

Bihar Engineering University, Patna
B.Tech. 5th Semester Examination, 2023

Course: B.Tech.
Code: 101503

Subject: Geotechnical Engineering – I

Time: 03 Hours
Full Marks: 70

Instructions:-

- (i) The marks are indicated in the right-hand margin.
- (ii) There are **NINE** questions in this paper.
- (iii) Attempt **FIVE** questions in all.
- (iv) Question No. 1 is compulsory.

Q.1 Choose the correct answer of the following (Any seven question only): **[2 x 7 = 14]**

- (a) Sieving is not practicable for grain sizes smaller than about
 - (i) 0.075 mm
 - (ii) 0.095 mm
 - (iii) 0.15 mm
 - (iv) 0.2 mm
- (b) The flow index in soils indicates the
 - (i) ratio of liquid limit to plastic limit
 - (ii) variation of liquid limit
 - (iii) variation of plastic limit
 - (iv) shear strength variation and water content
- (c) A flow line in seepage through a soil medium is defined as the
 - (i) path of particles of water through a saturated soil mass
 - (ii) line connecting points of equal head of water
 - (iii) flow of movement of fine particles of soil
 - (iv) direction of flow particle
- (d) The effective stress on the soil is due to the
 - (i) external load acting on the soil
 - (ii) weight of the soil particles
 - (iii) weight of water present in the soil pores
 - (iv) both (i) and (ii)
- (e) By means of Boussinesq's stress distribution theory, which one of the following pressure distribution diagrams can be prepared?
 - (i) Strain isobar
 - (ii) Vertical pressure distribution on a horizontal plane
 - (iii) Vertical pressure distribution on an inclined plane
 - (iv) Pressure distribution diagram on an oblique plane
- (f) A soil sample has a porosity of 40 percent. The specific gravity of solids is 2.70. what is void ratio ?
 - (i) 0.467
 - (ii) 0.567
 - (iii) 0.667
 - (iv) 0.743
- (g) A line showing the dry density as a function of water content for soil containing no air voids, is called
 - (i) saturation line
 - (ii) zero air void line
 - (iii) liquid limit line
 - (iv) none of these
- (h) The critical gradient of a soil increases
 - (i) with increase in void ratio
 - (ii) with decrease in void ratio
 - (iii) with decrease in specific gravity
 - (iv) none of these
- (i) Consistency is term used to indicate
 - (i) the quantitative analysis of soils
 - (ii) the degree of firmness of cohesive soils
 - (iii) the fineness of non-cohesive soils
 - (iv) the fineness of clay soils
- (j) Which one of the following does not affect the permeability of soils?
 - (i) void ratio
 - (ii) soil strength
 - (iii) grain size
 - (iv) temperature

- Q.2** The soil profile in a particular site consists of 7 m thick sandy layer overlain by a layer of clay. The water table is at 1 m below the ground surface. Above the water table, the sand is saturated with capillary moisture. The dry unit weight of sand is 17 kN/m^3 and its saturated unit weight is 20 kN/m^3 . Plot the total stress, neutral stress and effective stress with depth up to a depth of 7 m. [14]
- Q.3** An embankment is to be constructed using sandy clay compacted to dry unit weight of 18 kN/m^3 . The sandy clay has to be transported to the site from a borrow pit. The bulk unit weight of the sandy clay in the borrow pit is 16 kN/m^3 and its natural water content is 11%. Calculate the volume of sandy clay from the borrow pit required for 1 cubic metre of finished embankment. Assume that the soil swells by 10% due to excavation and during transportation. You can take $G_s = 2.7$. [14]
- Q.4** (a) A 1.2 m thick embankment of loose sand is to be compacted using a Vibratory Roller. If the void ratio decreases from 1.2 to 0.8 due to compaction, calculate the final thickness of the embankment. [9]
 (b) What is the effect of surcharge and the capillary action on the effective stress? Explain briefly. [5]
- Q.5** (a) Two columns A and B are situated 6 m apart. Column A transfers a load of 500 kN and column B, a load of 250 kN. Determine the resultant vertical stress on horizontal plane 20 m below the ground surface at points vertically below the points A and B. [10]
 (b) Derive an expression for bulk density in terms of its water content, void ratio, specific gravity of solids and density of water. [4]
- Q.6** (a) A sample of clay has a void ratio of 0.70 in the undisturbed state and of 0.50 in a remoulded state. If the specific gravity of solids is 2.65, determine the shrinkage limit in each case. [8]
 (b) What is the difference between the classification based on particle size and textural classification? Discuss the limitations of the two systems. [6]
- Q.7** (a) Distinguish between discharge velocity and seepage velocity in the case of flow of water through soils. [6]
 (b) A soil sample 90 mm high and 6000 mm^2 in cross-section was subjected to a falling head permeability test. The head fell from 500 to 300 mm in 1500 seconds. The permeability of the soil was $2.4 \times 10^{-3} \text{ mm/s}$. determine the diameter of the standpipe. [8]
- Q.8** (a) What are the different methods of compaction adopted in the field? How would you select the type of roller to be used? [10]
 (b) Atterberg limit tests were carried out on a soil sample, with the results LL as 40% and PL as 25%. Classify the soil according to Unified Classification system and the Indian standard classification system. [4]
- Q.9** Write short notes on *any four* of the following: [3½ x 4 = 14]
 (a) Thixotropy
 (b) Determination of Unit weight by sand-replacement method
 (c) Factors affecting permeability
 (d) Quick sand condition
 (e) Factors affecting compaction
 (f) Newmark's Influence chart