OR	iii.	A clay stratum has 3m thickness and has an initial overburden pressure of 40 kN/m^2. The clay is over-consolidated, with a pre-consolidation pressure of 60 kN/m^2. Determine the final settlements due to an increase of 50 kN/m^2 at the middle of clay layer. Take the following values; Swelling Index = 0.05; Compression Index = 0.28; Initial Voids Ratio =1.3.	**7**	3	5	3	1
Q.5	i.	Describe the shear strength measurement using the triaxial compression test.	**4**	3	2	4	1
	ii.	Explain the factors leading to liquefaction of soil and its impact on soil properties.	**6**	3	4	4	1
OR	iii.	A concentrated load of 1000 kN is applied at the ground surface. Compute the vertical pressure (a) At a depth of 4 m below the load (b) At a distance of 3 m at the same depth Use Boussinesq's equation.	**6**	3	3	3	1
Q.6		Attempt any two:					
	i.	Explain the different types of slope failures with neat diagrams.	**5**	4	4	5	1
	ii.	Discuss the graphical methods of slope stability analysis.	**5**	4	5	5	1
	iii.	Analyze the stability of earth dams and the effect of groundwater on slope stability.	**5**	4	4	5	1

******

Total No. of Questions: 6 *Total No. of Printed Pages:4*

Enrollment No.....

Faculty of Engineering
End Sem Examination Dec 2024
CE3CO27 Geotechnical Engineering -I

Programme: B.Tech. Branch/Specialisation: CE

Duration: 3 Hrs. **Maximum Marks: 60**

Note: All questions are compulsory. Internal choices, if any, are indicated. Answers of Q.1 (MCQs) should be written in full instead of only a, b, c or d. Assume suitable data if necessary. Notations and symbols have their usual meaning.

			Marks	BL	PO	CO	PSO
Q.1	i.	Which of the following represents the correct order of Atterberg limits as the moisture content of a soil decreases? (a) Plastic Limit → Liquid Limit → Shrinkage Limit (b) Liquid Limit → Plastic Limit → Shrinkage Limit (c) Shrinkage Limit → Plastic Limit → Liquid Limit (d) Liquid Limit → Shrinkage Limit → Plastic Limit	**1**	1	2	1	1
	ii.	A soil sample has a total mass of 200 g and a total volume of 100 cm³. If the mass of solids is 160 g, what is the void ratio of the soil? (a) 0.25 (b) 0.5 (c) 0.75 (d) 1.0	**1**	3	2	3	1
	iii.	Which of the following is a key property of a flownet? (a) Flow lines and equipotential lines intersect at an angle of 60° (b) The area between two flow lines represents the flow quantity (c) The flow rate is proportional to the number of flow channels (d) Flownets are used to determine soil composition	**1**	1	1	1	1

iv.	Which of the following factors does NOT affect the permeability of soil? (a) Grain size of the soil (b) Void ratio of the soil (c) Fluid viscosity (d) Soil color	**1**	1	1	1	1
v.	The primary objective of the standard proctor test is to determine: (a) The shear strength of the soil (b) The permeability of the soil (c) The maximum dry density and optimum moisture content of the soil (d) The consolidation characteristics of the soil	**1**	1	4	1	1
vi.	Which of the following factors primarily influences the rate of consolidation in a clay soil layer? (a) The liquid limit of the soil (b) The permeability of the soil (c) The type of compaction equipment used (d) The specific gravity of soil solids	**1**	1	4	1	1
vii.	Which of the following tests is commonly used to determine the shear strength parameters of soil? (a) Triaxial compression test (b) Atterberg limits test (c) Hydrometer test (d) Proctor compaction test	**1**	1	3	4	1
viii.	Which of the following conditions is most likely to cause soil liquefaction? (a) High shear strength of the soil (b) Low pore water pressure during an earthquake (c) High pore water pressure during rapid loading or an earthquake (d) Saturated sandy soils with low plasticity	**1**	1	3	1	1

