Code No: R1932013 **R19** **SET - 1**

III B. Tech II Semester Regular Examinations, June-2022

GEOTECHNICAL ENGINEERING-I

(Civil Engineering)

Time: 3 hours Max. Marks: 75

Answer any **FIVE** Questions **ONE** Question from **Each unit**

All Questions Carry Equal Marks

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UNIT-I

1. a) Explain about the formation of soil in detail. [8M]
   b) The natural water content of an excavated soil from the borrow pit is 35%. Its liquid limit is 65% and plasticity limit is 25%. Determine the Liquidity Index of the soil and comment about the consistency of the soil. [7M]

(OR)

2. a) Derive the formula between soil moisture content (w), degree of saturation (S), specific gravity (G) and void ratio (e). [8M]
   b) Explain about Atterberg limits and their uses. [7M]

UNIT-II

3. a) Define 'Permeability' and explain how you would determine it in the field. [8M]
   b) A flow net analysis was performed for estimating the seepage loss through the foundation of a coffer dam, results of the flow net analysis gave a number of flow line 'N_f' = 6 and number of drops 'N_d' = 16. The head of water lost during seepage was 5m. Assume the co-efficient of permeability of the soil is 'k' = 4×10^{-5} m/min. Estimate the seepage loss per meter length of the coffer dam per day. Also estimate the exit gradient if the average length of the last flow field is 0.9 m. [7M]

(OR)

4. a) Calculate the ratio of average permeability in horizontal direction to that in the vertical direction for a soil deposit consisting of three Horizontal layers, if the thickness and permeability of second layer are twice of those of the first and those of the third layer twice those of second? [8M]
   b) Differentiate total, effective and neutral stresses. [7M]

UNIT-III

5. a) Compare Boussinesq and Westergaard analysis for stress distribution. [8M]
   b) A circular area on the surface of an elastic mass of the great extend carries a uniformly distribute the load of 120 kN/m^3. The radius of the circle is 3 m compute the intensity of vertical pressure at a point 5 m beneath the center of the circle using Boussinesq's method. [7M]

(OR)

6. a) Two columns A and B separated by 4.0 m carries load of 50 t and 75 t respectively. Estimate the vertical stress at 3.0 m below the column load locations. [8M]
   b) Explain how Newmark's influence chart is constructed. [7M]

UNIT-IV

7. a) Following results refer to a standard compaction test: [8M]

Water content(%)	5	10	14	20	25
Bulk density (kN/m^3)	17.6	19.6	21	21.7	21.5

   Determine the optimum moisture content and maximum dry density. Also determine the degree of saturation and percentage air voids at maximum dry density. Take G = 2.7.
   b) Differentiate between 'compaction' and 'consolidation' and explain their individual importance. [7M]

(OR)

8. a) What is a zero air voids line? Draw a compaction curve and show the zero air voids line. [8M]
   b) A sand fill compacted to a bulk density of 18.84 kN/m^3 is to be placed on the compressible saturated marsh deposit 3.5 m thick. The height of the sand fill is to be 3 m. If the volume compressibility mc of the deposit is 7×10^{-4} m^2/kN. Estimate the final settlement of the fill. [7M]

UNIT-V

9. a) Describe the principle of direct shear test. What are the advantages of this test? What are its limitations? [8M]
   b) Explain the Mohr-Coulomb strength envelope. [7M]

(OR)

10. a) Explain about Coulomb failure theories. [8M]
    b) Write about the basic mechanism of Shear strength. [7M]

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Code No: R1932013 **R19** **SET - 2**

III B. Tech II Semester Regular Examinations, June-2022

GEOTECHNICAL ENGINEERING-I

(Civil Engineering)

Time: 3 hours Max. Marks: 75

Answer any **FIVE** Questions **ONE** Question from **Each unit**
All Questions Carry Equal Marks
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UNIT-I

1. a) A partially saturated soil from an earth fill has a natural water content of 22% and a bulk unit weight of 19 kN/m^3. Assuming the specific gravity of soil solids as 2.65, compute the degree of saturation and void ratio. If subsequently the soil gets saturated, determine the dry density, buoyant unit weight and saturated unit weight. [8M]

   b) Describe the procedure for determining water content and specific gravity of a given soil in the laboratory by using a pycnometer. [7M]

