximum dry density.

- b) Discuss about the different types of boring used for subsoil investigations. 5
- c) Explain borehole logs. 5