	ix.	Which of the following is a characteristic of a rotational slope failure? (a) The failure surface forms a straight line parallel to the ground surface (b) The soil mass slides along a curved surface (c) The failure occurs due to the settlement of the soil (d) The failure occurs in granular soils	**1**	1	2	1	1
	x.	Which of the following shear strength parameters is most critical for analyzing the stability of slopes in fine-grained soils? (a) Cohesion and friction angle (b) Shear modulus and Poisson's ratio (c) Internal friction angle and dilatancy angle (d) Cohesion and effective stress	**1**	1	2	1	1
Q.2	i.	Describe the impact of soil formation on soil composition.	**2**	2	4	2	1
	ii.	Explain the concept of consistency limits and their importance in soil classification.	**3**	2	3	2	1
	iii.	Define the three-phase system and derive mass-volume relationship equations.	**5**	2	3	3	1
OR	iv.	Write short notes on the behavior of clay minerals and soil structure.	**5**	3	2	4	1
Q.3	i.	Explain critical hydraulic gradient with reference to quicksand condition.	**2**	3	4	4	1
	ii.	Derive the general flow equation for two-dimensional seepage (Laplace equation).	**8**	3	1	3	1
OR	iii.	Discuss the properties and applications of a flownet. Include neat sketches.	**8**	3	3	4	1
Q.4	i.	Explain the differences between compaction and consolidation.	**3**	3	2	4	1
	ii.	Discuss the procedure and significance of the modified proctor test.	**7**	3	4	4	1

Marking Scheme

CE3CO27 Geootechnical Engineering-I

Q.1 i) (b) Liquid Limit → Plastic Limit → Shrinkage Limit **1**

ii) (b) 0.5 **1**

- Total mass = 200 g, Mass of solids = 160 g
- Volume of solids

= Mass of solids/Specific gravity of solidsMass of solids/Specific gravity of solids (assume Gs=2.65Gs=2.65).

- Void volume = Total volume - Volume of solids.
- Void ratio (ee) = Void volume / Volume of solids.

iii) (d) Soil color **1**

iv) (c) The flow rate is proportional to the number of flow channels **1**

v) (c) The maximum dry density and optimum moisture content of the soil **1**

vi) (b) The permeability of the soil **1**

vii) (a) Triaxial compression test **1**

viii) (c) High pore water pressure during rapid loading or an earthquake **1**

ix) (b) The soil mass slides along a curved surface **1**

x) (a) Cohesion and friction angle **1**

Q.2 i. Describe the impact of soil formation on soil composition. -2 **2**

ii. Explain the concept of consistency limits and their importance in soil classification. **3**

Concept of consistency limits -1.5

Importance in soil classification -1.5

iii. Define the three-phase system and derive mass-volume relationship equations. **5**

Definition of three-phase system -2

Derivation of mass-volume relationship equations -3

OR iv. Write short notes on the behavior of clay minerals and soil structure. **5**

Behavior of clay minerals -2.5

Soil-Structure -2.5

Q.3 i. Explain critical hydraulic gradient with reference to quicksand condition. **2**

Critical hydraulic gradient -2

ii. Derive the general flow equation for two-dimensional seepage (Laplace equation). **8**

-8

OR iii. Discuss the properties and applications of a flownet. Include neat sketches. **8**

Properties of flownet -3

Application of a flownet -3

Neat Sketch -2

Q.4 i. Explain the differences between compaction and consolidation. **3**

Three differences -3

ii. Discuss the procedure and significance of the Modified Proctor Test. **7**

Procedure of Modified Proctor Test -3.5

Significance of Modified Proctor Test -3.5

OR iii. A clay stratum has 3m thickness and has an initial overburden pressure of 40 kN/m^2. The clay is over-consolidated, with a pre-consolidation pressure of 60 kN/m^2. Determine the final settlements due to an increase of 50 kN/m^2 at the middle of clay layer. Take the following values; Swelling Index = 0.05; Compression Index = 0.28; Initial Voids Ratio =1.3. **7**

Solution- Final stress after the increase at the middle= 90kN/m^2

Settlement in Over-consolidated, Soc=0.11538×3×0.1761=0.0609m (60.9mm)

Settlement in Normally Consolidated, Snc =0.21538×3×0.1761=0.1138m(113.8mm)

Total Settlement: Stotal=Soc+Snc

Stotal=0.0609+0.1138=0.1747m(174.7mm)

Q.5 i. Describe the shear strength measurement using the triaxial compression test. **4**

-4

ii. Explain the factors leading to liquefaction of soil and its impact on soil properties. **6**

Factors leading to liquefaction -3

Impact on soil properties -3

OR iii. A concentrated load of 1000 kN is applied at the ground surface. Compute the vertical pressure (i) at a depth of 4 m below the load, (ii) at a distance of 3 m at the same depth. Use Boussinesq's equation. **6**

(i) at a depth of 4 m below the load (Solution- 29.85kN/m^2) -3

(ii) at a distance of 3 m at the same depth. (Solution- 15.28kN/m^2) -3

Q.6	i.	Explain the different types of slope failures with neat diagrams. -5		**5**
	ii.	Discuss the graphical methods of slope stability analysis. -5		**5**
	iii.	Analyze the stability of earth dams and the effect of groundwater on slope stability.		**5**
		Analyze the stability of earth dams	-2.5	
		Effect of groundwater on slope stability	-2.5	

******