(OR)

2. a) By three phase soil system, show that the degree of saturation S (as ratio) in terms of mass unit weight (γ), void ratio (e), specific gravity of soil grains (G) and unit weight of water (γ_w) [8M]

$$\gamma = \frac{(G + eS)\gamma_w}{1+e}$$

   b) Define Sensitivity and Thixotropy for a soil. [7M]

UNIT-II

3. a) The water table in a deposit of sand 8m thick is at a depth of 3 m below ground surface. Above the water table, the sand is saturated with capillary water. The bulk density of sand is 19.62 kN/m^3. Give the effective pressure at 1 m, 3 m, and 8 m below the ground surface. Hence plot the variation of total, neutral and effective stress over the depth of 8 m. [8M]

   b) Write a short note on quick sand conditions in soil. [7M]

(OR)

4. a) Explain about various factors affecting co-efficient of permeability. [8M]

   b) A soil stratum consists of 3 layers of thickness 1 m, 1.5 m and 2 m having coefficient of permeability of 2×10^{-3} cm/s, 1.5×10^{-3} cm/s and 3×10^{-3} cm/s respectively. Estimate the average co-efficient of permeability in the direction of [7M]
   (i) Parallel to the bedding Plane
   (ii) Normal to the bedding plane

UNIT-III

5. a) A concentrated load 10 kN acts on the surface of a soil mass. Using Boussinesq analysis find the vertical stress at points (i) 3 m below the surface on the axis of loading and (ii) at radial distance of 2 m from axis of loading but at same depth of 3 m. [8M]

   b) List the Boussinesq's theory assumptions and limitations. [7M]

(OR)

6. a) Draw the Newmark's chart and what is basis of the construction of Newmark's influence chart? [8M]

   b) A concentrated point load of 200 kN acts at the ground surface. Find the intensity of vertical pressure at a depth of 10 m below the ground surface and situated on the axis of the loading. What will be the vertical pressure at a point at a depth of 6 m and at a radial distance of 3.5 m from the axis of loading? Use Boussinesq analysis. [7M]

UNIT-IV

7. a) Explain the mechanism of compaction. Write the factors affecting the compaction. [8M]

   b) The following results were obtained in a compaction test in the laboratory: [7M]

Water content (%)	17.5	19.0	20.0	20.8	21.8	22.4
Bulk unit weight (kN/m^3)	18.8	20.0	20.5	21.0	21.0	20.0

   Draw the compaction curve and estimate OMC, MDD and also draw the 100% saturation line, G = 2.67.

(OR)

8. a) Discuss the effect of compaction on various engineering properties of soils. [8M]

   b) In a consolidation test on a soil, the void ratio of the sample decreased from 1.25 to 1.10 when the pressure is increased from 200 kN/m^2 to 400 kN/m^2. Calculate the coefficient of consolidation, C_v if the coefficient of permeability is 8×10^{-8} cm/sec. [7M]

UNIT-V

9. a) Three clay specimens having a small air-void content were tested in a shear box under undrained conditions and the following observations were made: [8M]

Normal stress (kN/m^2)	100	200	300
Shear stress at failure (kN/m^2)	90	102	108

   Find the apparent cohesion and angle of shearing resistance of the clay. What value of apparent cohesion would be obtained from an unconfined compression test on the same soil?

   b) Explain with neat sketches Mohr-Coulomb Failure theory. [7M]

(OR)

10. a) An unconfined compression test was conducted on a clay sample of 38 mm diameter and 75 mm height. The load at failure was 28 N under an axial deformation was 13 mm with a failure angle of 50°. Determine the unconfined compressive strength and shear strength, and shear parameters, c and φ. [8M]

    b) Explain pressure-void ratio in clays. [7M]

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Code No: R1932013 **R19** **SET - 3**

III B. Tech II Semester Regular Examinations, June-2022

GEOTECHNICAL ENGINEERING-I

(**Civil Engineering**)

Time: 3 hours Max. Marks: 75

Answer any **FIVE** Questions **ONE** Question from **Each unit**
All Questions Carry Equal Marks
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UNIT-I

1. a) Explain Indian Standard soil classification system for classifying coarse grained soil. [8M]
   b) Sandy soil in a borrow pit has unit weight of solids as 25.8 kN/m^3, water content equal to 11% and bulk unit weight equal to 16.4 kN/m^3. How many cubic meters of compacted fill could be constructed of 3500 m^3 of sand excavated from the borrow pit, if the required value of porosity in the compacted fill is 30%. Also calculate the change in degree of saturation. [7M]

(OR)

2. a) A sample of sand above water table was found to have a natural moisture content of 15% and a unit weight of 18.84 kN/m^3 laboratory test on a dried sample. Indicates value of e_{max} = 0.85 and e_{min} = 0.5 in loosest and densest state respectively. Compute degree of saturation and relative density. Assume G = 2.65. [8M]
   b) In its natural condition, a soil sample has a mass of 22.9 N and a volume of 1.15 × 10^{-3} m^3. After being completely dried in the oven sample weighs 20.35 N. Find bulk density, water content, void ratio, porosity, degree of saturation, air content, dry density and percentage air voids. [7M]

UNIT-II

3. a) Calculate the effective stress at a depth of 2 m, 4 m, 6 m, 8 m and 10 m in a soil mass having Y_s = 21 kN/m^3. In water table there is a capillary rise up to ground surface. Also draw the total stress diagram up to 10 m. [8M]
   b) Explain briefly about the applications of flow net. [7M]

(OR)

4. a) Describe the Unconfined Pumping Out Flow and determine the coefficient of permeability of soil. [8M]
   b) For a homogeneous earth dam 52 m high and 2 m freeboard, a flow net was constructed and following results were obtained: Number of potential drops = 25; Number of flow channels = 4. Calculate the discharge per meter length of the dam, if the coefficient of permeability of the dam material is 3 × 10^{-5} m/sec. [7M]

UNIT-III

5. a) Find intensity of vertical pressure at a point 3 m directly below 25 kN point load acting on a horizontal ground surface. What will be the vertical pressure at a point 2 m horizontally away from the axis of loading and at same depth of 3 m.? Use Westergaard's equation. [8M]

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b) Explain the 2:1 stress distribution method. [7M]

(OR)

6. a) Discuss in detail about the Boussinesq's analysis to find vertical stress and horizontal shear stress for point load. [8M]

b) A concentrated load of 22.5 kN acts on the surface of a homogeneous soil mass of large extent. Find the stress intensity at a depth of 3 m, 6 m, 9 m, 12 m, and 15 m directly below the point load; draw the vertical stress distribution diagram along vertical axis. [7M]

UNIT-IV

7. a) Describe Terzaghi's theory of one-dimensional consolidation along with the spring analogy. [8M]

b) A clay layer of 8 m thick with single drainage settles by 120 mm in 2 years. The co-efficient of consolidation for this clay was found to be 6×10^{-3} cm^2/sec. Calculate the likely ultimate consolidation settlement and find out how long it will take to undergo 90 % of this ultimate settlement. [7M]

(OR)

8. a) Describe the proctor compaction test in detail. [8M]

b) A layer of soft clay is 6 m thick and lies under a newly constructed building. The weight of sand overlying the clay layer produces a pressure of 2.6 kg/cm^2 and the new construction increases the pressure by 1.0 kg/cm^2. If the compression index is 0.5. Compute the settlement. Water content is 40% and specific gravity of grains is 2.65. [7M]

UNIT-V

9. a) Explain the three drainage conditions for conducting Shear testing of soils in detail. [8M]

b) A saturated specimen of cohesionless oil was tested in triaxial compression and the sample failed at a deviator stress of 482 kN/m^2 when the cell pressure was 100 kN/m^2 under the drained conditions. Find the effective angle of shearing resistance of sand. What would be the deviator stress and the major principal stress at failure for another identical specimen of sand, if it is tested under cell pressure of 200 kN/m^2. Use analytical method. [7M]

(OR)

10. a) Describe the vane shear test in detail and explain the two methods adopted in this test - fully submerged vane and partially submerged vane. [8M]

b) Derive a relationship between the principal stresses at failure using Mohr-Coulomb failure criterion. [7M]

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Code No: R1932013 **R19** **SET - 4**

III B. Tech II Semester Regular Examinations, June-2022

GEOTECHNICAL ENGINEERING-I

(Civil Engineering)

Time: 3 hours Max. Marks: 75

Answer any **FIVE** Questions **ONE** Question from **Each unit**
All Questions Carry Equal Marks
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UNIT-I

1. a) A soil sample is found to have the following properties. Classify the soil according to IS classification system. Passing 75 μ sieve = 10%; passing 4.75 mm sieve = 70%; Uniformity coefficient = 8; coefficient of curvature = 2.8; Plasticity index = 4%. [8M]

   b) Discuss in detail the engineering significance of the consistency limits of soil. [7M]

(OR)

2. a) The following data on consistency limits are available for two soils A and B: [8M]

S.No.	Index	Soil A	Soil B
1	Plastic limit	16%	19%
2	Liquid limit	30%	52%
3	Flow index	11	6
4	Natural water content	32%	40%

Indicate which soil is

(i) Better foundation material on remolding.
(ii) Better shear strength as function of water content.
(iii) Better shear strength at plastic limit.
(iv) More plastic

Classify the soil as per IS classification system. Do those soils have organic matter?

   b) Explain Indian Standard soil classification system for classifying fine grained soil. [7M]

UNIT-II

3. a) Explain about permeability of layered system. [8M]

   b) Explain the characteristics of flow nets. [7M]

(OR)

4. a) A soil deposit consists of a sand layer of 5 m thick followed by clay layer. The water table is at a depth of 2 m from ground level and dry ans saturated unit weight is 16 kN/m^3 and 20 kN/m^3 respectively. Draw the variation of total, neutral and effective stress variation in sand layer. If there is a sudden pore water pressure of 20 kN/m^2 at the bottom of sand layer, what will be the change do you expect in effective stress in the sand layer? [8M]

   b) What is Quick sand condition? Under what circumstances can it occur? [7M]

UNIT-III

5. a) A concentrated point load of 200 kN acts at the ground surface. Find the intensity of vertical pressure at a depth of 10 m below the ground surface and situated on the axis of the loading. What will be the vertical pressure at a point at a depth of 5 m and at a radial distance of 2 m from the axis of loading? Use Westergaard analysis. [8M]

   b) Explain the assumptions in Westergaard theory. [7M]

(OR)

6. a) Explain about the theories for point loads. [8M]

   b) Write the difference between Boussinesq's and Westergaard's theories. [7M]

UNIT-IV

7. a) In a laboratory consolidometer test on a 20 mm thick sample of saturated clay taken from a site, 50% consolidation point was reached in10 minutes. Estimate the time required for the clay layer of 5 m thickness at the site for 50% compression if there is drainage only towards the top. What is the time required for the clay layer to reach 50% consolidation, if the layer has double drainage instead of single drainage? [8M]

   b) Discuss the engineering behaviour of compacted cohesive soils. [7M]

(OR)

8. a) Explain in detail of the determination of coefficient of consolidation using log t method. [8M]

   b) A partially saturated soil samples collected from a pit has a natural moisture content of 18% and bulk unit weight of 20 kN/m3. G = 2.68. Estimate the void ratio and degree of saturation. What will be the unit weight of the soil sample on saturation? [7M]

UNIT-V

9. a) The shearing resistance of a soil is determined by the equation $S=c'+\sigma \tan\varphi$. Two drained triaxial tests are performed on the material. In the first test, the all-round pressure is 200 kN/m^3 and failure occurs at an added axial stress of 600 kN/m^2. In the second test, all round pressure is 350 kN/m^2 and the failure occurs at an added axial shear of 1050 kN/m^2. What values of c' and φ' correspond to those results? [8M]

   b) Explain the triaxial shear tests based on drainage and their applicability. [7M]

(OR)

10. a) Two identical soil specimens were tested in a triaxial apparatus. First specimen failed at a deviator stress of 770 kN/m^2 when the cell pressure was 2000 kN/m^2. Second specimen failed at a deviator stress of 1370 kN/m^2 under a cell pressure of 400 kN/m^2. Determine the value of c and Φ analytically. If the same soil is tested in a direct shear apparatus with a normal stress of 600 kN/m^2, estimate the shear stress at failure. [8M]

    b) Write a note on shear strength of sands and clays. [7M]

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